DOI: 10.18843/ijcms/v8i3/03
DOI URL: http://dx.doi.org/10.18843/ijcms/v8i3/03

COST MITIGATION OF NATURAL DISASTERS THROUGH INSURANCE

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ABSTRACT

Climate change has an enormous impact on public infrastructure and health. Studies reveal natural disasters instigated by climate change have increased in intensity and frequency and they cause immense economic losses. Financing the rebuilding process after a disaster is a challenge of massive proportion that demands enormous resources on behalf of countries. The rebuilding process is an uphill task even for developed countries that have considerably better planning and finances at their disposal in comparison to low-middle-income countries (LMIC's) which lack access to extensive funds. For LMIC's, the limited financial resources for the development of infrastructure are further constrained due to the occurrence of a natural disaster. According to estimates, global economic losses to a whopping amount of 200 billion dollars is incurred every year due to climate change worldwide due to extreme weather. According to projections in the case of India, it experiences an average loss to the amount of 9.8 billion dollars annually on an average due to climatic disasters. Usually no matter how much money is poured for disaster management through public funds its mostly never adequate to cope up with losses in most natural disasters and the brunt of the majority of losses is to borne by the public. It is in such a scenario that insurance, which fundamentally implies risk management for the insured at a premium comes into play for mitigation of cost due to losses. Insurance assumes a significant role in natural disaster prone zones like north-western region in India. It assists in extenuating the financial impact of natural disasters to a large extent. This review paper aims to firstly, to understand the significance and role that insurance plays in financing the rebuilding process for coping up with the challenges brought forth by natural disasters. Secondly, understand and highlight issues faced by the increased occurrence of natural disasters for insurance companies forcing them to innovate new strategies for the sustaining current profitability while also preserving the viability of its future operations for stakeholders.

Keywords*: catastrophic insurance, natural disasters India, economic challenges, innovative financing, under-insurance.*

Introduction:

In contemporary history especially the past few decades, global connectivity has increased on most of the dimensions, prominently in the form of free movement of people, information flow, capital flow patterns, trading trends, regulatory changes and interaction of diverse cultures. These have been a prominent and an evident increase in the economic and, commercial, demographic and environmental indices that has been regarded as the Great Acceleration (Hibbard et al. 2007). This consequentially impacts the environment in various ways, altering the natural order of things in the earth systems. The world recognizes that the development of nations is dependent upon the stable and resilient earth systems (Rockström 2016). It's important to measure economic resilience so as to devise better strategies (Grislain-Letrémy 2015)Studies show that the climate changes have increased the occurrence of natural disasters globally (Zahid, Khan, and Bhat 2015, Bouwer 2011, Field 2012) (Fig 1). Extreme weather events have seen an increased occurrence in last decade this includes all types of events like floods, hailstorms, storm surges and tropical and extratropical

cyclones, forest fires, heat waves. There has been a surge in the international recognition for addressing the potential repercussion that climate change could be having on such escalating trend in adverse weather events. LIC's and LMIC's have a weaker per capita income and as such adoption of risk transfer instruments like insurance is predominately very low, leaving them prone to more economic losses.

Droughts, floods and other natural disasters are a cause for loss of income for people, especially in lower and middle-income countries .Gitay et al. (2013) in their study of the global impact of climate change on world economy conclude that while it's not possible to associate the exact amount of damage due to climate change but in the past three decades the human capital loss stands at about 2.5 million and 4 trillion dollars have been lost to natural disasters .Also, there has been an upsurge economic losses as they rose from $50 billion each year in the 1980s to just under $200 billion each year in the last decade and about three-quarters of those losses are a result of extreme weather (Fig 1). There is a substantial difference between the chances of disasters in different continents, and geographical location plays a crucial role in deciding the disaster vulnerability. (Kahn 2005) in his studies observes that people in Asia are 28.1 percentage point more likely to experience a natural disaster than people of Africa. (Cropper and Sahin 2009) note that Asia experiences the highest loss due to geophysical, hydrological and meteorological disasters. 58.6 per cent of the Indian landmass is prone to landmass is prone to earthquakes of moderate to very high intensity , 12% of land is prone to soil erosion due to floods , 75% of coastline is susceptible to tsunami or cyclones and 58% is prone to droughts (NDMA , Nair, K., and Röder 2013). In the northeast Himalayan region, there is a high probability of huge earthquakes and floods (Parvez and Ram 1997). The annual exposure to flood damages is highest in the world in India in terms of the GDP, which stands at 14.3 billion US$ and this exposure could increase to 154 billion US$ by 2030 (Luo et al. 2015). (Peduzzi, De Bono, and Herold 2015) in their study assess the global expected average annual loss (AAL) in the environment estimated to be US$314 billion in the buildup environment in future. Thus, it is a challenge to the global agenda of sustainable development. (Peduzzi, De Bono, and Herold 2015) also estimated the AAL India bears on an average on account of floods, tsunami, earthquake to be US$9.8 billion (Table 1). In India responsibility for management and planning for mitigation of natural disasters through disaster management plans falls on the respective states. Through disaster management, an annual global investment of 6 billion US$ will help to generate benefits of 360 billion US$ through risk reduction (Peduzzi, De Bono, and Herold 2015).There need to understand the urgency in managing the various concerns related to the reducing the effect of the natural disasters. This need becomes, even more, when in a country like India, which most of its population living in rural areas and distributed across a variety of geographical locations (Singh and Awasthi 2013). The rural population has limited ability to cope up with losses from adverse climatic events and as such rural people suffer extreme hardships, loss of assets and consequentially default on their debt in the years that follow the disaster (Hazell 2001). Disaster management efforts are on a broader level and involve a diverse multi-dimensional approach towards tackling the natural disasters. Insurance can provide financial support to the affected and it can be taken at sovereign and individual level for tackling financial distress caused by a natural disaster. Uninsured people incur huge financial losses and usually the tax payer has to share the cost in the form of low-interest loans and relief provided by the government (Kunreuther 1984). Carter et al. (2007) analyzed the effect of Hurricane Mitch on certain households and found that households with lower income groups took a longer time span to recover from disaster losses than households who were in a higher-income as they were able to recover at a much faster rate. There is a need to develop and promote effective mechanisms that help in mitigation of the financial risk associated with future disasters at the individual level.

The deficiency on the part of governments in enforcing the protective measures, substantial growth of population in coastal areas, natural fault lines, all has considerably contributed to increasing the probability of disaster occurrence, consequentially leading to an increase in the severity of losses. In most scenarios government relief and insurance are bearing the lion's share of recovery costs (Kunreuther 1996). Toya and Skidmore (2007) in their study of economic development of countries while considering natural disasters note that countries which with high income, higher education, developed financial systems and greater openness experience fewer losses due to climate change.

Financial assistance is provided by the central governments frequently in case of occurrence of a catastrophic disaster in most of the countries worldwide as some people willingly don't insure against natural disasters (Raschky and Weck-Hannemann 2007). Routinely government provides specific types of relief following an unusual and unexpected natural disasters, which is in itself a form of ex-post insurance (Priest 1996). Various leading economists hold the view that such measures are a matter of concern (Anderson 1976, Kunreuther 2006, 1984). It is such free disaster assistance by the center for bailing out the people every time becomes leaves people unaware of their exposure to losses in disaster and as such it becomes a persistent problem (Kaplow

1991). Government relief distorts the insurance decisions of an individual and increases inability to take into account the degree of risk exposure on account of a natural disaster. Many researchers through their studies suggest that the government compensation and relief measures encourage development along the geographic fault lines or hurricane-prone coastal areas. Similarly, in the case of agricultural disaster, the reparation by central governments encourages further farming in environmentally sensitive areas. If the people who live in these areas expect central government compensation, it emboldens them to take supererogatory risks in future. As such the central disaster relief becomes a continuous incessant process because the individuals are unaware of the real exposure to losses from natural disasters. To put a halt to this unremitting sequence risk must be internalized. People must be responsible for the risks they take, and this can be partially realized by participation contingent claim market that allows for a complete risk sharing (Skees and Barnett 1999). There is a sense of disagreement on whether the losses due to natural disaster fall under private or public responsibility.

Business and science merge together to help insurers tackle the economic implications of natural disasters. Policy makers, researchers, private and public sector stakeholders need to understand how the development of new strategies are important for facilitating new market-based solutions for risk sharing. Insurance sector acts as an umbrella in bringing together various economic sectors and distributing global risk exposure to natural disasters. Insurers can aim to achieve their business-oriented objectives and the objectives of sustainable development concurrently (Mills 2004). Insurers have a potential to assist countries in their attempts towards sustainable development.

Hallegatte and Ghil (2008) developed an endogenous business cycle model (EnBC) which suggests that natural disaster have a larger impact on economies experiencing expansionary growth, and they are more vulnerable to natural disaster. The model suggests that natural disasters spifflicate the productive assets in countries having full employment and high growth rate. The insurance industry can play a crucial role in reducing the reducing the susceptibility of low and middle-income countries to weather-related natural disasters. Linnerooth-Bayer and Mechler (2006) suggest two level approaches to making insurance as a viable solution for tackling climate change by developing a specialized climate change programme for developing countries. According to them, there would be a two-fold approach to the problem of climate-related shocks which would be achieved through a global organisation dedicated to climatic change. This organisation would help developing nations in developing novel insurance products that are affordable to the poor and also assist countries that make credible efforts for disaster management in when is distress due to a catastrophic natural calamity through relief efforts. This strategy by might seem noble in intent, but the effort required for its realization at the global level is huge which renders it almost ivory-towerish in the real world. Insurance alone can't be a one-stop solution to the problems of natural disasters in LMIC's and LIC's, but public, private partnerships can help in heightening the effectualness of insurance to disseminate the risk and help in better management of costs of natural disasters as well as be improve the accessibility and thereby inclusiveness.

The two basic tools for catastrophic risk are insurance and instruments that spreading risk directly to the capital market insurance is a very powerful risk mitigation tool that can be used to modify the behaviour of the insured and promote risk reduction (Benson and Clay 2004). The influence of climate change varies from country to country depending upon the geographical location, the level of adoption of strategies for contesting climate change, susceptibility to external economic shock and insurance penetration levels (Gurenko 2015). Kellenberg and Mobarak (2011) in their study point out that need to develop disasters insurance markets given the cost associated with the natural disasters is increasing with each passing year. Insurance can be employed at three levels a sovereign level, micro level and index-based insurance (UNFCCC 2016)(Table 2). Sovereign insurance is taken at national level involves catastrophic bonds and is ideal for developing countries. Micro level is at household level where insurance risk is transferred to a larger base through reinsurance companies. Lastly, the index based insurance can be used from micro (individual farmer) to sovereignty level and can provide emergency response to weather-associated catastrophes.

Mechler, Linnerooth-Bayer, and Peppiatt (2006) in their review of micro insurance for natural disaster mitigation in developed countries appreciate the role which micro insurance plays in ensuring the financial liquidity, facilitate recovery and rehabilitation of poor after a calamity. While they also maintain that there are viability concerns and challenges that micro insurance faces in these countries which need to be addressed through strategies. To be able to understand the role of insurance industry there is a need to have a fair understanding of the position of the insurance industry in the global scenario. The discussions in following sections explain some of the facets of insurance with regard to its use for mitigation.

Current status of Insurance Industry:

At its core insurance industry deals mainly with risk management and financing. The insurance sector is the largest industry in the world globally in terms of GDP insurance sector would be the third largest country with annual growth of 4.7 percent and a net

value of 4,778 billion USD (SwissRe 2015a). Globally insurance premiums grew by 4.3% in life premiums and 2.9 % of non-life premiums contributing to a total growth (SwissRe 2015a). Insurance sector faces an array of challenges due the climate change and has been reacting to them in various ways. Insurers exercise discrimination while undertaking a risk and by their very nature can't undertake all types of risk and as such try to reduce their exposure to huge losses as a measure to deter financial insolvency. Being the largest industry in the world, it is in a position that could help in bringing a change in the society about understanding the impacts of climate change and promote innovative solutions that could be adopted for the mitigation of losses. In the past insurers have played a guiding role to make the building safer from fire and earthquakes through their intervention and guidance, climate change also brings a similar opening, wherein need for intuitive methods of risk reduction and innovative new products are required. In doing so, the insurance industry will reduce the financial burden of rehabilitation on the government, prevent consumers from financial distress and also reduce its own exposure to associated risk.

The trend of losses due to in global events (Fig 2) shows that almost over the past 25 odd years the overall loss seems to be always dominant on the insured losses in the past year. Which provides an opportunity as well as a challenge to the insurers globally.

Indian insurance sector has a CAGR of 13.07% for non-life for past ten years with a similar figure in of a number of non-life policies also experiencing a nearly similar growth of about 9.2 percent over the past decade (Fig 3).While it might seem to be encouraging it still is very low because the current insurance penetration is low 3.3 per cent in FY15 (Fig 4) .Though the above figures are promising but the growth of non-life insurance industry is more or less stagnated due to the prevalent nationalised model even though post-liberalisation of Indian insurance sector there has been some relatively registers minuscule growth (Padmavathiti 2012) .In India, the financial inclusion efforts of the government are likely to improve the insurance levels as it is oriented towards building a robust financial system in the country. India partly further eased FDI in insurance sector permitting investments up to 49% and this is further expected to develop private insurance market in India. The vast network of banks is ideally suited to increase the accessibility to insurers to a wide majority of the population in India. Indian insurance sector has a huge potential to capture the untapped market.

Impact of Climate changes on the Insurance Industry:

Climate change has increased the complexity and brought forth new challenges for insurers to the task of providing protection to its customers from natural hazards is becoming more intriguing. Insurers face a challenge of being able to assess the probability of a catastrophic event. Measuring the impact of climate change is not possible accurately because of the scale of the parameters involved are huge. To ascertain the degree of economic losses in a natural disaster accurately is not possible as there are several interweaved or extremely difficult to measure making it an imprecise science. From an economist's point of view, the depreciation adjusted value would help in ascertaining the cost of infrastructure, but it can be argued that it can be biased (Kliesen 1994). There is a need for an integrated knowledge management with regard to cost assessments into risk management will support disaster so that better decisions can be made with regard to mitigation measures by the concerned (Meyer et al. 2013). This will help in reducing the uncertainties for the insurer regarding the probability of disaster and the cost associated with it.

Catastrophes brought by climate change spifflicate the developed infrastructure in any region where they occur, while also negatively impacting the livelihood of the people of the region. North-east region of India has a sensitive eco-system and recent aggressive climatic change has a drastic impact on the people living in these states. Let's take a typical scenario for understanding how insurer reacts to climate change. In Jammu and Kashmir after the floods of 2014, private insurance companies were obligated by an Indian court legislation to pay 95% of the insured amount for insured parties having insurance of less than 2.5 million INR and 50% the parties that have more an insurance more than that and that too without following due diligence(Apoorva 2014). This resulted in the insurance companies paying upfront and amount of 40 billion while they had an annual outlay for the same of a 5 billion to 7 billion. Almost as a knee-jerk reaction for almost six months after the devastating floods of 2014 in Jammu and Kashmir, private insurance players desisted from taking new insurance business. This is just one instant of how insurance companies react to climate change in India. It proves the need for evolving new insurance products that have a more innovative approach to understanding the risk. In 2015, the property insurance sales witnessed a huge boom in the same region as they rose by a margin of 30% while also out-performing the national growth of 10% (Parvaiz 2015). This is a characteristic behavior after a natural disaster wherein people tend to be over cautious, and insurers are able to negotiate higher property premiums. Browne and Hoyt (2000) confirmed such behaviour through their empirical study wherein the concurred that insurance is purchasing decision is highly co-related to the level of losses in the previous years. The risk perception towards losses is impacted by the losses incurred in hindsight motivates the purchase decision for buying insurance cover. In India in the year 2015-2016 the cost of insured losses to

insurers is US$ 2 billion which set back to insurance companies (Asian Insurance Review 2016). Private insurance companies in India are mulling to establish a natural catastrophe pool for tackling the cost of natural disasters, but it has been stuck in the legal and legislative system. Bang and Johari (2014) suggest that India needs to establish a natural catastrophe model on the basis of which such natural catastrophe pool can be devised. Such probabilistic models would enable to test various insurance penetration scenarios at different levels of penetration and provide a risk-based pricing for different coverage.

Climate change is being recognized as one of the most primary threats faced globally by insurance companies and they respond to it through increasing the cost of the insurance premium. Born and Viscusi (2006) studied a large dataset in the USA from different states studied the pattern of insurance claims by households in a time frame of 10 years. They found that insurers tended to increase their premiums and in an effort to reduce the losses incurred due to unexpected disasters. Private insurers tend not readily offer cover from a natural disaster like earthquakes, floods or cyclones due uncertain nature of low-probability of such events, as a large natural disaster could lead to financial insolvency (Kellenberg and Mobarak 2011). There is a need to have an efficient and reliable data source for assessment of risk exposure in natural disasters so that insurance providers can effectively assess the risk exposure. This would enable to fairly and evenly distribute the risk making the natural disaster insurance market more efficient and reducing the risk of financial insolvency for the insurer. The government can assist insurers by making data required for risk assessment available to the insurers through various agencies so that real-time risk assessment based on facts and figures can be made.

Tackling the Issue of Underinsurance:

There is an annual gap of 168 billion US$ between the complete coverage of the actual cost and the real over available to businesses and government (Edwards and Davis 2012). Countries are exposed to huge losses which are not covered due to underinsurance (Fig 5).US, Japan, and China together account for the biggest exposure to natural catastrophes. India has insurance gap of 84.3% and an average uninsured loss experienced due to natural catastrophe is 1.96 billion US$ (Bevere et al. 2013). It is evident that there is a huge gap in the insurance cover globally. And different measures can be implored to tackle the issue of underinsurance.

Grislain-Letrémy (2015) while studying the reasons for disaster under insurance in France found reduced unavailability and unaffordability are among the primary reasons for low disaster insurance levels. For insurance markets to function adequately it is imperative that there should be the existence of sufficient demand. Seifert et al. (2013) in their study of disaster insurance demand between Germany and Netherland's found that the willingness to pay(WTP) for insurance is lower in Netherlands' for low probability high impact flood than a medium probability medium impact flood in Germany. They concluded that there was a need to make insurance mandatory or design information campaigns. Social marketing could be used to bring about behavioral change in the perceptions of people towards adopting disaster insurance as a form of financial literacy. Petrolia, Landry, and Coble (2013) in their study of the impact of subjective risk perception and preference on the enrolment in flood insurance program is positively correlated with the risk aversion, the perceived expected loss, eligibility for disaster assistance, and credibility of insurance providers. They found that mitigation efforts through Community Rating Systems (CRS)[1] generally improved the insurance penetration levels. To tackle the problem of underinsurance several countries like United Kingdom, Turkey, New Zealand, Norway, Spain, Switzerland are making it mandatory to have disaster insurance with varying degree of coverage(SwissRe 2015b).Countries with highest annual losses in terms of GDP percentage include low-middle income countries like Bangladesh and also big global economic power like China (Table 3).Countries with lowest insurance penetration feature China and also developing economy like India(Table 4).The problem of underinsurance is widespread global in nature and is in every continent around the globe while reason underlying it are different for different countries. Kunreuther (1996) asserts that there are two interrelated components for low disaster insurance levels low interest in insurance prior to a natural disaster and high cost of insurance premiumsFurther, Kunreuther and Pauly (2006) suggest to make it mandatory in disaster-prone regions to have a complimentary disaster insurance programme. The premium of such plans would be based on the type of risk potential which a region carries. The Government in this disaster-prone region can subsidize the premium and for low-middle income households, this would transpire into an effective utilization of government funds than through public disaster relief following a natural disaster.People fail to obtain insurance even when the insurance provided is at actuarial level (Kunreuther and Pauly 2004) suggests that even after providing a subsidised disaster insurance the takers are still less and asserts the reason for this to be a high cost involved in searching the insurance cover.

[1] The CRS awards premium discounts for all flood insurance holders in communities that undertake specific types of hazard mitigation, including provision of flood hazard information, disaster preparedness, and flood damage reduction. A lower score indicates a higher level of preparedness.

Looking forward to Solutions:

Insurance is not a replacement for mitigation or adaptation, but it can be a key part of the overall suite of measures to manage the risk of catastrophic climate change. While formulating, better strategies countries need to keep in mind the economic pliability so as to ensure they are effectively implemented. Improvement in insurance coverage can reduce the financial burden on the government for bailing out people after a natural disaster. The government can better utilize the funds that are used for providing post relief disaster by subsiding the disaster insurance premium for marginalized sections of the society especially in disaster prone zones. Insurers help reduce the burden on the customers who are exposed to risk especially in zones which are highly susceptible to disasters caused by climate change. Social marketing can be used to promote adoption of natural disaster insurance and bring about a behavioral change which would lead to improving underinsurance scenario in many countries. Implementation of building codes would help in rating the risk for insurers and also help in ascertaining the exposure of the insurers. Insurers and governments can play an important role in making adoption and mandating the green building techniques respectively. This would help in making insurance premiums lower for household owing to less potential risk exposure and make the market more viable for insurance activities for the insurers. The government policy in India in the past decade has strongly advocated financial instruments like social insurance schemes; similar initiatives need to be taken up on a large scale for natural disasters. There is a widespread need for a national subsidized natural disaster insurance programme in countries like India, which could be modeled on similar lines to what is already in certain developed and developing countries especially targeting marginalized sections of society. Establishment of a natural catastrophe insurance pool would help to spread the risk evenly. The government can play a pivotal role through enacting regulations that enable development of natural disaster insurance markets. Insurers need to develop disaster insurance products with a premium that would be based on risk propensity of natural disasters in a particular region. It's important to realize that there is further need for research in analyzing the role of and impact that insurance can play in mitigating the effects of natural disasters especially in developing countries like India. Research into the development of disaster insurance markets in developing countries could help to improve the insurance picture in long term. Insurers could use a better understanding of natural disasters with the country and geographic location specific research's that help them in better assessment of risks and devise policies accordingly. It is important to realize that insurance against natural disaster is one of the most effective tools for financial risk mitigation it alone can't be a single answer, needs to be augmented with other efforts like disaster management and encouraging safe practices behavior at an individual level.

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Fig 1: Source: SwissRe Economic Research & Consulting and Cat Perils

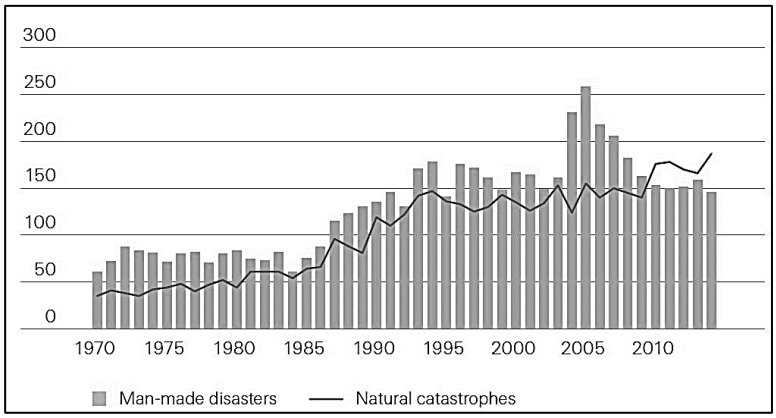


Table 1: India's Average Annual Loss (AAL) by Disaster

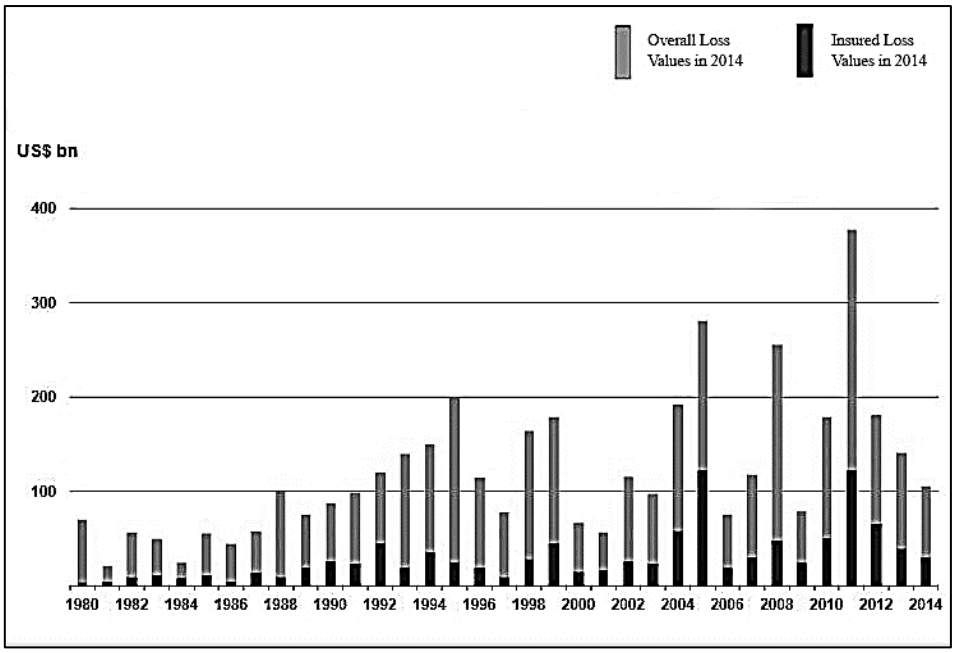
Type of Disaster	Figures in Million $
Earthquakes	19
Cyclones	447
Storm Surge	727
Tsunami	1160
Flood	7472
Total	9825

Source: Global Assessment Report 2015 of UN office for Disaster Risk Reduction

Table 2: Forms of insurance schemes Source author intercepts (UNFCCC).

Forms of insurance	Schemes
Sovereign level insurance	Turkey: Turkish Catastrophe Insurance Pool (TCIP)
Micro level insurance	Bangladesh: Proshika
Index-based insurance	
➢ *Micro index-based insurance*	
Crop index-based insurance	Malawi: crop insurance
Livestock index-based insurance	Mongolia: livestock insurance
➢ *Meso-index based insurance*	Peru: schemes against natural disasters
➢ *Macro-index based insurance*	Mexico: Catastrophe Bond Caribbean Catastrophe Risk Insurance Facility (CCRIF)

Fig 2: Loss events worldwide insured vs. uninsured losses during 1980-2014



*losses adjusted for inflation based on country CPI
Source: (MunichRe 2015)

Fig 3: Growth in non-life insurance

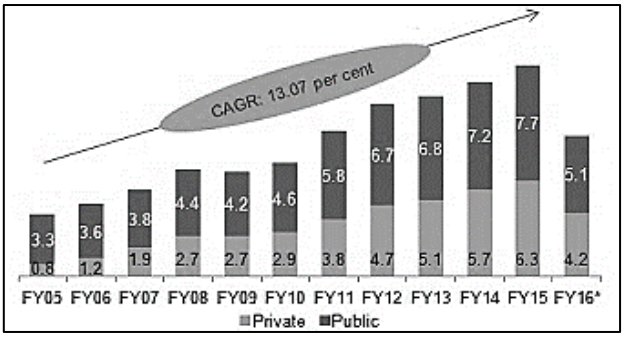
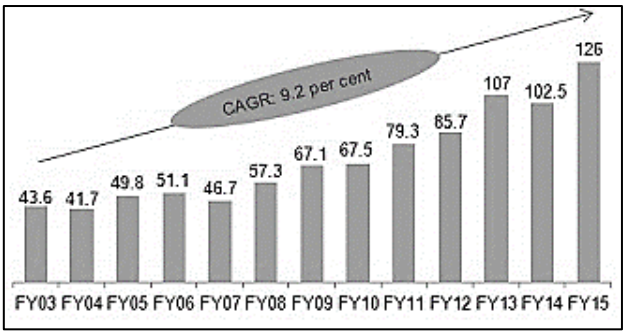
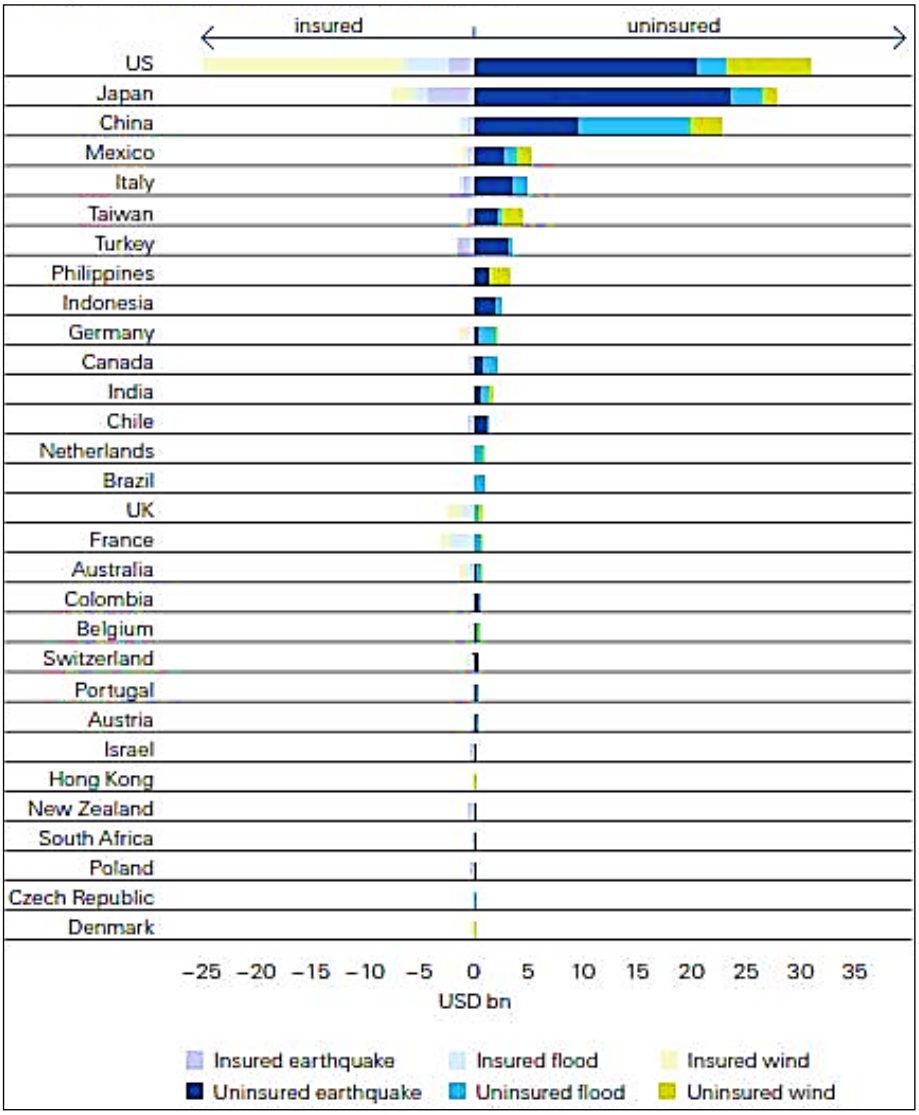


Fig 4: Number of non-life insurance policies



Source: Insurance Regulatory and Development Authority, TechSci Research (2015) (IBEF 2015)

Fig 5: Expected losses due to natural disasters for various countries



Source: Adapted from SwissRe Economic Research & Consulting and Non-Life Risk Transformation.(SwissRe 2015b)

Table 3: Countries with highest expected annual losses (% of GDP)

Country	Expected Loss
Bangladesh	1.26%
Chile	0.87%
New Zealand	0.73%
China	0.71%
Vietnam	0.70%
Indonesia	0.69%
Thailand	0.53%
Turkey	0.52%

Table 4: Bottom 10 countries by insurance penetration

Country	Insurance Penetration
China	1.30%
Turkey	1.10%
Mexico	1.00%
Saudi Arabia	1.00%
Vietnam	0.80%
India	0.70%
Indonesia	0.50%
Philippines	0.40%
Egypt	0.40%
Bangladesh	0.20%

Source: "EM-DAT", World Bank, CEBR analysis.

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