MAPPING THE ROLE OF INSURANCE IN MANAGING DISASTER LOSSES

A STUDY OF LOW AND LOW-MIDDLE INCOME COUNTRIES

MAY 2017

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Executive Summary

- RMS has performed an analysis of how feasible insurance schemes could reduce the financial burden of disaster losses on low and low-middle income countries within the next ten years. The analysis combines four separate data sources to produce a comprehensive assessment of disaster losses and associated aid payments.
- The analysis looks at the levels of insurance structures that are feasible to be in place in ten years, and applies recoveries from these systems to event losses given present day exposure and population levels.
- The analysis finds that the average annual asset losses from natural catastrophe events in low and low-middle income countries is equal to $29.1 billion. $2.2 billion of this (approximately 8% of total losses) is met by humanitarian aid expenditure. A further $0.9 billion (approximately 3% of total losses) is currently covered by insurance.
- Pre-existing insurance mechanisms were reviewed, and insurance structures that could realistically be adopted by low and low-middle income countries over the next ten years were determined. Three different hypothetical insurance structures were chosen, and applied to a set of simulated losses at present day exposure and population levels. Sensitivity analyses were performed around base assumptions for each structure.
- Under the base assumptions, the average annual recovery from all three insurance schemes is $3.1 billion (approximately 11% of total losses). The two additional sensitivity analyses show that the average annual recovery could vary between $1.5 billion and $5.1 billion.
- Annual insurance for private assets recoveries vary between $1.2 billion for the low sensitivity analysis and $2.2 billion for the high sensitivity analysis. Insurance for public assets recoveries vary between $0.3 billion and $2.1 billion, and emergency response and insurance backed social protection, recoveries vary between $0.1 billion and $0.9 billion. Under the base assumption, the one in ten-year return period insurance recovery is $5.2 billion. This compares with a one in ten-year asset loss of $48.3 billion.
- Due to inherent loss escalation after an event, the reduction in the financial consequences of natural disaster events achieved through insurance recoveries is greater than the monetary value of the insurance payout. Under the base assumption, simulated one in ten-year asset losses are reduced from $48.3 billion to $40.7 billion, a reduction in financial consequences of $7.6 billion, or 16%. This is a 45% increase in the monetary value of the one in ten-year recovery of $5.2 billion.
- The range of plausible increases in insurance penetration over the next ten years reduced the simulated average annual asset losses from $28.7 billion to between $21.9 billion under the high insurance sensitivity assumptions and $26.4 billion under the low insurance sensitivity assumptions, representing an annual reduction in financial consequences of between 8% and 24%.

Introduction

This report has been commissioned by the UK Department for International Development (DFID) to provide quantitative evidence of the potential scale of natural disasters that could be covered by insurance, or other ex-ante risk financing instruments, in the next ten years. The study is focused on the set of countries identified by the World Bank to be low or low-middle income economies[1], however the analysis excludes those countries deemed to be in conflict based on data from the UN Refugee Agency[2]. Overall a total of 77 countries are included in the study (see Appendix 1 for full list). Many of these countries are exposed to a wide range of natural catastrophes, including earthquakes, flooding, drought and tropical cyclones. Typically, these low income or low-middle income countries have very limited insurance markets and a poor ability to manage the consequences of catastrophic events.

In the period 2000 to 2015, the set of studied countries have received $35.9 billion in humanitarian aid commitments related to natural disasters[3]. According to data from the reinsurance company Swiss Re, and the Centre for Research on the Epidemiology of Disasters (CRED), overall natural disaster losses for the same period were $466.3 billion[4]. Due to limitations in the collection of data on natural disasters, it is not clear to what extent these aid commitments and reported disaster losses overlap. Nonetheless, there is clear potential for

[1] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519
[2] http://popstats.unhcr.org/en/persons_of_concern
[3] Source: UN OCHA Financial Tracking Service (https://ftsbeta.unocha.org/). Losses are inflated for CPI and increases in exposure. Loss escalation assumptions have been applied. See Technical Appendix for full details of methodology.
[4] See Technical Appendix for determination of historical asset loss totals. Losses are inflated for CPI and increases in exposure. Loss escalation assumptions have been applied.

insurance to both reduce the shortfall in funding for natural disaster losses in low and low-middle income countries, and to relieve pressure on humanitarian aid budgets.

Beyond acting as a simple replacement for sources of funding, ex-ante solutions such as insurance have the potential to reduce the overall financial impacts of natural disasters[5,6]. Insurance can be used to protect national budgets and provide governments with resources needed for immediate response as well as long term recovery and reconstruction. Recent research has shown that the financial impact of a natural disaster escalates with the time taken for damaged assets to be restored to working conditions[7]. When aligned with a coherent risk management framework, scalable sources of ex-ante risk-financing such as insurance can therefore mitigate the development of immediate disaster damages into longer term losses.

While this report is focused primarily on the potential impacts of ex-ante risk financing, disaster risk reduction (DRR) measures are also vitally important tools to help reduce the consequences of disasters in developing countries. Although an attempt to quantify the opportunity cost of different DRR measures against ex-ante risk financing is beyond the scope of this study, an analysis equivalent to that presented in this report could be conducted to assess the financial benefits of employing DRR measures.

Data

We use empirical data and loss simulation methodologies for the period 2000 - 2015 to characterise the disaster risk profile, and associated humanitarian aid expenditures, of the combined group of countries. Estimates of asset loss due to natural disasters are drawn from two global disaster datasets: Sigma[8], maintained by Swiss Re and EM-DAT[9] maintained by CRED at the Université Catholique de Louvain in Brussels. These databases are conceived for different purposes. EM-DAT is a public-service database which draws its data mainly from humanitarian agencies and development organisations. Sigma is focused on the financial impacts of disasters, related particularly to insurance.

Sigma is used as the primary source of asset loss data for this report. As Sigma has more focused criteria for including an event based on the number of people affected and the overall asset loss, there are fewer entries per year in the database than in EM-DAT. Where EM-DAT includes an event which is not included in Sigma we use the asset loss value as reported in EM-DAT to augment the time series. EM-DAT is also used to provide data on the number of people affected by natural disaster events.

Records of humanitarian aid commitments following natural disaster events are provided by the UN OCHA Financial Tracking Service (FTS). FTS collects, curates and publishes all data reported to it by donors and operational humanitarian actors, known as total reported funding. FTS is preferred as a data source for this study over sources such as the OECD Creditor Reporting System (CRS) database because its records include designation of humanitarian aid flows by country in response to specific natural disaster events. This allows us to differentiate between humanitarian aid for other disaster categories such as conflict, which can be significantly greater in size. We do, however, use OECD CRS data to determine the split of aid payments between emergency response and reconstruction expenditures[10].

We caution that it is not possible to quantify the extent to which differences between reported asset losses and humanitarian aid spend are a simple reflection of a coverage gap, or whether there are some aspects of asset losses which are not expected to be covered by humanitarian aid, such as damage to private assets. It is expected that the situation in reality is best described by the diagram in Figure 1a, however, where most of the losses met by humanitarian aid are captured in reported asset losses.

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[5] Clarke, D., *et al.* (2016). *A Methodology to Assess Indicative Costs of Risk Financing Strategies for Scaling Up Ethiopia's Productive Safety Net Programme*, World Bank Group
[6] De Janvry, A., del Valle, A., Sadoulet, E. (2016). *Insuring Growth, The Impact of Disaster Funds on Economic Reconstruction in Mexico*, World Bank Group
[7] Hallegate, S. (2015). The Indirect Cost of Natural Disasters and an Economic Definition of Macroeconomic Resilience, World Bank Group
[8] http://www.swissre.com/sigma/
[9] D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
[10] For more information on this methodology please see the Technical Appendix.

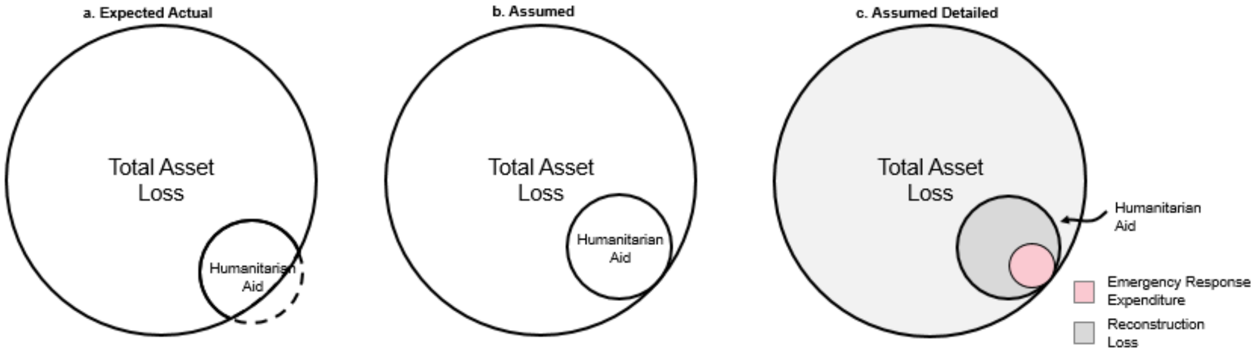

Figure 1: Venn diagram showing relationship between reported humanitarian aid expenditure (FTS) and total asset loss (Sigma/EM-DAT) for natural disaster events in the analysed set of countries: a. In reality, there is significant but incomplete overlap; b. We assume for this analysis that humanitarian aid is a subset of the total asset loss; c. Further assumption that all emergency response expenditures are covered through humanitarian aid expenditure.

For the purposes of this analysis, we have made the simplifying assumption that humanitarian aid is a subset of the total asset loss associated with a disaster event (Figure 1b) and, for the set of countries, that all emergency response expenditure is provided by humanitarian aid (Figure 1c). The remainder is therefore assumed to be focused on reconstruction of physical assets and other forms of relief and rehabilitation. The term asset loss therefore represents more than just simply losses from damage to buildings, although likely omits some of the total economic loss associated with disaster events.

As FTS data does not include purpose categories for humanitarian aid expenditure, the total emergency response expenditures for each event are estimated using peril specific factors that are derived from empirical data in the OECD Creditor Reporting System (CRS) database[11]. To minimise the influence of expenditure in response to conflict, we exclude those countries which have experienced war during the study period when deriving these factors. Private reconstruction losses are subsequently calculated as 19% of total reconstruction losses, as derived in the Technical Appendix.

It should be noted that there are significant limitations in data relating to natural disaster impacts that are available for low and low-middle income countries. Further details on data sources are provided in the Technical Appendix.

Empirical Risk Profiles

The asset loss data are scaled to reflect inflation in the value of underlying assets, by multiplying historical losses by the increase in the country's GDP index to 2016, and normalised to current US dollar prices. Data are then aggregated by year to allow calculation of an empirical exceedance probability (EP) curve, which describes the probability that total losses from natural disaster events will exceed a certain amount in a given year. For example, Figure 2 (left) suggests that there is a 10% probability that natural disaster losses in low and low-middle income countries will exceed $46.6 billion in any one year.

[11] https://stats.oecd.org/

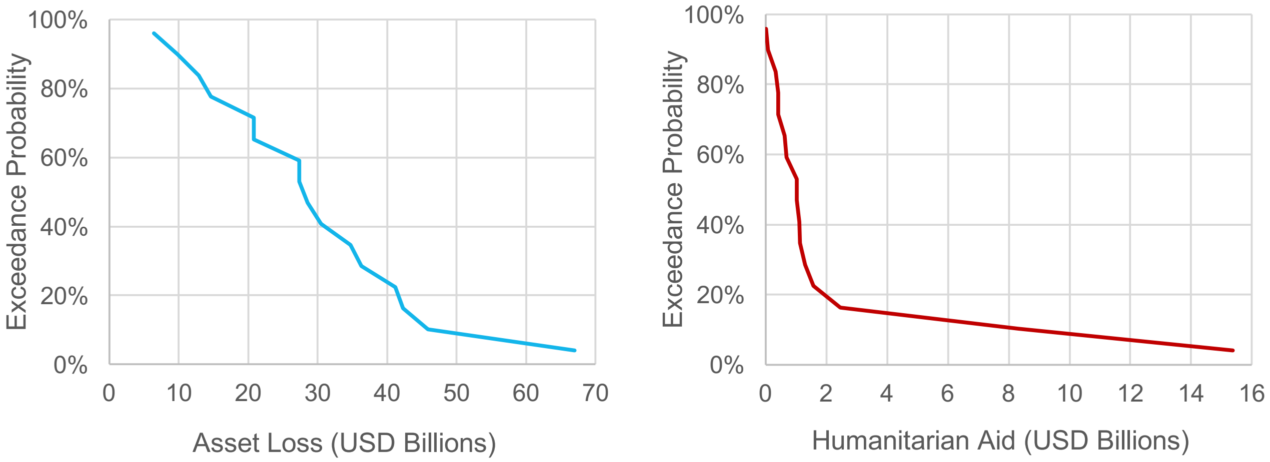

Figure 2: Empirical exceedance probability curves for natural disaster events in low and low-middle income countries. Left: Total asset loss. Right: Total humanitarian aid expenditure. All values normalised to 2016 US dollars and adjusted for inflation to present day values.

The empirical EP curve for humanitarian aid commitments shows a very different risk profile as compared with asset losses. (Figure 2, right). This figure displays a shape similar to an exponential decay curve, with a long tail, showing that there is a small, but non-zero probability that humanitarian aid expenditure will be an order of magnitude greater than expected annual expenditure.

Looking at the aid expenditure since 2000 (Figure 3 lower), there are significant spikes in both 2004 and 2010 in response to the Pacific tsunami and the Haiti earthquake respectively. Considering these data alongside asset losses (Figure 3 upper), it can be seen that while there are still years with asset losses that are markedly higher than average, for example in 2004 due to the Pacific tsunami, the spikes are not as striking. Overall asset losses in 2010 (driven by the Haiti earthquake) and in 2013 (driven by typhoon Haiyan in the Philippines) are very similar. Yet aid expenditure in 2010 is over seven times higher than in 2013. This suggests that only certain, likely lower income countries require much larger scale humanitarian aid to assist with the consequences of disaster events. It should also be noted that large global humanitarian appeals for aid followed the 2004 Pacific tsunami and 2010 Haiti earthquake events.

Clearly the humanitarian aid system can increase the scale of expenditure to help those countries that require aid. However, at the same time the overall scale of aid expenditure is significantly lower than the total asset losses, implying that aid expenditure does not typically cover the full losses of natural disasters in low and low-middle income countries.

The annual average asset loss from natural disasters in the group of countries is $29.1 billion; by contrast, the annual average humanitarian aid expenditure from natural disasters is $2.2 billion (8% of total asset losses). Historically, insurance has contributed minimally towards disaster relief in low and low-middle income countries; the average annual insurance recovery is $0.9 billion (3% of total asset losses). Other sources of funding might include government reserves, additional loans or costs borne by private citizens. Still, these data suggest strong potential for large shortfalls between a country's disaster needs and available aid, emphasising the requirement for alternative methods, such as ex-ante risk financing.

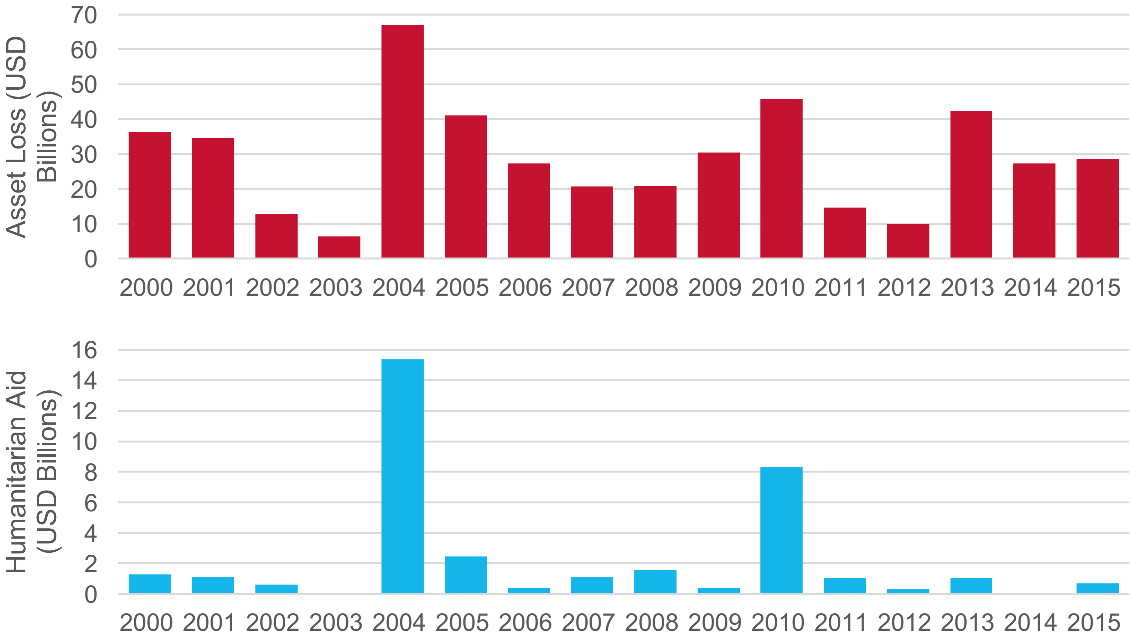

Figure 3: Time series of total asset loss (top) and humanitarian aid expenditure (lower) for low and low-middle income countries in response to natural disasters for the period 2000 to 2015. All values normalised to 2016 US dollars and adjusted for inflation to present day values.

The Human Dimension

While asset losses are a standard metric for reporting the overall impacts of a natural disaster, particularly in the media, the loss from an event is strongly influenced by the underlying value of assets which are affected, and the individual characteristics of an event. Some kinds of natural disaster, such as droughts affecting rural areas in low-income countries, may have low asset losses but a significant impact on the human population. Figure 4 shows an empirical EP curve of the number of people in low and low-middle income countries affected by natural disasters, and therefore potentially requiring emergency aid. Population numbers have been adjusted to the present-day values based on population growth on a country by country basis.

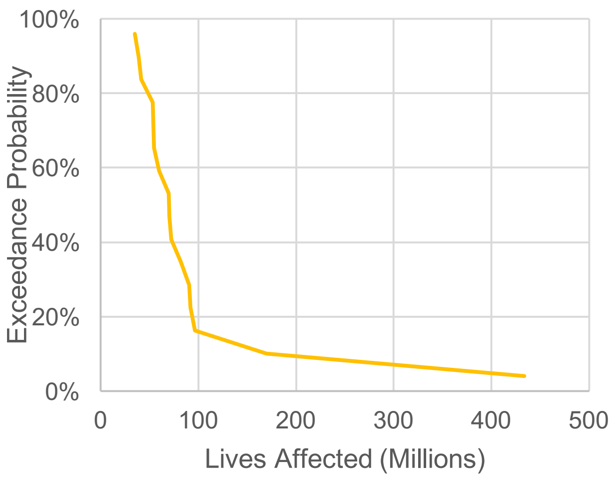

Figure 4: Empirical exceedance probability curves for the number of people affect by natural disaster events in low and low-middle income countries. Population numbers have been adjusted for population growth to present day values.

Accounting for Loss Escalation

Economic research has demonstrated that indirect losses increase as a function of the time taken to restore damaged assets to working assets. Recent publications suggest that factors as high as three are appropriate for recoveries that apply to reconstruction and longer term relief costs[12]. Studies have shown that emergency response expenditures can be reduced by 64% with early intervention[13]. We account the phenomenon of loss escalation by increasing emergency response expenditures and reconstruction losses using loss escalation factors.

There is much uncertainty around the true extent of loss escalation, with the actual number likely to vary widely by event depending on factors including, but not limited to, the ability of the government to respond to losses, the spatial extent of the event, and the percentage of people affected who live in urban environments. Therefore, we have used a base assumption, as well as two sets of sensitivity factors, to gauge the extent to which losses vary depending on the loss escalation assumptions used. The three sets of loss escalation assumptions employed are shown in Table 1.

Loss Escalation Type	*Base Scenario*	*Sensitivity (Low)*	*Sensitivity (High)*
Emergency Response	*2*	*1*	*4*
Reconstruction	*1.5*	*1*	*3.5*

Table 1: Escalation assumptions used for base analysis and for sensitivity testing.

Figure 5 shows total asset losses for each of the three sets of escalation assumptions described in Table 1. Total losses vary widely depending on which of the sets of assumptions is used. Therefore, it should be noted that loss escalation is a source of significant uncertainty around the true asset loss amount.

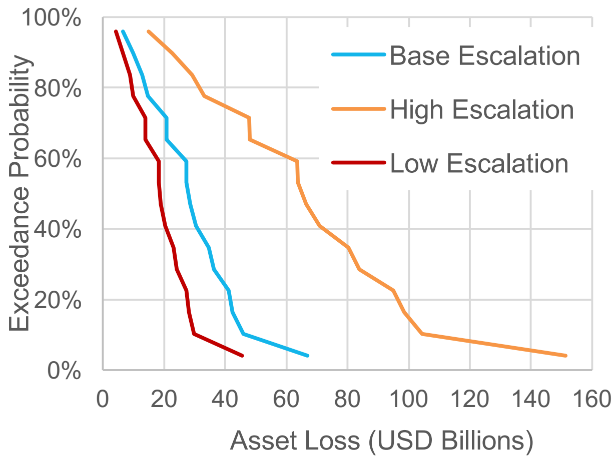

Figure 5: Empirical exceedance probability curves for total asset loss for each of the three sets of loss escalation assumptions

Simulated Risk Profiles

An empirical analysis is limited in its ability to represent extreme scenarios that have not occurred in the historical record. Empirical risk profiles also have the potential to be disjointed, particularly when they depend on a limited number of historical observations. We have therefore developed a simulation framework for natural disaster impacts in low and low-middle income countries. Loss distributions which are based on the historical data are used to extrapolate the probability of extreme events and their associated losses to give a realistic view of risk at longer return periods.

[12] De Janvry, A., del Valle, A., Sadoulet, E. (2016). Insuring Growth, *The Impact of Disaster Funds on Economic Reconstruction in Mexico*, World Bank Group

[13] Cabot Vent, C., Shitarek, T., Coulter, L., Dooley, O. (2013). The Economics of Early Response and Resilience: Lessons from Ethiopia

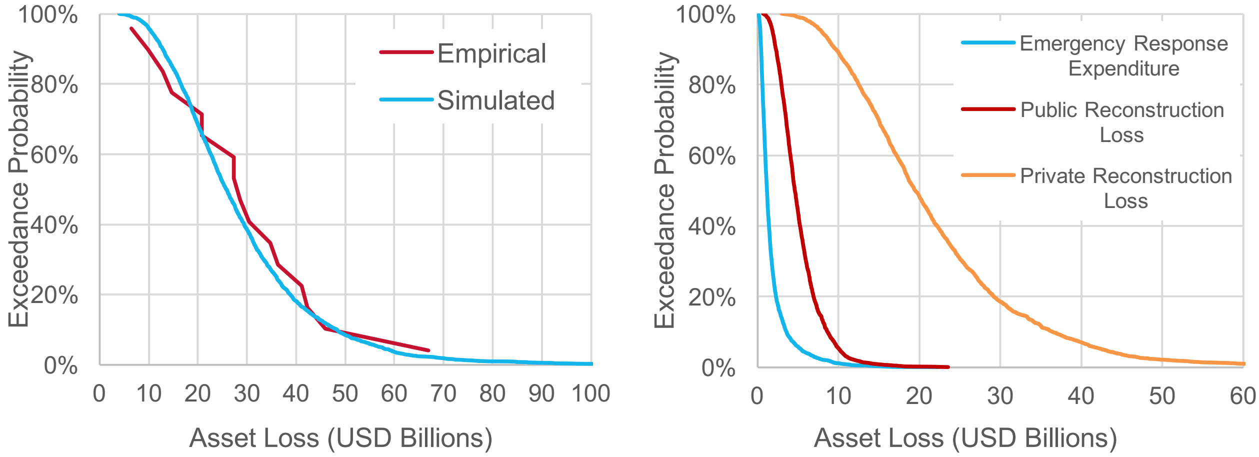

Figure 6: Simulated exceedance probability curves for natural disaster events in low and low-middle income countries. Left: Total asset loss (blue) against the empirical exceedance probability curve (red). Right: Asset loss by category.

The simulated dataset is constructed first by creating a hypothetical set of event occurrences for six different perils across a 2,500-year period. We then assign an occurrence to a country, based on the relative probability of each country being impacted by the peril. We then develop a probability distribution, represented by a beta function, to determine the number of people affected by the occurrence. Reconstruction losses and emergency response expenditures are estimated using empirically-derived peril-specific factors which relate the losses to the number of lives affected.

Simulated EP curves for asset losses are shown on the left-hand side of Figure 6. According to these data, the one in 25-year asset loss from natural disasters in low and low-middle income countries is approximately $59.5 billion, rising to $78.6 billion at the one in 100-year level. Metrics at key return periods are also shown alongside those derived from the empirical risk profiles in Table 2. The close agreement between simulated and empirical risk profiles is expected in the annual average loss (AAL) as the empirical data form the basis of our simulation.

We find that reconstruction represents the largest proportion of overall disaster losses. At short return periods, emergency response expenditures are estimated to be approximately 5-10% of the overall loss. At longer return periods, however, this share increases significantly. We note that this result is driven by the two most extreme events in the historical data – the 2004 Pacific tsunami and the 2010 Haiti earthquake - both of which had greater proportions of emergency response expenditures compared with smaller events.

	Empirical	***Simulated***			
Return Period	***Total Asset Loss***	***Total Asset Loss***	***Emergency Response Expenditure***	***Public Reconstruction Loss***	***Private Reconstruction Loss***
AAL	*$29.1 bn*	*$28.7 bn*	*$1.8 bn*	*$5.2 bn*	*$21.7 bn*
2	*$28.0 bn*	*$25.8 bn*	*$1.2 bn*	*$4.6 bn*	*$19.5 bn*
5	*$41.6 bn*	*$38.9 bn*	*$2.3 bn*	*$6.9 bn*	*$29.2 bn*
10	*$46.6 bn*	*$48.3 bn*	*$3.6 bn*	*$8.7 bn*	*$36.5 bn*
25	-	*$59.5 bn*	*$6.1 bn*	*$10.5 bn*	*$44.3 bn*
50	-	*$68.6 bn*	*$8.6 bn*	*$12.1 bn*	*$50.8 bn*
100	-	*$78.6 bn*	*$10.3 bn*	*$14.2 bn*	*$59.7 bn*

Table 2: Return period losses for empirical and simulated total asset losses of natural disaster events in low and low-middle income countries. Simulated losses are broken out by category.

Role of Insurance

An estimate for the potential scale of natural disaster losses which could be covered by insurance schemes is determined by applying the payouts from hypothetical examples of plausible insurance schemes to the simulated loss histories derived above.

The majority of asset losses and humanitarian aid expenditure from natural disasters could conceptually be covered under an insurance program. Traditional indemnity insurance is suitable for funding the reconstruction of physical assets, although it may be less suited to emergency response expenditures because it is slower to release critical funding in emergency situations. Payouts from parametric insurance schemes have the potential to be used for a much wider range of purposes, and have been deployed successful in recent years by a number of governments.

Constraints such as the development of a private insurance market and capacity of governments to participate in sovereign insurance schemes limit the scale of possible payments for any given disaster, however. On a practical level, it is therefore unrealistic to anticipate complete insurance coverage for all low and low-middle income countries in the near future. In this study, we determine a baseline for the potential role of insurance from analysis of existing insurance schemes in low- and middle-income countries, and estimates of the role of private insurance. The categories of insurance we consider are:

i. Insurance for public assets
ii. Insurance for private assets
iii. Emergency response and insurance backed social protection (ER & IBSP)

For each category, we have developed multiple scenarios to reflect a range of different insurance development scenarios that we consider plausible over the next ten years. It should be noted that these schemes have been applied to losses that have not been projected to be commensurate with expected trends in asset or population growth over the next ten years. The resulting insurance recoveries can therefore be interpreted as the recovery assuming the asset losses that are expected today, with insurance structures that could plausibly be in place at the end of the ten-year period being active now.

For insurance coverage to expand in low and low-middle income countries, the governments of these countries need to support insurance market growth as a means to protecting the assets and livelihoods of the populations at risk from natural disaster events. Of primary importance, governments need to encourage effective regulation of domestic insurance markets to enable: a) the financial stability of insurers, and b) consumer confidence in insurers' ability to pay claims. Once these two requirements are met, significant insurance market growth will become possible[14].

To capture the variations of expected insurance market growth in low and low-middle income countries over the next ten years we have defined a base assumption, as well as low and high sensitivity assumptions. To arrive at the terms for the schemes that make up our insurance assumptions we have used the following set of guidelines:

- **Low Sensitivity:** Low estimate of what could be achieved at the end of the next ten years. Determined by reviewing current insurance recoveries under similar schemes for low and low-middle income countries.
- **Base Sensitivity:** Estimate of what could feasibly be achieved at the end of the next ten years assuming public policy supports insurance market growth. Determined by looking at specific low or low-middle income countries which already have traditional, or innovative insurance schemes in place, and then assuming that these schemes could be adopted by all low and low-middle income countries.
- **High Sensitivity:** Ambitious estimate of what could feasibly be achieved at the end of the next ten years assuming major public policy changes encourage insurance market growth. Determined by extrapolating current insurance structures so to provide more coverage than is typically seen today in any low or low-middle income country.

It should be noted that our analyses do not consider the values of any premiums associated with the insurance schemes. Derivations for each of the three sensitivity assumptions are described in more detail in the Technical Appendix.

Insurance for Public Assets

This scheme is designed to provide rapid funding following the occurrence of a catastrophic event, similar to how FONDEN in Mexico works. We assume that the payouts from this scheme will be used to part-fund the reconstruction of damaged public assets.

To arrive at the layer assumptions for this structure we looked at several pre-existing sovereign risk transfer schemes, including CCRIF, ARC and PCRAFI. Although some of these schemes are not strictly used solely for public assets, they provide useful context as to what could be achieved under a sovereign scheme. The main outcome of this analysis is that the payouts from these schemes are typically more closely related to a country's

[14] http://www.worldbank.org/en/topic/financialsector/brief/insurance

GDP (and hence what a country can afford) than the total asset loss from the event. We have therefore chosen to define covered layers based on the GDP of the impacted country. The assumptions used for this scheme are displayed in Table 3.

	Insurance for Public Assets Scheme		
	Base	***Sensitivity Low***	***Sensitivity High***
Attachment (% of GDP)	*1.0%*	*1.0%*	*0.5%*
Limit (% of GDP)	*2.5%*	*2.5%*	*4.0%*
Covered Percentage	*40%*	*10%*	*40%*

Table 3: Description of base hypothetical insurance for public assets insurance schemes

Emergency Response and Insurance Backed Social Protection

This structure aims to address emergency response expenditure in the immediate aftermath of an event. To determine the framework of this structure we looked at literature that describes instances of natural disaster social protection schemes. Most of these schemes pay out per person, or per family affected, so we have used the following equation for the basis of payments under this scheme.

$$ER\ \&\ IBSP\ Payout = Covered\ Percentage \times Payout\ Amount \times \#Affected$$

Papers on this topic find that the payout per person has typically been around $50[15,16], so we have used this amount for all sensitivities, and varied the “Covered Percentage” amount. To determine the covered percentage for the scheme we analysed social insurance percent covered data from The Atlas of Social Protection[17]. Although these percentages are not necessarily equivalent to the percentage of population covered in the wake of a disaster, they do give some indication about the willingness and ability of governments to help portions of the population through insurance backed assistance. Assumptions for this scheme are given in Table 4.

	Emergency Response and Insurance Backed Social Protection		
	Base	***Sensitivity Low***	***Sensitivity High***
Covered Percentage	*5%*	*1.5%*	*20%*
Payout Amount	*$50*	*$50*	*$50*

Table 4: Description of base hypothetical insurance for emergency response & insurance backed social protection schemes

Insurance for Private Assets

This structure is designed to act like traditional insurance. To determine assumptions for insurance for private assets we looked at historical insurance payments for low and low-middle income countries as reported in Sigma data. Ratios of private recoveries to private asset losses were found, and aggregated by country to find payout ratios by country.

For the low sensitivity assumption, we use a value of 8%, on par with the levels of insurance recovery that are seen today in India, El Salvador and Sri Lanka, and similar to the average overall recovery seen for low and low-middle income countries. For the base assumption, we use a value of 12%, roughly in between the level of recovery seen in India and in Indonesia. For the high sensitivity assumption, we use a value of 15%, the level of recovery seen in Indonesia. These assumptions are outlined in Table 5.

[15] Clarke, D., Coll-Black, S., Cooney, N., Edwards, A. (2016), A Methodology to Assess Indicative Costs of Risk Financing Strategies for Scaling Up Ethiopia’s Productive Safety Net Programme. World Bank Group
[16] Hallegate, S., et al. (2016), Shock Waves: Managing the Impacts of Climate Change on Poverty, World Bank Group
[17] http://datatopics.worldbank.org/aspire/

	Insurance for Private Assets		
	Base	**Sensitivity Low**	**Sensitivity High**
Payout Percentage	*12%*	*8%*	*15%*

Table 5: Description of base hypothetical insurance for insurance for private assets schemes

In addition to the practical limitations of insurance penetration described above, different insurance solutions are appropriate to provide cover for different aspects of natural disaster losses. For example, *insurance for private asset* schemes are applicable for losses stemming from damage to private properties, and some level of business interruption, but cannot be used towards emergency response expenditures or reconstruction of public assets. Likewise, *ER & IBSP* is more focused on protecting the livelihoods of people in low-income groups. We therefore assume that each of the hypothetical insurance schemes is applicable to different categories of loss from natural disasters, as outlined in Table 6.

	Risk Transfer Mechanism		
Loss Component	**Insurance for Public Assets**	**Insurance for Private Assets**	**Emergency Response and Insurance Backed Social Protection**
Emergency Response	✗	✗	✓
Private Reconstruction	✗	✓	✓
Public Reconstruction	✓	✗	✗

Table 6: Applicability of hypothetical insurance schemes to the categories of loss

The hypothetical insurance schemes are applied to simulated risk profiles on an event by event basis, to quantify the potential scale of insurance recoveries in low and low-middle income countries for different insurance development scenarios.

Overall, using the simulated data, we find that the average annual recovery under the base insurance schemes that cover natural disaster risk in low and low-middle income countries is $3.1 billion.

- **The highest recoveries under the base assumptions are achieved under *insurance for private asset* schemes that pay out approximately $1.7 billion on an annual basis.**
- ***Insurance for public assets* has the potential to cover $1.1 billion on an annual basis**
- ***ER & IBSP* could cover approximately $216 million per year. EP curves for recoveries from each of these schemes are shown in Figure 7**.

Although *insurance for private assets* schemes have the highest recoveries, it should be noted that the assets covered by this scheme have the highest associated losses (as shown in Figure 6).

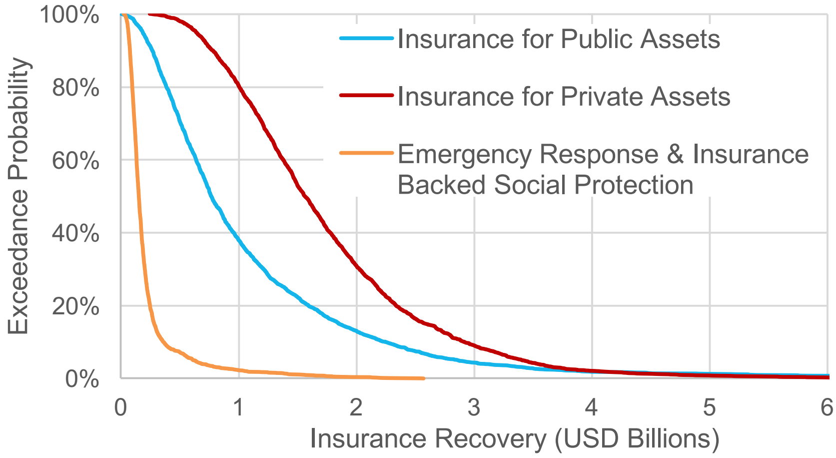

Figure 7: Simulated exceedance probability curves for each of the three insurance mechanisms using base insurance assumptions.

A key feature of natural disaster losses is the potential for years with extreme damages and loss. Ex-ante insurance schemes offer the potential for scalable and predictable sources of capital to help cover these losses. An exceedance probability curve showing overall insurance recoveries is shown on the left-hand side of Figure 8. The right-hand side of Figure 8 plots what losses would be if there was no insurance coverage, and losses with the base insurance assumptions. The difference between the two curves represents the reduction in the financial consequences of disaster events due to insurance coverage.

Our analysis suggests that the one in ten-year recovery from plausible insurance schemes in low and low-middle income countries is approximately $5.2 billion, compared to one in ten-year asset losses of $48.3 billion. This insurance recovery leads to a reduction in financial consequences of $7.6 billion, rising to an insurance recovery of $9.8 billion and reduction in financial consequences of $12.6 billion at the one in 100-year level. The reduction in the financial consequences due to insurance is greater than the insurance recovery itself as the insurance payout reduces the amount of loss that is subject to loss escalation, as described earlier and in detail within the technical appendix. This highlights one of the key benefits of insurance, namely that rapid access to a guaranteed source of post-event funding can give an economic benefit that is higher than the monetary value of the insurance payout.

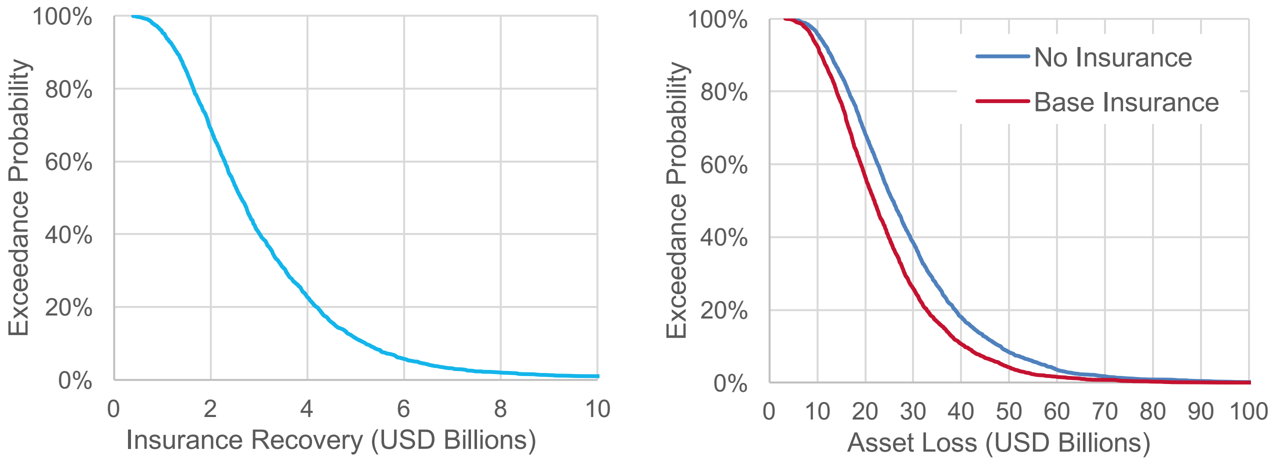

Figure 8: Left: simulated exceedance probability curve for total insurance recovery using base insurance assumptions. Right: simulated exceedance probability curves for total losses net of insurance. The blue line shows losses assuming no insurance and the red line shows losses assuming base insurance assumptions.

On an average annual basis we find that $1 of early insurance payout is worth $1.44 of payment provided many months or years after the event. It should be noted that this figure is highly dependent on the loss escalation assumptions used (as shown in Table 1). In order to maximise the impact of the insurance payout, the following conditions must be met:

1. The insurance payment must come quickly after the event
2. There must be a plan for the use of the payout
3. The plan must be executable.

Insurance Sensitivity Analysis

The analysis has also been run using the two sets of sensitivity assumptions described in tables 3, 4 and 5. Variation between total insurance recoveries under the three sets of assumptions are displayed in the left-hand side of Figure 9. The base assumption is shown as a solid blue line and the two sensitivities are shown as dashed lines. Total annual insurance recoveries vary between $1.5 billion for the low sensitivity assumptions and $5.1 billion for the high sensitivity assumptions. This wide range highlights the sensitivity of the insurance recoveries to the assumptions chosen, and the variability of the recoveries that could be achieved over the next ten years depending on how rapidly insurance markets are able to expand.

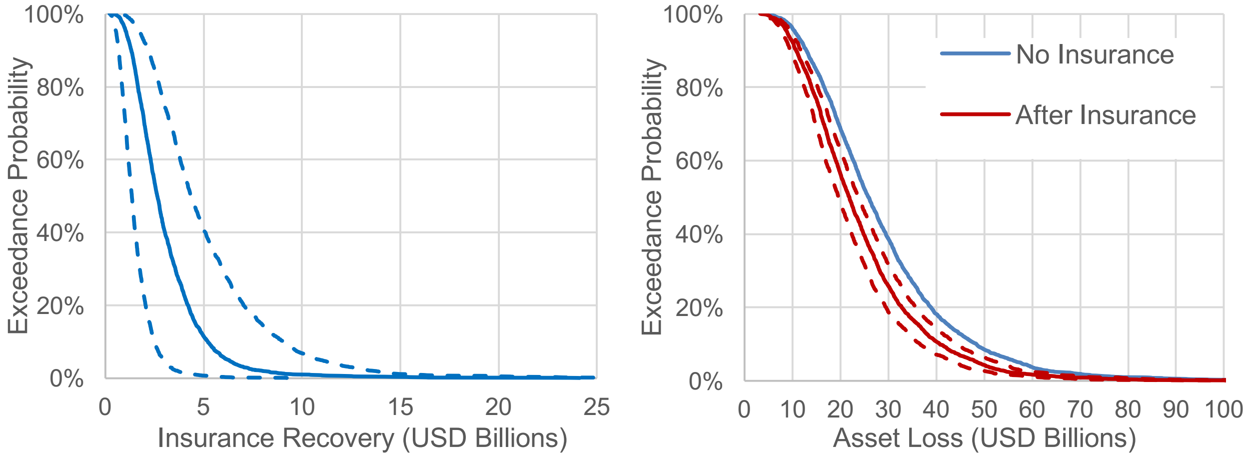

Figure 9: Left: simulated exceedance probability curve for total insurance recovery using base (solid line) and sensitivity (dashed lines) insurance assumptions. Right: simulated exceedance probability curves for total losses net of insurance. The blue line shows losses assuming no insurance and the red lines show losses assuming base (solid line) and sensitivity (dashed lines) insurance assumptions

The right-hand side of Figure 9 shows losses assuming no insurance recovery (blue line) and losses after insurance (red lines). Sensitivities around the base assumption are shown as dashed lines. It can be seen that losses net of insurance vary considerably depending on the set of insurance assumption shown. Asset losses are reduced from $28.7 billion to between $21.9 billion under the high insurance sensitivity assumptions and $26.4 billion under the low insurance sensitivity assumptions, representing an annual reduction in financial consequences of between 8% and 24%.

Conclusions

Overall, the quantitative analysis presented in this study suggests that plausible development of insurance schemes to cover losses from natural disasters in low and low-middle income countries over the next ten years has the potential to provide average annual insurance recoveries of $3.1 billion (approximately 11% of average annual asset losses). Taking into account the positive impact of ex-ante risk financing that acts to mitigate the longer-term development of disaster losses, these recoveries reduce the financial consequences of catastrophe risk by $4.4 billion per year (approximately 15% of average total asset losses).

Given uncertainty around the level of overlap between reported asset losses and humanitarian aid expenditures for natural disaster events in low and low-middle income countries, we refrain from making a direct analytical comparison of the proportion of the aid budget which could feasibly be covered by insurance. The potential for average recoveries of $1.1 billion through *insurance for public assets* schemes, and $216 million through *ER & IBSP* schemes per year, represents a significant proportion of losses that would otherwise be funded through aid expenditure, suggesting that there is mileage in pursuing the development of insurance these countries.

We find that the largest recoveries are provided by *insurance for private assets* schemes. We note, however, that insurance penetration levels are currently extremely low across the majority of analysed countries, and that its payout would primarily support reconstruction of private assets, rather than emergency response or support for livelihood among poorer groups in society. *Insurance for public asset schemes,* which pay out an amount based on the GDP levels of the country impacted, also give large insurance recoveries. These types of schemes are similar to sovereign risk transfer schemes that already exist for a number of developing countries and have strong potential to provide disaster risk financing across low and low-middle income countries.

An important part of this analysis is the attempt to estimate the benefits that ex-ante risk financing can have in mitigating the development of the immediate losses in a disaster into a larger long-term loss. This is achieved through application of crude loss escalation factors, derived from analysis of recent literature. Given the potentially large impact of loss escalation, and the variance found in asset losses from using different assumptions, we strongly advocate further research into this effect and its potential importance.

It should also be noted that while this analysis focusses on the ability of insurance mechanisms to reduce the financial impact of natural disaster events, the importance of disaster risk reduction measures should not be overlooked. DRR measures make societies more resilient, leading to reductions in both the financial and human consequences of natural disaster events. While DRR has not been analysed in detail here, it would be possible to produce similar analytics to quantify the economic benefit of DRR measures.

The results rest on objective analysis of data relating to natural disaster losses and humanitarian aid expenditure that are publicly available. It is acknowledged that there are significant limitations in the quality and detail of these data which are discussed further in the Technical Appendix, along with presentation of extensive sensitivity tests around the parameters and assumptions which are used. We caution that these data limitations restrict the confidence with which the results presented in this report should be interpreted. Nonetheless, we believe that this analysis provides robust order of magnitude estimates which describe the scale of coverage which could be provided by insurance.

Appendix 1- Countries Included in Analysis

Armenia, Bangladesh, Benin, Bhutan, Bolivia, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, Comoros, Congo, Rep., Ivory Coast, Djibouti, Egypt, El Salvador, Eritrea, Ethiopia, Gambia, Ghana, Guatemala, Guinea, Guinea-Bissau, Haiti, Honduras, India, Indonesia, Kenya, Kiribati, Korea, Dem. People's Rep., Kosovo, Kyrgyzstan, Lao PDR, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Philippines, Rwanda, Samoa, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Sri Lanka, Swaziland, Tajikistan, Tanzania, Timor-Leste, Togo, Tonga, Tunisia, Uganda, Uzbekistan, Vanuatu, Vietnam, West Bank and Gaza, Zambia, Zimbabwe.

Countries explicitly excluded from analyses detailed in this addendum due to conflict status:

Syrian Arab Republic, South Sudan, Somalia, Yemen, Sudan, Afghanistan, Ukraine, Democratic Republic of the Congo.