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DISASTER RISK FINANCE AS A TOOL FOR DEVELOPMENT

A Summary of Findings from the Disaster Risk Finance Impact Analytics Project

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OVERVIEW

Extreme natural events such as droughts, floods, earthquakes, tropical cyclones, and pandemics can threaten lives, livelihoods, and even entire economies. Disaster risk finance aims to increase the resilience of vulnerable countries to the financial impact of disasters as part of a comprehensive approach to disaster risk management. By increasing resilience, disaster risk finance offers the promise of protecting and promoting development.

But does it actually work in practice?

Critics of disaster risk finance often argue that investing to avoid or reduce risk is more cost-effective than investing in post-disaster expenditures. They also argue that insurance and other risk transfer instruments can be opaque and expensive, providing poor value to governments.

Generating the evidence to better-guide investments in sovereign disaster risk finance programs, to maximize their expected humanitarian and development impacts, and to ensure that public investments deliver value for money requires robust methodologies—ones that rigorously monitor and evaluate existing schemes and new products.

Since 2013 The World Bank Group has partnered with the Global Facility for Disaster Reduction and Recovery and the U.K. Department for International Development to address some of these gaps in evidence and methodologies. The Disaster Risk Finance Impact Analytics Project has made significant contributions to the understanding of how to monitor and evaluate existing or potential investments in disaster risk finance from a development perspective, and to the evidence base for where such investments have development impact.

This note summarizes the findings of this project, presenting the key messages of a book, a technical report, and 14 research papers, categorized into four themes.

Increasing Commitment Through Disaster Risk Finance. Independent central banks can, it is widely understood, resolve a commitment problem in macroeconomic policy—if governments allow themselves full discretion to set interest rates, short-term political incentives will tend to lead to interest rates that are too high, at a huge cost to the economy. By establishing an independent institution with the power to set

interest rates, but subject to pre-agreed rules or principles, governments around the world resolve this commitment problem. Financing post-disaster needs faces a similar commitment problem—if governments, firms, people, and development partners allow themselves full discretion to decide who will pay for what relief and reconstruction after a potential disaster, short-term political incentives will tend to lead to slow, fragmented, unreliable response, as well as to underinvestment in adaption and risk reduction. This happens again and again in rich and poor countries alike, and leads to unnecessarily high human and economic costs from natural hazards.

Part 1 presents insurance and insurance-like institutions—both public and private—as potential solutions to this commitment problem. Clarke and Dercon present the overarching argument in their book Dull Disasters; Clarke and Wren-Lewis provide a more theoretical economic analysis of the commitment problem and the range of potential insurance-like solutions; and Boudreau presents evidence from Mexico suggesting that disaster risk finance programs can indeed work as a commitment device for governments.

But building and using public or private institutions that provide post-disaster financing according to pre-agreed rules has a cost, and are the benefits really worth it?
The end use of the financing is crucial to answer this question. After a disaster, governments and partners may respond in a myriad of ways but most funding channels to two broad categories of response: reconstructing buildings and other damaged or destroyed physical capital—for example, a bridge lost in an earthquake or a road washed away in a flood—and supporting the individuals who have lost their livelihoods as a result of a disaster—for example, financial assistance to households that lost their harvest as a result of drought. Two elements of response, speed and reliability, can bring significant benefits to individuals and economies.

Timely Reconstruction. Part 2 explores the economic gains from speed and reliability through two papers. Hallegatte's elegant rule of thumb estimates the total economic cost of a disaster, beyond the direct loss of assets. De Janvry, del Valle, and Sadoulet report on an impact evaluation of Mexico's fund for natural disasters, FONDEN: the faster reconstruction of infrastructure assets made possible by FONDEN's disaster risk finance strategy contributes, on average, to an increase in post-disaster local economic activity of 2–4 percent.

Timely Support to Livelihoods. Part 3 investigates the gains to household welfare from speed and reliability and partitions this large body of research into empirical evidence and methodologies. Porter and White show that a rural safety net program in Ethiopia lessens a drought's impact by 25 percent. The speed with which this safety net makes transfers, Berhane, Abey, and Hoddinott demonstrate, affects the benefits realized by individuals. For example, when households receive financial support by the beginning of the lean season, they are better able to increase consumption, to reduce malnutrition, and to keep children in school. In a very different setting, de Janvry, Ramirez Ritchie, and Sadoulet find that when drought strikes, insurance payouts from the disaster risk finance program CADENA increase Mexican farmers' income by 38 percent and their consumption by 27 percent.

But a financial instruments' quality also determines the degree to which livelihoods and welfare improve. Taking agricultural index insurance as an example, Morsink, Clarke, and Mapfumo provide quantitative measures to answer two key questions: How well does the insurance insure what it set out to insure? And does the insurance really help reduce the income risk that poor households face? Jensen, Ikegami, and Mude examine two instruments well-suited to protect the livelihoods of pastoralists in northern Kenya—index insurance and scalable social protection—and discover both impact welfare positively.

Saving Money Through Disaster Risk Finance. Part 4 considers the cost of providing timely financing for ex ante response and lays out how well-structured risk finance strategies can reduce the economic costs of managing fiscal volatility. Three papers—Clarke, Mahul, Poulter, and Teh; Clarke, Cooney, Edwards, and Jinks; and Clarke, Coll-Black, Cooney, and Edwards—develop and then apply a methodology to quantify the costs of different combinations of budgetary and financial instruments that can be used to finance a disaster response. The approach results in a simple formula to capture the opportunity cost of risk finance strategies and to help decision makers choose the least-cost approach.

But can choosing the right combination of financial instruments markedly impact the cost of a more timely response?

In a worked example of scalable social protection in Ethiopia, the authors find that an alternative disaster risk finance strategy could reduce the average cost of financing scalability expenditures by 25 percent. Applying a macroeconomic model to Jamaica, Bevan and Adam show that reallocating budget expenditure on operations and maintenance to finance more timely reconstruction was three times more expensive than insurance, which was in turn slightly more expensive than raising taxes. Finally, Ley-Borrás and Fox explain catastrophe risk models and apply them to designing, implementing, and monitoring disaster risk finance strategies that ensure disaster risk analytics are based on sound physical science.

To sum up, this body of research presents a compelling case for disaster risk finance as a tool for development. But the details matter.


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INCREASING COMMITMENT THROUGH DISASTER RISK FINANCE

With Disaster Risk Finance plans are dependable

Dull Disasters? How Planning Ahead Will Make a Difference

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Natural disasters remain all too common, and the aftermath of such disasters is full of high-stakes political leadership and debate, media attention, public appeals, and well-intentioned actions. Yet well-intentioned responses by governments and the international community often fall short of their aims. In this book, Clarke and Dercon (2016) argue that the fundamental problem is the funding model, whereby after a disaster, farmers and homeowners, subnational governments, and national governments are required to plead for help to benefactors, such as subnational governments, national governments, and the international community, all of whom retain discretion over how to allocate their budgets until after a disaster strikes. This ad hoc post-disaster funding model does not work well. It is too slow, leads to a fragmented and underfunded response, and encourages underinvestment in risk reduction and preparedness, thereby increasing the economic and human costs of catastrophes.

The Solution? The solution is for governments and their partners to adopt pre-agreed, pre-financed, rules-based preparedness plans that can be implemented after a disaster strikes without the need for further political decisions. Specifically, the responses to disasters can be more business-like and more effective (indeed, duller) if three things are in place beforehand:

1. A sound, coordinated plan for post-disaster action agreed in advance
2. A fast, evidence-based decision-making process
3. Financing on standby to ensure that the plan can be implemented.

A Plan—But Not Just Any Plan. Good planning is based on an iterative dialogue among scientists, bureaucrats, implementers, and financiers about what or who is to be protected, how it or they are to be protected, and what the cost will be. Bad planning happens when at least one of these parties is missing from the dialogue. Planning is a political choice; it is not just a technical exercise. Political statements by governments or development partners about how much money would be made available or how many people would be mobilized in the event of a disaster are not conducive to good planning. Useful political statements focus on target outcomes and leave the details on the "how" to be worked out by the implementing agencies and financiers.

Benefactors who want to maximize the development impact of their support should think through different natural disaster scenarios, assess what support they would provide in each scenario, and own up to this contingent liability when in discussions with other partners. A benefactor with either no contingency plan or its own stand-alone contingency plan will fall short in its efforts to help people. Benefactors can channel their financial support into precise sets of plans in which it is clear who exactly is being protected, how, and who is paying.

Behavioral biases against good planning are strongest for the kinds of disasters that did not occur in the recent past—that is, for nearly all future disasters. To combat these biases, there is a particular need to invest in science-based risk information and clear communication of this information to ensure that everyone knows what contingencies they need protection for.

Sound Decision Making—But Based on Good Rules, Good Data. By ensuring that as little as possible must be decided by stakeholders when a disaster strikes, rules can promote decisive, timely action. The data driving these decisions need to be resistant to manipulation and strike the right balance among cost, speed, and accuracy.

Any data that could trigger action will depend on investments before a disaster in design of the data collection system, including an audit function, and in the human and technological capacity to collect data in a timely manner. Three types of data are particularly useful for triggering post-disaster action: ground data on the damage to or losses of people and buildings, area average index data on damage and losses, and parametric indices.

No rule is perfect, and so there should be some discretionary backup system to deal with situations in which the rules fail.

Standby Financing—But Based on Smart Choices of Instruments and Triggers. Financial and budgetary instruments are the glue that hold credible plans together and make them strong enough to withstand the whirlwind of highly charged post-disaster politics (see table).

When designing and implementing disaster risk finance strategies, details matter. Financial experts add value. It is important to pay for financial advice and build in-house expertise.

The triggers in the financial strategy should match the triggers in the plan. Traditional reinsurance can be particularly useful for locking in plans for reconstruction, and indexed reinsurance can play the same role to finance indexed early actions.

Partially subsidized financial instruments can be used to encourage others to contribute toward the cost of well-defined plans.

Leaders should focus on providing protection, not relief, and using financial incentives to encourage others to own up to and finance their share up-front. Ad hoc, post-disaster support is still needed, but it should act as a backup when plans fail. It should not be the first line of defense for droughts, floods, earthquakes, tropical cyclones, or pandemics.

FINANCIAL AND BUDGETARY INSTRUMENTS

Goal	Ex ante instrument *(arranged before a disaster)*	Ex post instrument *(arranged after a disaster)*
Risk retention *(changing how or when one pays)*	Contingency fund or budget allocation Line of contingent credit	Budget reallocation Tax increase Post-disaster credit
Risk transfer *(removing risk from the balance sheet)*	Traditional insurance or reinsurance Indexed insurance, reinsurance, or derivatives Capital market instruments	Discretionary post-disaster relief

Solving Commitment Problems in Disaster Risk Finance

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Clarke and Wren-Lewis (2016) examine the ways in which risk transfer instruments—insurance, reinsurance, derivatives, and capital market instruments—can act as commitment devices, helping governments and development partners to commit ahead of the disaster to restrict their post-disaster discretion for the good of the country.

They identify three distinct problems that can arise from an inability of benefactors to commit:

1. *Disaster relief may be prone to a moral hazard problem and the classical "Samaritan's dilemma" in particular.* Those at risk deliberately underprotect themselves because they know governments or donors will come to their rescue.
2. *Benefactors do not undertake the steps needed to avoid the misallocation of disaster relief.* Many who should receive relief do not, and sometimes funds are diverted to those who suffered no losses at all. Before a potential disaster, benefactors would like to reduce misallocation, but if they cannot commit to doing this, recipients will self-insure. This serves to diminish the incentive to pay to reduce misallocation.

3. *Finally, disaster relief frequently arrives too late.* Besides practical reasons for relief not arriving in a timely fashion, benefactors may wait to see what others give before giving. This strategy may be motivated by the wish to gain clarity on burden sharing among donors before making payouts.

Especially in countries with poor governance, solving commitment problems by improving the functionality and credibility of the respective relief institutions is not feasible. Instead, investing in a system of risk transfer to third parties could be a more effective solution and has become part of countries' disaster risk finance strategies.

DRF INSTRUMENTS AND COMMITMENT PROBLEMS

Commitment problem	Recipient insurance subsidies	Benefactor insurance	Common payout triggers	Disaster index
Samaritan's dilemma	+	+	0	+
Aid misallocation	+	0	+/-	+/-
Delayed disbursements	+	+	0	0

Note 1 +/- policy mitigates/worsens the commitment problem, 0 effect unclear.

Clarke and Wren-Lewis consider four properties of schemes to transfer risk to third parties, each having different implications for the commitment problems (see table).

- *Recipient insurance subsidies. Benefactors purchase or mandate the purchase of insurance for the poor and vulnerable.* Or benefactors subsidize a fixed or proportional part of the premium payment.
- *Benefactor (re)insurance.* Benefactors, prior to disaster, coordinate insurance coverage with donors and purchase insurance.
- *Common payout triggers.* Benefactors ensure uniform relief triggers for public monies and private insurance.
- *Disaster indices.* Benefactors gather and publish statistics on disaster-loss proxies (such as satellite data on wind speed, rainfall) and construct disaster-loss indices to trigger payout.

Disasters and Discipline: The Political Economy of Natural Disasters and of Sovereign Disaster Risk Finance and Insurance in Mexico

Laura Boudreau, The World Bank Group

Natural disasters are often highly political events that are closely followed by the public—especially the government's response. Evidence from around the world suggests that voters' responses to these events may give governments incentives to prepare for and respond to natural disasters in ways that are suboptimal, or costly, for society.

In light of this dynamic, one possible benefit of disaster risk finance instruments may be to discipline governments and other benefactors to abide by rules and commitments determined before disasters occur. Specifically, disaster risk finance instruments may help governments credibly commit to cover certain risks and help to hold governments accountable to voters. The role of disaster risk finance instruments as commitment and accountability devices, however, is largely unexplored.

Boudreau (2016) provides preliminary empirical evidence that risk financing instruments can serve as a commitment device based on the experience of Mexico's Fund for National Disasters, FONDEN. The author's findings support the claim that Mexico's disaster risk finance program has disciplined politicians in light of the incentives provided by voters.

Mexican voters punish politicians for the occurrence of natural disasters in the run-up to elections but reward them for the allocation of post-disaster relief. Voters also respond to delays in post-disaster reconstruction by punishing the incumbent political party in the upcoming election.

Governors and the federal government respond to the incentives set by voters—requests and approvals for funds from FONDEN increase in presidential election years. Moreover, post-disaster relief increases in the run-up to these elections. These results do not imply that the FONDEN system is ineffective at disciplining politicians during election cycles—the behavior in the absence of FONDEN is unknown. However, FONDEN may be helping to address a commitment problem resulting from elections that would otherwise be more severe.

In fact, the evidence is consistent with FONDEN helping to discipline benefactors. In the early years of FONDEN, almost all applications for funds were granted by the federal government. Over time, the ratio of approvals-to-applications has fallen significantly, particularly for events when parametric thresholds are used to determine municipalities' eligibility. Furthermore, FONDEN's efforts to increase the insurance coverage of assets appear to be successful. In 2011 FONDEN implemented rule changes that promote the take-up of insurance and increase the overall coverage of assets. Since that time, the proportion of loss events with insurance relative to those without insurance has increased markedly. At the municipality level, events after the 2011 policy change are about 15–25 percent more likely to be covered by insurance.

A 2011 policy change triggered a rise in the likelihood of municipal sectors insuring by 15 – 25 percent.


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THE BENEFITS OF TIMELY RECONSTRUCTION

Without Disaster Risk Finance fast reconstruction does not happen

Indirect Cost of Natural Disasters and an Economic Definition of Macroeconomic Resilience

Stéphane Hallegatte, The World Bank Group

Being able to quantify the total loss to an economy from a disaster is a key component when trying to determine the importance of disaster risk finance. Essentially, two categories of losses must be considered. Direct losses are the assets lost because of the disaster. Indirect losses, also called output losses, are the reduced production and income stemming from the asset losses, including all adverse long-term consequences for economic growth resulting from the disaster. The latter can be extremely challenging to quantify accurately.

Hallegatte (2015) develops a theoretical model to motivate a simple, intuitive rule of thumb for measuring output losses. The rule takes into account constraints that render it impossible to immediately reallocate assets to their most efficient uses, as well as ripple and stimulus effects.

Ripple effects appear in infrastructure and utility services—for example, a house itself may not be damaged, but the owner still has to relocate because there is no running water. Or the damaged part of a road prevents the rest of the road from being used. More generally, the stock of capital consists of complementary assets; the destruction of one part may reduce the productivity of other parts.

The stimulus effect refers to the ability of an economy to react to the new production constraints (such as road closure) and the increase in demand for reconstruction through input substitution, production rescheduling, or mobilization of existing idle resources. This effect can lead to an increase in economic output beyond the pre-disaster level and can be seen as positive even though a classical stimulus policy could have the same effect without the negative welfare and human impacts of the disaster.

In this model, one dollar of direct loss in productive capital translates into a decrease in instantaneous (annualized) output that is equal to the average productivity of capital. This decrease in output is about three times the interest rate and may be increased by a factor that represents ripple effects and the duration of reconstruction.

Along these lines, the rule of thumb includes the interest rate, the decreasing return in the production function (also equal to the share of profits in national income), and the instantaneous and dynamic resilience—that is, the ability to limit damage and reconstruction. The latter comprises the reconstruction duration (longer reconstruction increases welfare losses) and a ripple effect factor that increases or decreases immediate losses. This factor is negative if enough idle resources are available to cope; positive if cross-sector and supply-chain issues impair the production of nonaffected capital.

A disaster that causes capital losses equal to US$500 million, for example, in a country with a 10 percent interest rate and with a reconstruction period likely to span three years would lead to total (asset plus output) losses of US$725 million (145 percent of direct capital losses), with a discounted value of US$650 million (130 percent of direct losses).

Insuring Growth: The Impact of Disaster Funds on Economic Reconstruction in Mexico

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Given the cost of financing post-disaster reconstruction, it is important to understand whether such reconstruction can have a considerable impact on local economic activity. This research presents unique evidence on the impact of disaster risk finance on economic activity in a long-established program for the reconstruction of public assets.

Federal and state governments in Mexico spend almost US$1.5 billion annually on the reconstruction of public assets and low-income housing after natural disasters, and this amount can be much larger in bad years. In 2010 alone, the reconstruction after major floods totaled over US$5 billion. In response to the recurrent need for post-disaster budget reallocations to finance reconstruction, the Government of Mexico established the Fund for Natural Disasters (FONDEN) in 1996. Its original mandate was to provide adequate financial resources for federal and state reconstruction efforts without compromising committed government spending.

De Janvry, del Valle, and Sadoulet (2016) focus on the peril that represents 68 percent of all events that led to financial support from FONDEN—heavy rainfall. They analyze a 10-year period (2004–2013) in which road reconstruction dominated expenditures and estimate FONDEN's impact on economic activity at different points in the post-disaster period. The expected effect, quickly reconstructed infrastructure and housing accelerated the resumption of economic activity.

The researchers use a regression discontinuity design to identify this effect. They turn to high-resolution satellite measures of night lights as a proxy for the differential economic performance created by the provision of rapid reconstruction funds through FONDEN. And they use quarterly employment data as a high-frequency measure of local employment after a disaster.

Overall, they estimate that FONDEN boosts local economic activity between 2 and 4 percent in the year following an event.

Is this effect worth the resources absorbed by FONDEN? The researchers find that the benefit to the economy in the year after the disaster is substantially greater than the total government expenditure, with a benefit–cost ratio of between 1.52 and 2.89. Although this range of ratios is quite broad, it does suggest that FONDEN is likely to provide benefits in excess of its cost.

The scale of gains to local economic activity brought about by the availability and rapid disbursement of disaster funds in the Mexican program could encourage policy makers in other countries to consider using disaster risk finance schemes such as FONDEN to enhance their own response capabilities.

FONDEN boosts local economic activity between 2 and 4 percent in the year following an event.

THE BENEFITS OF TIMELY SUPPORT TO LIVELIHOODS

Without Disaster Risk Finance early response does not happen

The Application of a Probabilistic Catastrophe Risk Modelling Framework to Poverty Outcomes

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Porter and White (2016) explain the power that probabilistic catastrophe (cat) risk models could have if applied to the assessment of household poverty outcomes. The authors argue that the challenge in applying cat risk models in this way is quantifying the relationship between hazard and outcome in a poverty context—the "vulnerability module" in a cat risk model. The authors attempt to derive such vulnerability relationships for the impact of drought on households in Ethiopia, asking whether a relationship can be derived between drought and household consumption that has internal and external validity and, if so, can help (1) model risk (in a probabilistic framework) and (2) understand the benefits of interventions, including early response.

Porter and White examine the impact of drought hazard on the welfare of rural households in Ethiopia using reductions in household consumption as their welfare indicator and crop-yield losses for drought. They use household income and consumption expenditure survey data as well as welfare monitoring surveys for 2005 and 2011 to provide representative cross-sectional data for rural Ethiopia, including household characteristics, consumption outcomes, and measures of realized shocks such as illness and unemployment. A view of drought hazard is taken from the World Food Programme's Livelihood Early Assessment and Protection (LEAP) data, a drought measure showing expected community crop losses based on water adequacy specific to the respective crops.

A regression model is defined, where the outcome of interest is the log of household consumption per adult, to be examined against drought in the context of other household/community characteristics. The authors consider the consumption–drought relationship will be attenuated by certain household and community characteristics: access to coping strategies (such as education); the occurrence of other shocks (such as illness); and access to institutional coping strategies (such as public safety nets). These factors are examined explicitly within the model. The results are then tested for robustness using Statistical Learning Methods to infer applicability of the derived relationships within a cat risk modelling framework.

According to the regression results, the impact of drought (represented as the LEAP drought variable) is significant across all models examined, with the baseline result showing that for every 10 percent worsening of the LEAP drought variable, consumption falls on average by 1.5 percent. The other models typically show about a 2 percent fall in consumption per 10 percent drought worsening. The results also reveal that access to a safety net (Ethiopia's Public Safety Net Programme, PSNP) mitigates the drought impact by 0.5 percent—that is, households with PSNP access experience a 1.5 percent decrease in consumption rather than a 2 percent decrease. The results of the Statistical Learning exercise suggest that the relationship between drought and consumption is fairly homogeneous and stable, leading Porter and White to conclude (with caveats) that the derived drought–poverty relationship demonstrates some level of external and internal validity. Therefore, this relationship could form the basis of a vulnerability module in a catastrophe risk model.

Effects of Timing of Public Work Payments on Welfare: The Case of Ethiopia's Productive Safety Net Programme

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The Government of Ethiopia has developed and implemented its Productive Safety Net Programme (PSNP), covering nearly 8 million Ethiopians. Beneficiary households can engage in public works in the months when labor is slack in return for income designed to increase the food security of households during the lean season. The program is also scaling up in times of disaster.

Berhane, Abay, and Hoddinott (2016) look at whether increasing the ability to provide more timely support to beneficiaries has an impact on welfare. They examine the relationship between the existing variation in the timing of payments to PSNP public works beneficiaries and poverty outcomes. In doing so, they focus on household consumption, child-level nutrition, and schooling outcomes, across four main regions that have implemented the PSNP since 2005.

The PSNP makes monthly payments for work conducted and is designed to provide income to households in advance of the lean season. However, actual implementation varies by region and over time: 57 percent of public works participants reported no delay; 27 percent, a small delay of one or two months; and 16 percent, a delay of three months or more. Very few payments are delayed by more than four months, and once monthly payments are started, they are likely to continue smoothly.

When payments are delayed prior to the start of the lean season (June–September for most of Ethiopia's highlands), household consumption and nutrition are negatively affected. Delayed payments reduce the household consumption expenditure, although the observed effect is weak. In addition, delayed payments reduce agricultural income—perhaps because the households who do not receive timely payments are forced to sell their crops when prices are at their lowest. Finally, payment delays are also found to increase the probability that children of primary school age will drop out of school, and therefore the delays decrease educational attainment. These negative welfare effects of payment delays are more pronounced when delays are preceded by bad harvests in the previous season. Conversely, payments delayed well into and made in lump sum during the lean season are observed to have strong positive (unintended) effects on other welfare outcomes, mainly non-food expenditures, ownership and total value of livestock owned, value of productive assets owned, food gap, and net private transfers. These latter effects suggest the lumpy structure of delayed payments likely has an investment role albeit at the cost of lost welfare in terms of consumption, nutrition, and schooling during the public works months.

In sum, the timing of the payment does affect its welfare effect, suggesting that if payments to households in need become more timely (that is, arrive in advance of the lean season), they would have a larger impact on welfare. The findings also suggest delayed lump sum payments in the lean season may result in unintended positive effects on some outcomes that should be weighed against the welfare losses in the months they are meant to be paid.

For every 10 percent of drought worsening, consumption falls by between 1.5 and 2 percent.

Early Warning, Early Action: The Use of Predictive Tools in Drought Response Through Ethiopia's Productive Safety Net Programme

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Drechsler and Soer (2016) examine how Ethiopia's early warning system could be used to enable early action to respond to drought. And, they find three clearly defined, transparent, and complementary systems which are already in place: the Livelihood Early Assessment and Protection (LEAP) tool monitors food security among the rural population using a water index; the Livelihood Impact Assessment Sheet (LIAS) captures bottom–up information on local livelihoods and markets; and ad-hoc and hotspot assessments identify deteriorating food security situations. These tools, when used together, could inform early response.

Early response to drought is crucial in protecting lives and livelihoods while saving costs. Response through the humanitarian system requires fundraising and can take up to eight months. In contrast, response using early-warning data triggers contingency financing and can respond in as little as two months—four times faster.

By using the three tools' intermediate and final outputs effectively, LEAP, LIAS, and hotspot assessments could be used to detect the onset of a drought and the need to respond. Moreover, as each tool is based on a different methodology, it is possible to compare drought predictions to obtain a more accurate view of the severity of a drought.

LEAP, based on a basket of primary crops in a geographic area, estimates the number of people in need of food assistance based on the Water Requirements Satisfaction Index (WRSI). In the process of computing beneficiary numbers, the LEAP tool computes three intermediary outputs: planting dates, WRSI and yield reduction estimates. By combining the WRSI, past beneficiary numbers, and demographic data, the LEAP tool estimates beneficiary numbers.

LIAS employs a risk-modeled Household Economy Approach (HEA). Its components zone livelihood and market systems geographically; set wealth categories within the zones; calculate the average cash income and food intake for each wealth category (baseline); model the impact of droughts on livelihood baselines; analyze coping capacities; and estimate beneficiary numbers according to livelihood viability and collapse under duress.

Hotspot and ad-hoc assessments deploy uniform food security and nutritional criteria to ensure comparability across regions. Quarterly, they prioritize the use of scarce resources to enable targeted supplementary feedings with the support of woreda health workers and offices.

These instruments, Drechsler and Soer conclude, could represent the building blocks of a well-functioning early action framework. Ethiopia has consistently extended LEAP and LIAS, producing more and better data and further improving their predictive powers.

How to Measure Whether Index Insurance Provides Reliable Protection

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Agricultural index insurance has become a common risk management instrument for low-income farmers. For index insurance, payouts correlate with the performance of an index, not actual losses. An imperfect correlation—basis risk—means the index may pay out when no losses occur and may not pay out when losses do occur. The impact on poverty is thus highly sensitive to the reliability of the coverage. Until now, the lack of an operational and measurable definition of basis risk and the underutilization of appropriate statistical techniques have precluded monitoring this reliability.

Morsink, Clarke, and Mapfumo (2016) discuss the reliability of index insurance and propose monitoring indicators that, with basic technical knowledge, can be applied by donors, governments, and insurers to any context in which payouts are based on indices correlated with losses.

Establishing whether index insurance reliably protects low-income individuals against losses from agricultural production requires answering two key questions:

1. *Does the insurance provide reliable coverage of the losses it was designed to insure?* The performance of the index can be measured by assessing the basis risk of the insured peril (such as drought and flood). This assessment will reveal how well the index insurance product actually captures losses caused by the insured peril—that is, does drought insurance pay out when there is a drought?
2. *Does the insurance provide coverage for losses that are important, keeping in mind that households face many sources of income risk?* The reliability of index insurance for smoothing agricultural production can be evaluated by comparing claim payouts to actual losses from agricultural production—that is, going beyond the risks stipulated in the contract. For example, if a farmer is insured against floods, losses from a drought are not covered. And although her insurance product performs perfectly during droughts, the farmer still suffers a production loss.

Morsink et al. devise two indicators to measure insured-peril and production-smoothing basis risk and thus the reliability of index insurance. The first, the probability of catastrophic basis risk, assesses the probability of not receiving a claim payout when a farmer has catastrophic losses from agricultural production. The second, the catastrophic performance ratio, measures what a farmer receives back relative to the premium paid when the farmer experiences catastrophic losses.

These indicators are simple to calculate and easy to understand, providing proxies for the reliability of indexed protection. They can be used to compare agricultural insurance products against a benchmark, to one another, and over time, and to generate the cost and effectiveness of alternative disaster risk finance instruments. They provide invaluable inputs for disaster risk finance strategies, while improving the quality of products, better protecting consumers, and reducing reputational risk.

Integrating Social Protection Strategies for Improved Impact: A Comparative Evaluation of Cash Transfers and Index Insurance in Kenya

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Munenobu Ikegami, International Livestock Research Institute
Andrew Mude, International Livestock Research Institute

Social safety nets are an important tool used by policy makers to support and protect their constituents. Recently, there has been a push to increase the sophistication of the targeting mechanisms and to combine multiple protection tools to improve the efficiency of these programs. This effort is motivated by the recurring humanitarian interventions in regions that have existing social protection programs.

Although a number of countries have or are planning to implement integrated social protection programs, there is little existing empirical evidence on the welfare outcomes from these programs. Not only might the added logistical burden of implementation offset potential gains, but it is still not clear that welfare dynamics are sufficiently homogeneous to make sophisticated targeting around specific inflection points in wealth a realistic objective.

Jensen, Ikegami, and Mude (2016) examine how to develop evidence-based policy recommendations by studying the impacts of various social protection programs on poverty. They test whether there are poverty benefits to using an integrated approach to social protection, providing differential programs for the ultra-poor and those who are less poor but still vulnerable. Of particular interest is the use of cash to help the poorest and the use of insurance to protect the vulnerable from falling into poverty during large shocks. They also examine other policy-relevant questions, including the benefits of insurance transfers versus insurance subsidies and the extensive scaling of cash transfers conditional on environmental conditions.

Kenya, which is currently implementing a set of social protection schemes, offers an excellent opportunity to study the effects of different protection strategies and simulate the welfare and fiscal gains of integration. The authors use data from five annual rounds of panel household survey data and instrumental variables to identify the observed impacts of a cash transfer program, the Hunger Safety Net Program, and insurance, the Index Based Livestock Insurance (IBLI) product, on pastoralist households in northern Kenya. Those parameter estimates are then used to simulate the impacts of a menu of hypothetical social protection policies, which would each have the same cost.

Jensen et al. find for the most part very few differences in the poverty outcomes associated with the various targeted approaches. Although this apparent ambiguity may seem disappointing, it frees policy makers to develop their social protection strategies with additional objectives in mind—for example, to pursue strategies with the lowest overhead or to support the development of a robust insurance market.

This study is not without its own shortcomings, which the authors discuss and use to highlight the need for further research.

Weather Index Insurance and Shock Coping: Evidence from Mexico's CADENA Program

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Elizabeth Ramirez Ritchie, University of California–Berkeley
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Few tools have been successfully implemented at scale for the rural poor to manage the risks of weather shocks and to cope in their aftermath. Mexico is an exception. Its government pioneered a weather index insurance program in 2003 that by 2013 insured more than 6 million hectares of cropland. CADENA grew from a drought index insurance for maize in one state to a near-national insurance program for many perils and crops.

De Janvry, Ramirez Ritchie, and Sadoulet (2016), recognizing the expansive coverage and tenure of the CADENA program, use the unique setting to evaluate index insurance's effects on ex post production decisions and coping mechanisms. They focus on the program's largest component historically, drought index insurance.

CADENA insures farmers growing staple crops on less than 20 hectares of rain-fed land. If precipitation as measured by the corresponding weather station falls below the designated threshold in any of the three phases, the insurer makes a payment to the state. The state then transfers payments to eligible farmers in the insured area in time for the next growing season. Overall, results comparing municipalities that receive payments with those that do not show the federal government–funded program helps sustain rural livelihoods, mitigating the losses from drought without the need to assess individual damage. Another finding was farmers in municipalities that receive insurance payments increase the hectares sowed of insured crops by about 17 percent relative to those in municipalities that do not receive payments.

The impact of drought index insurance when comparing a municipality that receives no payment with one that receives payment is an increase of about 27 percent in expenditure per capita and 38 percent in income per capita. This increase corresponds to about 6,000–8,000 pesos in additional income. However, results suggest that the insurance transfer induces a reduction in remittances sent by migrants, lowering the net income effect of the payouts.

Turning to the cost side, premium payments exceed indemnity payments in all but two years, resulting in an overall loading factor of 73 percent. Although these results suggest that the cost of insurance is high relative to the payouts received, a cost–benefit analysis using the increase in household income implied by the regression estimates finds that the benefits of the program exceed the costs for a wide range of estimates. Moreover, CADENA, by design, makes government expenditures more predictable and disciplines the responses of state governments to weather shocks. Recognizing these benefits, the federal government provides subsidies of up to 90 percent for CADENA while simultaneously increasing the required contributions of uninsured states seeking funds for ex post relief.

CADENA insurance payments to municipalities increase the hectares of insured crops by about 17 percent.

SAVING MONEY THROUGH DISASTER RISK FINANCE

Without Disaster Risk Finance disaster response is too expensive

Evaluating Sovereign Disaster Risk Finance Strategies: A Framework

Daniel Clarke, The World Bank Group
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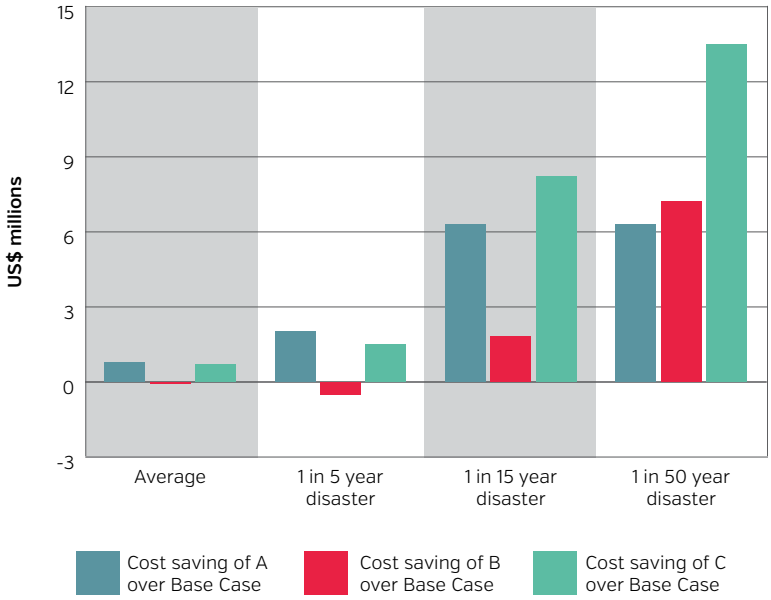
Ministries of Finance of disaster-prone countries, along with donor partners who are also facing rising costs from disasters, are increasingly asking such questions as:

- Should we set aside funds in a reserve fund, and how large should this reserve fund be?
- How much reliance should be placed on emergency reallocations of funds away from other parts of our budget to finance disaster losses?
- Should we seek to establish a line of credit on which we can immediately draw if a disaster were to occur?
- How can we evaluate proposals for risk transfer products such as disaster insurance or catastrophe bonds?

These questions, and others about how to decide on the details of disaster risk finance strategies, have been difficult to answer, in part because of lack of a robust methodology that allows a full range of budgetary and financial instruments to be compared side by side in a consistent, comprehensive way. This methodological limitation has meant that strategies may be chosen and implemented without systematic analysis of whether the programs and financial strategies being employed are appropriate and cost-effective, bearing in mind the risks faced.

To begin to solve the problem of this analytical gap, Clarke et al. (2016) develop a robust, comprehensive methodology to allow quantitative analysis of the full economic cost of these financial instruments. The methodology builds on insights from actuarial science and financial economics to divide the problem in a way that makes ex ante evaluation of the financing side of the problem possible.

Specifically, the paper considers the case in which a government has chosen a set of fixed responses for possible future disasters and wishes to understand the costs and benefits of financing these responses through various combinations of financing instruments (see figure).



Source: Clarke, Mahul, Poulter, and Teh 2016.

The framework is flexible enough to be useful for decision makers concerned with different aspects of disaster. For example, it could be used to calculate the long-run average cost or the cost for specific potential extreme disasters.

Evaluating Sovereign Disaster Risk Finance Strategies: Guidance and Case Studies

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Clarke, Cooney, Edwards, and Jinks (2016) apply the framework developed in Clarke, Mahul, Poulter, and Teh (2016) to five practical case studies, and present a guidance note on how the framework can be applied in practice. In doing so, they illustrate the flexibility of the framework and its ability to be used by governments to systematically determine whether their financial strategies are appropriate and cost-effective in view of the risks they face.

Application of the framework to the five anonymized, simplified, real-world countries involves the following steps:

1. *Define the contingent liability.* To enable quantitative analysis, implementers have to decide on a set of rules that would trigger expenditures. The contingent liabilities considered in this report range from country-wide response costs arising from drought to an insurance program covering public emergency losses in multiple regions of a country arising from earthquake and tropical cyclone events.

2. *Specify the choice of financing strategies.* Each case study compares at least three alternative financing strategies, including a base strategy against which alternative strategies can be compared.

3. *Set base assumptions.* Assumptions are set in reference to the economic and political conditions of the underlying country, simplified to avoid identification of the countries.

4. *Calculate the opportunity cost of each strategy.* For each strategy, an analysis is presented for the financing cost both on an average basis and for different shock severities using the previous assumptions made about the economic environment and the probability and magnitude of the events.

5. *Consider sensitivity and scenario testing.* Each case study includes a sensitivity analysis in which assumptions and specifications are varied to illustrate how the costs might change.

The report does not make any generalized conclusions about which instruments or strategies are cheapest. Instead, for each country, results and sensitivities are presented. The most cost-effective strategy for each case study depends on the risk tolerance of the relevant policy makers.

A Methodology to Assess Indicative Costs of Risk Financing Strategies for Scaling Up Ethiopia's Productive Safety Net Programme

Daniel Clarke, The World Bank Group
Sarah Coll-Black, The World Bank Group
Naomi Cooney, The World Bank Group
Anna Edwards, U.K. Government Actuary's Department

Rural safety nets in low-income countries remain a challenge to develop, yet the Government of Ethiopia has developed and implemented the Productive Safety Net Programme (PSNP), providing nearly 8 million Ethiopians with the means to work their way out of chronic poverty.

Clarke, Coll-Black, Cooney, and Edwards (2016) adapt the framework of Clarke, Mahul, Poulter, and Teh (2016) to comparatively analyze potential risk finance structures that support drought response through the PSNP. They define a hypothetical version of the PSNP in which *woredas* (districts) receive automatic financing based on an early warning system that is tied to a water deficit index. Under these hypothetical "rules," the PSNP scale-up supports annually, on average, 2.9 million transitory poor, requiring an average expenditure of US$139 million per year.

Three primary hypothetical risk strategies are then considered to finance these expenditures. The initial instrument in all strategies is the federal contingency budget (FCB), which must be exhausted before other instruments can be applied. Unlimited humanitarian response (HRD) is always assumed to be a last resort. The base case, strategy A, includes the FCB and HRD only; strategies B and C consider a layer of insurance and budget reallocation, respectively, between the two (see figure).

Under the best estimate assumptions, the average cost of financing the US$139 million average liability (average of 2.9 million additional beneficiaries) ranges from US$175 to $230 million.

Both the FCB and budget reallocation are depleted in a significant proportion of the 5,000 simulated scenarios. Because of the assumed layer of insurance available and the relatively low pricing multiple (1.35 compared with an opportunity cost of 2.0 applied to the HRD), strategy B is the cheapest on average. As the figure shows, the cost savings of insurance also rises for more severe droughts; the results of the costs of a one-in-five-year and a one-in-30-year event demonstrate this clearly.

Finally, the paper highlights that financial cost is only one component of the risk financing decision, and that other aspects need to be considered for any practical recommendation.

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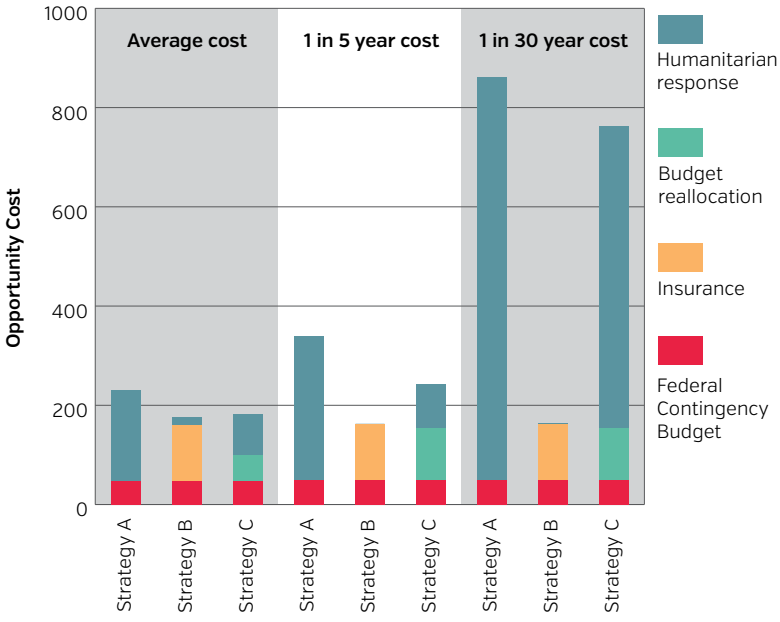
The average cost of financing the US$139 million average liability ranges from US$175 to US$230 million, depending on the disaster risk finance strategy.



Source: Clarke, Coll-Black, Cooney, Edward 2016.

Financing the Reconstruction of Public Capital after a Natural Disaster

David Bevan, University of Oxford
Christopher Adam, University of Oxford

Using a macroeconomic model, Bevan and Adam (2016) simulate the effects of alternative post-disaster financing mechanisms when increased foreign borrowing is impractical. They examine sovereign disaster risk insurance, increased taxation, and budget reallocation as alternative financing mechanisms for rebuilding public capital. The model measures costs and benefits in terms of real household consumption and decomposes the expected net cost of the public finance responses into gross benefits from the rebuilding of the public capital stock and the gross cost of mobilizing the required fiscal resources (that is, the opportunity cost).

Although their model can be adjusted to fit various financing and disaster scenarios, they use the risk profile and national accounts data from Jamaica as an example and simulate a number of possible outcomes for a cyclone disaster. In addition to doing nothing, the government has three choices: (1) to take out full insurance with premiums financed from taxation; (2) to reallocate public expenditure away from recurrent operations and maintenance expenditures; or (3) to raise taxes. Their calculations estimate the internal rate of return of faster reconstruction to be in the range of 11–17 percent. The opportunity cost of funds is more variable, depending on the financing choice. For the tax financing regime, the opportunity costs are lowest, at 6–9 percent, measured on an internal rate of return basis. Reallocations away from operations and maintenance, by contrast, result in an opportunity cost as high as 37–44 percent. For insurance, the equivalent numbers fall in the range of 12–15 percent, higher than the tax alternative, but much lower than the reallocation. Overall, direct tax financing appears to be the most attractive option. Yet it requires that raising taxes be a feasible option. In the chosen model application, tax-financed reconstruction would require a tax increase of 1.5–2 percent over a full decade. The researchers propose that for high-damage rare events insurance could be a better choice because of the faster pace of reconstruction. In any case, budget reallocation is associated with the most costly and substantially slower recovery in all scenarios. These results span a limited range of financing options, and it is straightforward to extend the analysis to examine "blended" financing packages, including ones incorporating debt financing.

Post-disaster budget reallocations away from operations and maintenance result in an opportunity cost as high as 37–44 percent.

This methodology does not adequately capture some aspects of disaster risk finance that merit further research. First, this analysis assumes that the risk transfer products perfectly match the government's expenditure rules. It would be useful to extend the analysis to accommodate the case in which payments from risk transfer instruments do not synchronize with expenditures. Second, many of the assumptions required for practical implementation of this methodology, such as the opportunity cost of budget reallocations or the cost of delayed response, are based on limited evidence. The analysis would benefit from further work addressing these empirical limitations. Finally, this paper addresses only responses to the destruction of public capital. A natural extension would be to incorporate the loss and reconstruction of private capital.

Using Probabilistic Models to Appraise and Decide on Sovereign Disaster Risk Financing and Insurance

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Benjamin D. Fox, The World Bank Group

Ley-Borras and Fox (2015) provide an overview of how catastrophe (cat) risk models can be used to appraise disaster risk finance strategies and identify the impacts of natural disasters on the poor and vulnerable. Probabilistic cat risk models typically comprise four modules:

1. *Hazard module:* a catalog of simulated natural hazards.
2. *Exposure module:* a database of the physical characteristics of assets and households that are at risk from specific events in the hazard module.
3. *Vulnerability module:* a database of generated damage estimates and uncertainty parameters.
4. *Loss module:* conversion of the damage estimates into direct and indirect economic losses.

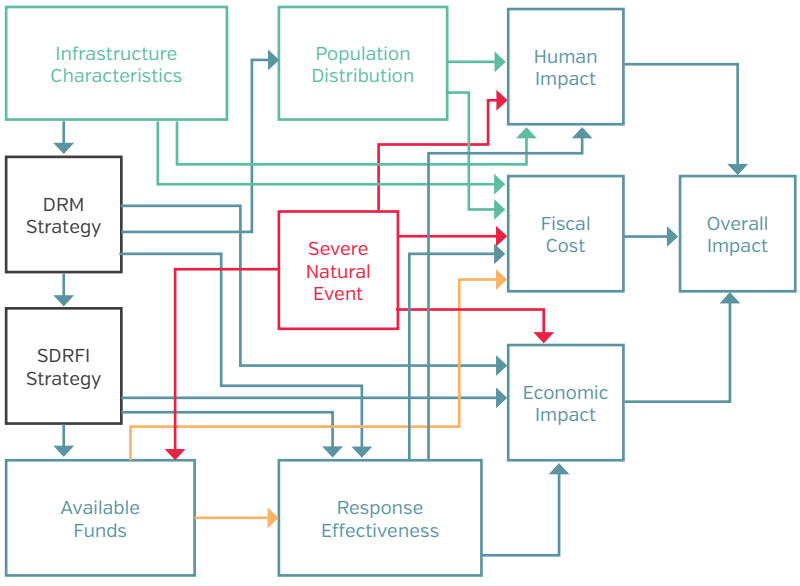
Probabilistic cat risk models usually contain tens of thousands of event scenarios. As a result, the model produces more risk estimates (magnitudes) for rarely occurring natural disasters than can be found in the historical records. Cat risk models also provide probabilistic estimates of costs and consequences—key inputs for any formal decision-making process on disaster risk finance instruments.

Influence diagrams—showing the relationships among decisions, uncertain events, and consequences—support the linked decision making of disaster risk management and disaster risk finance instruments (see figure). Such diagrams can provide insights and are valuable in gaining consensus and buy-in.

Strategy generation tables can help anyone seeking to design a small number of coherent, effective, and affordable strategies. The tool is easy to use and can be scaled to the desired level of detail, with the type of financial instrument heading the columns and the specific alternatives in the body of the table.

Integral decision analysis brings all of the interested parties to the process, helps them understand the pros and cons, and moves the parties forward in unison through climatic events. Four valuable steps are: (1) define the scope, (2) structure the objectives, (3) generate alternatives and strategies, and (4) identify and measure uncertain (including manmade) events.

In concluding, Ley-Borrás and Fox provide eight suggestions to build catastrophe risk models that facilitate decisions on sovereign disaster risk finance.



Source: Ley-Borrás and Fox 2016.

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