



MITIGATING THE IMPACT OF NATURAL DISASTERS ON PUBLIC FINANCES

DAVID HOFMAN*

In September 2004, the small Caribbean island of Grenada was severely hit by hurricane Ivan. The category 3 windstorm, afterwards nicknamed ‘Ivan the Terrible’, caused an estimated 200 percent of GDP in damage on the island. The disruptive impact of the storm caused the local economy to contract sharply, while at the same time public spending needs soared. Faced with the overwhelming costs of the event, soon after the storm, the Grenadian authorities saw themselves forced to approach their creditors for a voluntary restructuring of the island’s public debts.

Natural disasters (such as catastrophic hurricanes) can have far-reaching negative effects on macroeconomic conditions in affected countries, including on their public finances. And this is especially the case in developing and smaller countries. Developing countries are often unable to marshal the substantial resources needed in the aftermath of a major disaster. Smaller countries (such as the small island states in the Caribbean and the South Pacific) are typically unable to achieve the geographic redistribution of risk available to larger countries, which can subsidize the costs associated with catastrophic events by using revenues from unaffected regions. In these countries, therefore, the large costs associated with natural disasters can quickly diminish the public sector’s ability to respond effectively.

Catastrophe insurance markets, however, increasingly offer opportunities for the transfer of such risks. Thus far, developing countries have only tepidly

begun to tap these opportunities – indeed, only 3 percent of potential losses in developing countries are insured compared to 45 percent in advanced countries – and more frequent and intensive use of insurance markets may be desirable. This article discusses available insurance modalities and a few promising initiatives in developing and emerging market countries, along with some key challenges for the insurance community, donors and international financial institutions.

Preparing for disaster

Although natural disasters have taken their toll throughout history, there are strong indications that they have become more frequent and severe in recent decades and that this upward trend is set to continue in the period ahead. In part, this trend can be explained by growing urbanization which has led to an increasing concentration of population in vulnerable areas (see Freeman *et al.* 2003). For another part, it reflects changes in weather patterns – possibly associated with the rise in global surface temperatures – which appear to have caused an increase in the frequency and intensity of adverse weather events such as hurricanes, floods and droughts (see e.g. Webster *et al.* 2005). With more frequent and intense natural disasters affecting increasingly densely populated areas, their costs have risen strongly over time.

Natural disasters can put considerable pressure on public finances. In the wake of a disaster, governments typically face a weakened revenue base while pressures on spending are likely to soar. Such pressures could come from short-term disaster relief operations, the need to restore key public infrastructure, or from their provision of financial support to the private sector (for example, a government will often be called upon – or even be required by law – to restore damaged or destroyed housing).

To meet immediate expenditure needs, developing disaster-prone countries often rely on *ex post* financing in the form of grants and loans from external

* International Monetary Fund. This article is an update based on an earlier paper written with Patricia Brukoff (2006), *Insuring Public Finances Against Natural Disasters – A Survey of Options and Recent Initiatives*, IMF Working Paper WP/06/199. The views expressed in this article are those of the author and should not be attributed to the IMF, its Executive Board, or its management.

Table 1

Large natural catastrophes and estimated losses 1950–2008
(billion US dollars, constant 2008 prices)

	1950–59	1960–69	1970–79	1980–89	1990–99	2000–08
Number of events	20	27	47	63	91	37
Overall losses	53.6	93.3	161.7	262.9	778.3	620.6
Average loss	2.7	3.5	3.4	4.2	8.6	16.8

Sources: Munich Re; Guy Carpenter & Co.; author's calculation.

donors. Relying on such flows, however, has considerable disadvantages, including because of uncertainty about financing following a disaster. It takes considerable time before donor resources are committed and even more time before the funds are actually made available. And there may be 'competition' for donor resources from other countries with relief needs at the same time. Indeed, it is often found that donor contributions following disasters fall short of actual needs (see e.g. Wong *et al.* 2009). Another disadvantage is that to the extent that help comes in the form of loans, it could add to already high public debt stocks.

Providing for disasters by means of insurance, in contrast, secures at least some of the needed resources in advance. Such insurance is not a remote theoretical prospect. The experience in high-income countries, in particular the United States and Japan, has shown that many natural perils are insurable, and markets for disaster risk insurance are well established there.

Given trends in catastrophe insurance pricing and the available resources in the countries involved, donor contributions will often be needed, *ex ante*, to contribute to the premia. But such a shift from *ex post* to *ex ante* donor financing still has important benefits for both parties. *From the perspective of the recipient* it introduces an important element of predictability into post-disaster public finance conditions since the available amount of insurance financing would be known in advance. *From the perspective of donors* it helps smooth cash flow by converting 'if and when' outlays into predictable insurance premia. It might also give donors greater leverage over preventive policies (such as building codes). Last, but not least, it reduces the perverse incentives that recipient countries face in their dependence on post-event donor financing. Indeed, vulnerable countries currently often have little incentive to set aside fiscal savings or take preventive measures for natural disasters, since this might reduce donor support following an adverse event – the so-called Samaritan's

Dilemma. With predictable insurance payouts, in contrast, countries retain incentives for fiscal provisioning and preventive structural policies.

Choosing the right insurance

Governments that seek to shield their public finances from the impact of natural disasters by means of insurance face a few key choices. A first choice for governments pertains to *who* should be the insurance taker and *what* should be insured? The inability of the private sector to cope with the impact of a disaster is often a key source of budgetary pressures following a disaster. Therefore, one useful strategy involves promoting, facilitating or subsidizing the purchase of insurance by private sector parties (for instance, property insurance for homeowners or crop insurance for farmers) in order to limit the government's contingent liabilities. Alternatively, or as a complementary strategy, a government can also seek to insure itself directly against disaster-related outlays, or budgetary pressures more broadly, in a lump-sum manner.

A second key choice for governments regards the degree to which the risk is transferred and the entity that ultimately comes to bear the risk. The various modalities differ crucially in the size of the pool of risk capital among which the risk is spread. There are several options:

- *Pooling.* At one end of the spectrum, countries can *pool* their disaster risk with other countries – thus creating a form of cooperative insurance. Such a mechanism can be effective when the number of countries sharing the risk is large enough, and the correlation of risks between participating countries is low.
- *Commercial insurance and reinsurance.* Insurance companies, however, may be better placed to absorb risks because they typically maintain a well-diversified portfolio of risks. Further, second tier insurance is available through reinsurers, who act as the insurance

companies of the insurers, allowing the latter to pass on risks that exceed their absorptive capacity. In fact, because of its peculiar loss-distribution – with low payouts in most years, but sudden spikes in disaster years – a large portion of catastrophic risk ends up with reinsurers. However, reinsurers, too, have at times had difficulty coping with peaks in insurance claims, which is reflected in a high volatility of reinsurance premia (for instance, insurance premiums, as measured by the ‘rate-on-line’, rose sharply following costly disasters such as hurricane Andrew in 1992 and hurricane Katrina in 2005).

- *Capital markets.* There where risks are testing reinsurers’ capacity, capital markets are progressively providing risk capital that can be tapped by both reinsurers and countries themselves through the use of insurance-linked securities. This is an encouraging development because by allocating risks – and potential losses – efficiently over a large pool of investors, insurance through capital markets offers promising prospects of reducing the premium volatility associated with traditional reinsurance.

Advances in catastrophe insurance

The possibilities for passing risk to capital markets have been greatly enhanced by two related innovations: the use of parametric insurance triggers and the growth of the ‘cat bond’ market.

Parametric insurance – keeping it simple

Traditionally, insurance has relied on *indemnity*-based triggers where insurance payouts are calibrated

on the basis of actual and verified losses. The key advantage of this type of trigger is that the insurance payout is typically close to the actual loss incurred. There are, however, also important disadvantages, such as time-consuming claims settlement and moral hazard issues. The use of alternative *parametric* insurance triggers can alleviate some of these disadvantages, while also offering greater scope for the standardization of contracts and thereby facilitating the transfer of risks to capital markets.

Parametric insurance uses objective variables that are exogenous to the policy holder but have a strong correlation with losses against which insurance is desired. The payout is determined upfront and is conditional on the chosen exogenous variable reaching a preset threshold within a certain time period. An example of parametric insurance are so-called weather derivatives, which link payouts to the occurrence of a certain weather event (such as wind speeds exceeding, or precipitation falling short of, certain pre-agreed thresholds). Parametric insurance could be seen as essentially an informed bet against the elements. As such, parametric insurance contracts are kindred to the options and futures contracts traded on financial markets and distinct from traditional indemnity-based insurance.

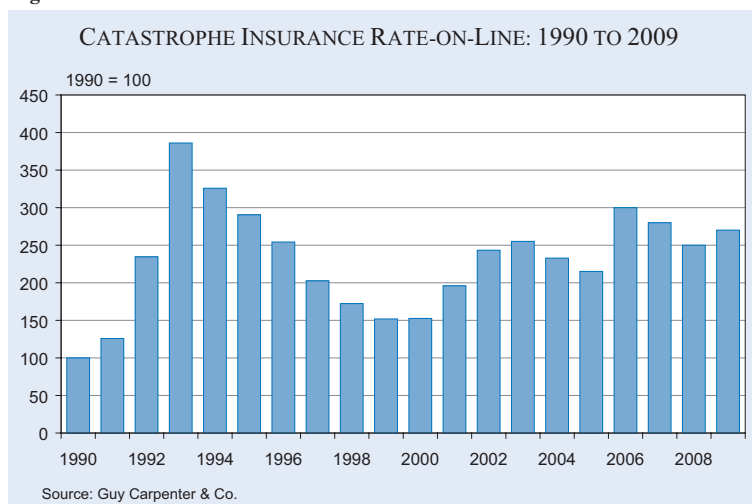
In contrast to indemnity-based insurance, parametric insurance tends to have a benign incentives structure. Since payout and actual damage are not directly linked, moral hazard is limited and the insured party retains incentives for prevention and mitigation of risks.

Another key advantage of parametric insurance contracts is their relative simplicity and transparency. The

use of an exogenous variable greatly reduces the information asymmetries associated with traditional insurance and eliminates the need for an assessment or verification of actual damage. Consequently, transaction costs are relatively low. A related advantage is the potential speed of payout, which, in contrast to indemnity-based insurance, can be a matter of weeks or even days after the contract is triggered.

Since parametric insurance uses objective and often publicly available information, it also allows for contract standardization,

Figure 1



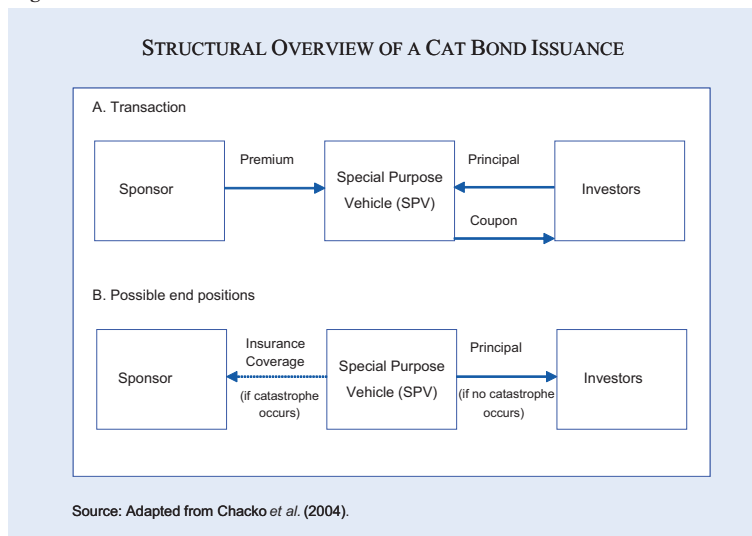
thereby facilitating risk transfer to international capital markets. Indeed, as more sophisticated systems (including satellite imagery) become available to monitor and measure natural events, parametric insurance contracts have the potential to become increasingly palatable to international capital markets. Moreover, such technological advances also increasingly facilitate the reliable monitoring of events in developing countries, thereby expanding their possibilities to successfully tap international insurance and capital markets.

The main inherent disadvantage of parametric insurance triggers is the so-called basis risk: since there is no relation (at least *ex post*) between the predetermined payout and actual damage, the insurance claim may either exceed or undershoot the actual loss. Refinements in loss modeling, however, can potentially reduce basis risk.

Cat bonds – tapping a wider market

A key example of an innovative instrument which emergence was facilitated by the use of parametric insurance triggers is the catastrophe (or ‘cat’) bond. Cat bonds have been an important vehicle for the transfer of catastrophe risks to capital markets. Indeed, the market for cat bonds has grown rapidly since its inception in the second half of 1990s, and while – like many other financial instruments –

Figure 3

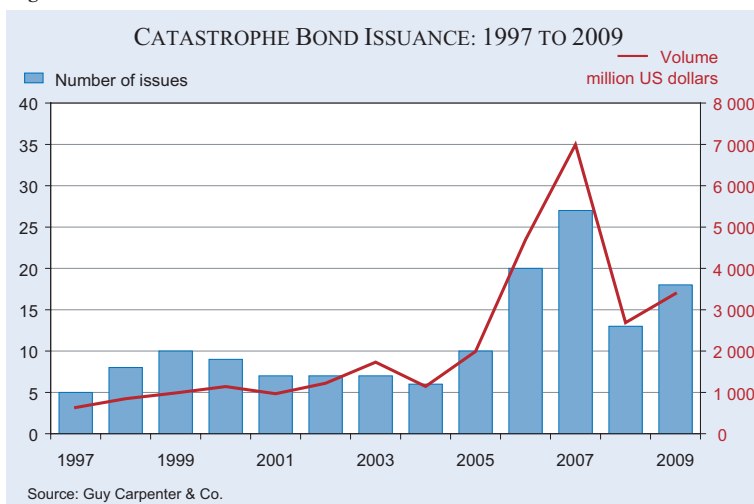


issuance has suffered from the global financial crisis, the market has been recovering swiftly over the past year.

The typical cat bond issue involves the establishment, by the ‘sponsor’ (usually a reinsurance company but conceivably another entity), of a Special Purpose Vehicle (SPV). The task of this SPV is to issue the bond and to invest the capital in low-risk securities (such as treasuries). The returns on these investments are paid to the holders of the bonds, together with a premium that is paid by the sponsor (see Figure 3, panel A). If the bonds mature without a prespecified event (i.e. a narrowly defined type of catastrophe) having taken place, the principal is repaid to the investors, similar to regular bonds (panel B). However, in the event that the prespecified catastrophe does occur within the life time of the bond, investors agree to forfeit part or all of their claims, and the SPV will pay out to the sponsor instead. The catastrophe risk is thus transferred to the investors.

Because assets and liabilities related to the bond issue are allocated with the SPV, cat bonds function as a pure insurance arrangement for the sponsor, and are not debt creating. The key advantage of cat bonds is that it allows for the break up and transfer of risks to a large group of investors in cases where insurance with a single counter party might not be

Figure 2



available or be more expensive. From the perspective of the investor, cat bonds yield above-market rates (since a premium is paid on top of the low-risk/risk-free return), while offering a unique opportunity for portfolio diversification as a catastrophe risks tend to be uncorrelated with trends in stock or bond markets.

Key initiatives in low and middle-income countries

In recent years, there have been several promising initiatives in low- and middle-income countries, some of which have benefitted from the recent innovations in insurance. The initiatives can be divided into three broad categories:

- *Schemes aimed at limiting government contingent liabilities.* These schemes target the private sector so as to reduce the need for government support following disasters. A good example is the Turkish Catastrophe Insurance Pool (TCIP), which is supported by the World Bank and pools and reinsures risks from a compulsory earthquake insurance scheme for private home-owners. Similarly, there have been World Bank and International Finance Corporation (IFC) supported projects that helped offer drought insurance to individual farmers in several low-income countries, including India and Malawi.
- *Schemes to provide resources for disaster relief and reconstruction.* With these schemes, the government seeks to secure resources to cover relief operations in the event of a catastrophe. An example is the 2006 World Food Program (WFP) project in Ethiopia that used a weather derivative to ensure resources in the case of a catastrophic drought. In this case, the insurance money was designed to be spent by the government and the WFP was responsible to relieve the plight of affected farmers, while donors contribute to the premia. Another example is FONDEN in Mexico. This fund started as a means of earmarking resources for future disaster relief, to be spent by local governments on an as-needed basis. In May 2006, the fund got on more secure financial footing when Mexico became the first middle-income country to issue a cat bond to secure sufficient funds in the event of a major earthquake, with a verifiable parametric trigger.
- *Schemes to provide lump sum support to the government budget.* Instead of purchasing insurance

against specific outlays, governments can seek general, lump-sum support that is conditional on a certain disaster taking place. Such funds could then be spent at the government's discretion. Schemes of this type have been gaining some popularity in recent years. For instance, the World Bank has implemented a scheme along these lines in the Caribbean from May 2007. This 'Caribbean Catastrophe Risk Insurance Facility (CCRIF)', is the first multi-country risk pool in the world and helps insure 16 islands in the region – including Grenada, which was mentioned above – to insure against the risk of earthquakes and hurricanes, using parametric insurance triggers. The pool is funded by resources from participating governments and contributions from donors, while risks that exceed the capacity of the pool are being transferred to reinsurance markets. This two-tier structure allows the facility to cope with large losses and also provides participating governments with insurance coverage at about half the price they would have paid if they had purchased insurance individually (Wong *et al.* 2009). The Caribbean facility has so far proven successful and it has made several payouts over the past 3 years. Most recently, a payout was made to Haiti, which received 8 million US dollars from the fund within two weeks after a devastating earthquake hit the island in early 2010. Based on the positive experiences, the CCRIF is currently considering the possibility of insuring more frequent events and widening its coverage to include flood coverage and agricultural damage, while the World Bank is preparing a similar initiative for Pacific island countries.

Amid these encouraging initiatives, the key area where exploring is still in its early stages, is the transfer of risk to capital markets. Thus far, only Mexico has significant experience with tapping the international capital market by means of cat bonds. Two promising new World Bank projects, however, are likely to enable a broader range of low and middle income countries to tap a range of financial market counterparties and capital markets.

- *Catastrophe bond issuance platform.* Building on Mexico's experience, in October 2009, the World Bank launched the 'MultiCat program', a catastrophe bond issuance platform that will make it easier for governments and public entities in low

income countries to access the cat bond market. Under the platform, the World Bank will act as arranger for the transactions and all bonds issued will carry the common MultiCat brand name and benefit from a common legal structure and documentation. This standardization reduces the set up costs to the issuing countries, and also makes the bonds more palatable to investors.

- *Weather derivative intermediation.* In 2008, the World Bank has also begun to offer intermediation services to low-income countries that want to use weather derivatives. Here, the World Bank intermediates the risk of weather-based catastrophes by entering into mirroring transactions with the client country and a financial market counterpart. In the event of a severe weather event, the country would receive a payout from the World Bank, the total value of which would be based on a parametric index used as an estimate of the financial impact. The payout would be funded with the payout that the World Bank would receive from the financial market counterpart in the mirroring transaction. Malawi has been the first country to use this new facility, purchasing insurance cover against a drought-related shortfall in maize production, with Swiss Re as the insurance provider. Malawi was sponsored by Britain (DFID) to cover the costs of the insurance premium.

Weathering storms on the horizon

Transferring risks to international capital markets has substantial benefits because it greatly expands the pool of insurance capital available to developing countries, and significant progress has been made in recent years. Nonetheless, there remain a number of uncertainties associated with the insurance of natural disaster risk. Importantly, even though there are well-established markets for insuring certain catastrophe risks, it cannot be taken for granted that all natural disaster risks can be insured in the market at an affordable cost. Specifically, the catastrophe insurance market faces two sources of uncertainty: the first is *climate change* and its possible effect on the frequency and intensity of natural disasters. While the insurance industry has coped so far, the record insurance losses in recent years – including high losses from a multitude of events in 2008 and the record-breaking USD 45 billion losses from hur-

ricane Katrina in 2005 – have been raising doubts about the way forward. Indeed, the insurance industry has been paying increasing attention to climate change and its implications for their risk modeling and risk management. The increasing risk of natural disasters, or persistent uncertainty with respect to the effects of climate change, may have an adverse effect on catastrophe insurance availability and premia going forward.

A second source of uncertainty lies with the *appetite for catastrophe risk* in international capital markets. Up to the global financial crisis that broke in the fall of 2008, issuers have had relatively few problems in selling the innovative and relatively risky cat bonds to international investors seeking risk diversification. But the success of these new (and relatively low volume) instruments was spurred by favorable global liquidity conditions and a quest for yield on the part of investors, which led to a gradual decline in risk premia. Although early indications of recovery in the cat bond market are encouraging, it remains to be seen whether a similar favorable environment will prevail in the years ahead.

These issues aside, affordability of catastrophe insurance for developing countries will remain an issue even under more favorable scenarios. Indeed, in light of the frequent high cost and volatility in insurance premia, the viability of catastrophe insurance mechanisms for developing countries may crucially depend on the contribution of donors, particularly in the low-income context. Mobilizing further, and continued, donor support for disaster insurance schemes is therefore another challenge. While donor involvement so far is encouraging, it is uncertain whether there is a willingness to increasingly engage in structural support arrangements at the expense of post-disaster relief. The latter remains the norm and may offer greater benefits in terms of public recognition and in satisfying the urge to show support after a catastrophe has taken place. Thus, further developing sustainable models for collaboration among donors and recipients in disaster insurance schemes remains key.

The potential benefits of a change from *ex post* to *ex ante* insurance financing are considerable. While natural disasters are likely to remain a painful fact of life, such a shift would at least help reduce the second round fiscal effects, thereby limiting economic disruption and facilitating faster recovery, while also providing better incentives for the adoption of preventive policies.

References

Freeman, P., M. Keen and M. Mani (2003), *Dealing with Increased Risk of Disasters: Challenges and Options*, IMF Working Paper WP/03/197.

Heller, P. and M. Mani (2002), "Adapting to Climate Change", *Finance and Development* 39, 29–31.

Rasmussen, T. (2006), "Natural Disasters and Their Macroeconomic Implications", in: Ratna Sahay *et al.* (eds.), *The Caribbean – From Vulnerability to Sustained Growth*, Washington DC: IMF, 181–203.

Webster, P. J., G. J. Holland, J. A. Curry and H. R. Chang (2005), "Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment", *Science* 309, 1844–1846.

Wong, Y. C., A. Lemus and N. Wagner (2009), *Insuring Against Natural Disasters in the Caribbean*, IMF Country Report 09/176, Washington DC: IMF.