



Government
Office for

Science

 **Foresight**

Indirect Economic Impacts from Disasters

Commissioned Review

Foresight, Government Office for Science

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Indirect Economic Impacts from Disasters

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27 November 2012

Report produced for the Government Office of Science, Foresight project 'Reducing Risks of
Future Disasters: Priorities for Decision Makers'

Executive summary

Purpose

This paper is one of a series of background papers that have been commissioned as part of a UK Government Foresight project on Improving Future Disaster Anticipation and Resilience. The project is intended to help the UK Government become more effective and efficient in dealing with disasters and to support the work of major international organisations. Foresight projects provide evidence and analysis to inform UK Government policy development and international policy-makers but do not make policy recommendations.

This paper is required to provide a review of existing evidence and case studies to outline and illustrate the types of indirect and long term economic impact that disasters can have; to summarise previous similar work highlighting any apparent temporal trends apparent comparing direct and indirect losses; and to explore economic impact on countries other than country in which a disaster has occurred.

Theoretical impacts of disasters

Disaster losses are conventionally categorized as direct losses, indirect losses and secondary effects. Direct losses relate to loss of human life and injury and physical damage to productive and social assets. Indirect losses refer to disruptions to the flow of goods and services stemming from these direct stock losses, Secondary effects concern the impacts on socio-economic imbalances and the functioning and performance of an economy.

There are two alternative hypotheses concerning the broad macroeconomic consequences of a disaster. The first rests on the fact that disasters destroy existing productive and social capital and divert scarce resources away from planned investments. As such, a major disaster could be expected to force an economy onto a lower growth trajectory. However, disasters can also generate construction-led booms and offer an opportunity to upgrade capital, raising factor productivity and competitiveness. Thus, a disaster could stimulate increased economic growth instead.

Whatever the broad macroeconomic impacts, at meso and household levels, disasters may be associated with considerable redistributive effects. It is widely observed that even small-scale localised events may have devastating consequences for the poor and near poor.

Cross-country quantitative evidence

Much of the body of econometric literature on the impact of disasters focuses on cross-country analysis of their consequences for GDP growth. In line with the two alternative theoretical lines of reasoning, this research has also produced two sets of apparently contradictory results. However, a more consistent picture emerges where the analyses distinguish between types of hazard, levels of development and economic sectors. Collectively, these suggest that disasters have larger relative adverse impacts on developing, than developed, countries; that the nature and overall magnitude of impact varies between types of hazard; that climatological hazards have negative long-term economic impacts, particularly in lower-income countries; that earthquakes may have positive long-term macroeconomic consequences for middle and upper income countries but negative consequences for lower income states; and that severe disaster events do not have positive economic impacts under any circumstances.

Unpacking the indirect and secondary impacts of disasters in a country-specific context

The broad evidence presented above notwithstanding, there is nothing inevitable about the impact of a natural hazard event. Policy makers, the private sector and individuals can do much to determine their direct, indirect and secondary consequences via both ex ante and ex post decisions. Ex ante actions most obviously relate to efforts to reduce direct losses. Ex post, the ultimate scale and nature of indirect losses and secondary effects is most crucially dependent on the scale and timing of availability of financing for public and private early recovery and reconstruction efforts and the sourcing of this financing.

Indirect losses and secondary effects can increase sharply if public and private funding is limited and reconstruction is spread over an extended period of time. In a developing country context, there is particular emphasis on the ex-post reallocation of government resources and realignment of investment plans, in effect delaying reconstruction and dampening the overall pace of capital accumulation. In the longer-term, where financially feasible, a countercyclical response may prove more cost-effective instead, spurring recovery and ensuring that sufficient

funding is available to 'build back better'. Comprehensive disaster risk financing strategies are urgently required to help facilitate such response where possible. These strategies should also include mechanisms and incentives to encourage the development of private insurance markets and to enhance the post-disaster flow of remittances, already an important source of disaster financing in many communities.

Anticipated rises in the frequency of major catastrophes, in part linked to rising exposure as economies expand, could result in an exponential increase in indirect losses in the future. These events could overwhelm public, private and household financing capacity if existing disaster risk financing arrangements are not enhanced. With increasing integration of the global economy, spill-over effects across borders could also become more common, primarily transmitted via impacts of disasters on the flow of internationally traded primary, intermediate and final goods and related price effects.

Considerable effort is required to improve the quality of data on indirect losses and secondary effects, including their evolution over time, for use in strengthening disaster risk management. Much of the country-level analysis is currently in the form of damage assessments undertaken in the immediate aftermath of a disaster, when direct physical losses are known but the level and nature of indirect losses and secondary effects are largely conjecture. Greater consideration of the consequences of potential hazard events as part of economic forecasting exercises is also important in guiding the pattern of allocation of investment resources towards a more hazard-resilient outcome.

I. Theoretical impacts of disasters

Forms of loss

Disaster losses are conventionally categorized as direct losses, indirect losses and secondary effects (e.g., White, 1964; ECLAC, 1991; OECD, 1994). Direct losses relate to loss of human life and injury and physical damage to productive and social assets occurring at the time of the disaster. The latter may include damage to, for instance, homes, schools, healthcare facilities, commercial and government buildings, industrial plants, transport, energy and telecommunications infrastructure, irrigation systems, standing crops ready for harvest, perennial crops, livestock and inventories of finished, intermediate and raw materials.

Indirect losses refer to disruptions to the flow of goods and services stemming from these direct stock losses. They take the form of goods and services that will not be produced as a consequence of a disaster together with disaster-induced increases in the cost of production and service provision. They include reductions in output from damaged assets; spill-over effects into other regions of the country, across international borders and into sectors that may have suffered little direct damage due, for instance, to disruptions to supply chains and power and water supply; loss of future harvests; reductions in personal income due to job losses; and loss in future earnings due to missed schooling. Initial indirect losses may be partly offset, however, by positive consequences of the rehabilitation and reconstruction efforts, such as increased activity in the construction industry. These, too, should be estimated and deducted from gross indirect losses (ECLAC and World Bank, 2003).

Secondary effects concern the short- and longer-term impacts of a disaster on overall socio-economic indicators. These are sometimes referred to in a more limited sense as macroeconomic effects, focusing on the post-disaster performance of economic fundamentals such as rates of GDP growth, the current account balance, external reserves, the fiscal balance, national debt, gross investment, consumption, employment, inflation, sovereign debt ratings, liquidity and domestic interest rates (ECLAC and World Bank, 2003). They can also be viewed more widely to include the consequences of a disaster for levels of poverty, income distribution, gender equality and nutritional, health and educational status. Secondary effects cannot be conflated with direct and indirect impacts because this would entail double counting.

Hazard pathways

The scale and nature of indirect losses and secondary effects – together the key focus of this paper – are obviously linked to the scale and nature of direct losses. These, in turn, rest in part on the type and intensity of hazard event experienced, as well as on the size of the population, the scale and nature of assets in the affected area (also referred to as the level of exposure) and the extent of vulnerability of these communities and assets to the hazard event.

Droughts are primarily associated with loss of crops, livestock and, in extreme cases, human life. They generate potential reductions in output in agro-processing industries, under-employment and unemployment in both the agricultural and agro-processing sector and rising food prices. Exports may fall whilst food imports rise, potentially triggering balance-of-payments difficulties. In countries that are heavily dependent on hydro-electricity there may be consequences for energy-intensive industry as well.

Floods and windstorms, too, can cause significant crop and livestock losses, triggering similar indirect effects whilst also causing extensive damage to poorly protected infrastructure and, if early warning systems are inadequate, loss of human life. Immediate indirect impacts may be felt across the whole affected area if power, transportation and telecommunications services are disrupted. However, a significant share of the built environment may require repair rather than total reconstruction.

Earthquakes have little impact on standing crops, excluding localized losses. However, they can potentially cause widespread loss of life and the destruction of infrastructure and other productive assets, including agricultural infrastructure and input distribution and marketing networks. A substantial reconstruction programme may be required if pre-existing seismic safety standards were insufficiently high.

Theoretical macroeconomic consequences: are disasters good or bad?

In exploring the impacts of disasters, economists have placed particular attention on their broad macroeconomic consequences as captured in terms of a country's long-term rate of growth. Typically, they have based their analyses on models emphasizing the roles of capital and labour growth and productivity, taking a lead from related theories of development (e.g.,

Solow 1956; Denison 1967). However, such theories suggest two contrasting hypotheses on the impact of disasters, the first that they reduce growth and the second that they stimulate it. The first rests on the facts that disasters destroy existing productive and social capital (including standing crops) and divert scarce resources away from planned investments. They can also reduce stocks of human capital by resulting in fatalities, long-term health problems and the withdrawal of children from education. As such, a major disaster could be expected to force an economy permanently onto a lower growth trajectory. The second hypothesis rests on the facts that disasters can generate construction-led booms and offer an opportunity to upgrade capital, raising factor productivity, competitiveness and thus long-term economic performance. Thus, a disaster could stimulate increased economic growth, in line with Aghion and Howitt's (1998) endogenous Schumpeterian model of growth through a process of creative destruction (Benson and Clay, 2004).

National versus local versus household impacts

The unit of analysis is also relevant in exploring the impacts of a disaster. Both the direct and indirect impacts are generally viewed from a national perspective. However, beneath this, there may be considerable short- and longer-term redistributive effects which are not immediately apparent from national indicators. Indirect losses in one region of a country may boost the local economy elsewhere, at least partly offsetting gross indirect losses. For instance, unaffected regions may benefit from a rise in demand for, say, construction workers, capital goods and consumables from the disaster zone. Producers in non-affected areas may also gain additional market shares domestically and even abroad, utilising slack in production capacity to satisfy additional demand. In some industries, these shifts in the centre of production could even prove permanent. In geographically large countries, redistribution of production and market shares may imply that even a major disaster causing extensive loss of life and destruction will have no discernible impact on national macroeconomic indicators – as notably observed in the case of Indonesia following the 2004 tsunami – but, nevertheless, will have significant regional redistributive consequences.

Longer-term impacts on regional inequalities depend to some degree on the extent to which local governments bear the costs of relief and reconstruction. If they allocate considerable capital investment resources over a period of several years to these efforts without compensation from central government or any means of increasing locally-retained revenue then existing regional inequalities may widen.

At the household level, there may be further consequences for inequalities between income groups. It is widely observed that even small-scale localised events can have devastating consequences for the poor and near poor, reflecting their particular vulnerability to disasters as a consequence of their social, cultural, economic and political standing. They are more likely, for instance to have sub-standard housing in highly hazard-prone areas, such as on the banks of rivers or steep slopes; uncertain tenure, reducing incentives to manage disaster risk; and more vulnerable livelihoods, particularly in the agricultural sector. In the event of a hazard, poor households are forced to rely far more heavily on informal, sub-optimal coping mechanisms, including high-interest informal sector loans, the sale of productive and household assets, withdrawal of children from school and reduced food intake. Each of these can prolong the adverse impact of an event for a number, even many, years via their consequences for factors such as earning capacity, health and levels of educational attainment. The threat of disaster can also reduce long-term earnings by triggering deliberate income-smoothing actions to ensure more certain but lower levels of income. As such, the poor may remain trapped in poverty in hazard-prone countries. More marginalized groups within poorer segments of society, such as women, children, the elderly, the disabled and minority groups, are often particularly vulnerable to natural hazards, and most firmly entrenched in this poverty-vulnerability-disaster nexus.

2. Cross-country quantitative evidence on the impact of disasters on economic growth

Over the past decade, there has been burgeoning interest in the empirical analysis of the economic impact of disasters, stimulated by a series of catastrophic disaster events and increasing levels of exposure. Much of the body of peer-reviewed literature on the topic has focused on cross-country analysis of the consequences of disasters for GDP growth.

Rather than resolving the theoretical dichotomy as outlined above, this research has similarly produced two sets of apparently contradictory findings. Some analyses have concluded that disasters boost economic growth or at least have little impact (e.g., Albala-Bertrand, 1993; Cavallo *et al*, 2010). Others have determined they that reduce growth and may even force countries onto lower long-term paths of growth (e.g., Hochrainer, 2009; Noy, 2009).

A more consistent picture emerges, however, where analyses distinguish between types of hazard, levels of development and economic sectors. Employing a vector auto-regressive model, Fomby *et al* (2009) found that droughts have a negative effect on GDP over the subsequent three years; moderate floods have a positive but lagged impact; severe floods and earthquakes have no significant effect; and storms have a negative but short-lived and small impact. Using a similar methodology, Raddatz (2009) found that geological disasters have a neutral to marginally positive impact on longer-run growth whilst climatological disasters reduce it. A closer examination of Albala-Bertrand's (1993) dataset also indicates that most of the 14 countries that achieved higher GDP growth in the two years succeeding, rather than preceding, a disaster had experienced as earthquake, compared to only two of the remaining 12 countries for which GDP growth fell (Benson, 1994).

Disaggregating further by income, Raddatz concluded that smaller and poorer states are more vulnerable to natural hazards, in particular to climatological events. According to his analysis, climatological hazards reduce GDP per capita by at least 0.6 percentage points in the long-term, rising to 1 percentage point for low-income countries alone and 2 percentage points more specifically for drought events in low-income countries. In contrast, disasters have a negative but statistically insignificant impact on GDP in high-income countries. Fomby *et al* (2009) similarly concluded that developing economies are more vulnerable to natural hazards.

Differentiation by origin of GDP is instructive as well. Fomby *et al* (2009) found that droughts have a cumulative negative impact on both agricultural and non-agricultural growth over the three-year period succeeding an event but that moderate floods tend to have a positive but lagged effect on agricultural and non-agricultural GDP. In developing countries, earthquakes also have a positive impact on non-agricultural growth but a negative effect on agricultural growth. Disaggregating non-agricultural GDP further, Loayza *et al* (2009) found that floods have a statistically significant, negative effect on industrial growth in developing countries but a significant positive impact on services output growth in all countries. Storms have a statistically significant negative impact on agricultural output and a positive impact on industrial growth.

Drawing on these differentiations by type of hazard, levels of development and economic sector, Benson (2010) draws some relatively consistent conclusions from the econometric literature on the impact of disasters on GDP:

- Disasters have larger relative adverse impacts on developing, than developed, countries.
- The nature and overall magnitude of impact varies between types of hazard.
- Climatological hazards have negative long-term economic impacts, particularly in lower-income countries.
- Earthquakes may have positive long-term macroeconomic consequences for middle and upper income countries but negative impacts on lower income states.
- Severe disaster events do not have positive economic impacts under any circumstances (a conclusion also drawn by the World Bank and UN (2010), which says that these disasters account for 10 percent of total events).

The observed variations in impact according to type of hazard can be explained by differences in the nature of losses. Earthquakes leave crops largely standing but damage infrastructure. As such, they may redress imbalances in the capital-labour ratio relating to relative over-investment in productive capital and under-investment in human capital, particularly in middle-income countries, thereby resulting in higher growth via both increasing returns and (re)construction-led booms (Lopez, 2009; Loayza *et al*, 2009). In contrast, climatological hazards destroy intermediate inputs to industry, particularly agricultural crops, resulting in a decline in production throughput. Droughts have the most extreme adverse impacts because there is little damage to infrastructure and thus no possibility of either increasing returns to production or a rise in construction activity.

Variations in impact on GDP according to the level of development of a country can be explained by differences in the relative extent of direct losses and the implications of those direct losses for indirect losses, a theme returned to below. Lower-income countries often have larger agricultural and agro-processing sectors, making them more vulnerable to climatological hazards whilst much of their infrastructure is lower quality, providing less resilience against both climatological and geological hazards. They are likely to suffer greater loss of life, reducing changes in the capital-labour ratio. Moreover, they are more likely to face significant public and private funding constraints in the aftermath of a disaster, in turn resulting in more prolonged reconstruction efforts and higher opportunity costs of reconstruction spending (Benson, 2010).

Some of the remaining differences in the analytical findings may reflect variations in the bases of analysis, relating to factors such as:

- The period of analysis;
- The selected indicator(s) of disaster impact (based on a mixture of loss of life, number of people affected, direct losses and number of disaster events);
- The set of countries and disaster events analysed (including the level of any cut-off thresholds);
- The types of hazard considered;
- The choice of control variables (e.g., levels of literacy or educational attainment, external debt stocks, foreign exchange reserves, aid flows or the degree of trade openness); and
- The length of time over which the impact of a disaster is examined, varying from just a couple of years to over a decade.

There are several further underlying issues that may also blur the findings, relating to notable measurement problems in countries that experience natural hazards on some scale every year or where disasters and conflict coincide and to limitations concerning the quality of data on disaster impact (see below). The 2011 Somali drought provides an extreme example of challenges in estimating the economic impact of a disaster against the backdrop of civil unrest. Meanwhile, in countries that experience disasters on an annual basis, the economic consequences of a disaster-free year cannot be directly observed yet the high frequency of disasters may imply that they exist on a permanently lower growth path. For instance, a study of the Philippines suggested that tropical storms may erode GDP by as much as 0.3 percent

(Benson, 1997). Productivity may also be curtailed by risk-averse behaviour in the face of frequent hazards. For example, Hazell and Hess (2010) cite studies of drought-prone areas in India and Burkina Faso that suggest that farmers may sacrifice 12 to 15 percent of average income to reduce risk. In both cases, the agricultural sector accounts for a significant share in GDP, estimated at around 19 percent of GDP in India and 34 percent of GDP in Burkina Faso in 2010, implying that these losses in earning potential represent non-negligible declines in GDP. More generally, it has been estimated that average farm incomes could be 10-20 percent higher in the absence of risk (Gautam, Hazell and Alderman, 1994; Sakurai and Reardon, 1997).¹

¹ Cited in IFAD and WFP (2010)

3. Unpacking the indirect and secondary impacts of disasters in a country context

The evidence presented above notwithstanding, there is nothing inevitable about the impact of a natural hazard event. Policy makers, the private sector and individuals can do much to determine both the direct and indirect impacts of a disaster via both *ex ante* and *ex post* actions and decisions. *Ex ante* actions most obviously relate to efforts to reduce direct losses. There are many opportunities for reducing direct losses via a vast range of structural and non-structural tools and measures ranging from options such as earthquake engineering and flood protection through to land use zoning, improved environmental management, the development of flood or drought tolerant crops, and livelihoods diversification. These, in turn, have a direct influence on the nature of indirect and secondary losses. In designing and assessing the potential benefits of disaster risk reduction strategies, it is essential that potential indirect as well as direct losses are taken into account, including potential consequences of disasters for the poor.

More indirectly, governments can also reduce the indirect and secondary effects of disasters via good governance, progress in meeting Millennium Development Goals and sound macroeconomic management. Various studies have found that factors such as higher rates of literacy or educational attainment, more stable democratic regimes, better institutions, greater political accountability, higher foreign exchange reserves, greater degrees of openness to trade and more developed financial sectors can limit the consequences of a disaster (see, e.g., Noy, 2009; Cavallo and Noy, 2009; Skidmore and Toya, 2007).

Ex post, the ultimate scale and nature of indirect losses and secondary effects is most crucially dependent on the scale and timing of availability of both public and private financing for early recovery and reconstruction efforts and the sourcing of this financing. Prevailing economic fundamentals can also play a central part, both influencing the possible outcome of a disaster event and determining the likely fiscal response.

A holistic approach is essential in exploring the indirect and secondary impacts of disasters and developing appropriate policy response. Some consequences of a disaster may appear detrimental when viewed in isolation but may ultimately serve to minimise long-term indirect

and secondary effects, be it with certain redistributive outcomes. For instance, post-disaster wage-push inflation may be a consequence of efforts to speed up the recovery process by attracting construction workers into the disaster zone whilst inflation may hurt consumers but may also encourage them to work longer hours, thereby partly offsetting reduced productivity from damaged assets (Hallegatte and Przyluski, 2010). Similarly, post-disaster increases in public indebtedness may be economically beneficial if they speed economic recovery and pre-existing levels of debt are low.

The remainder of this paper unpacks evidence on the indirect and secondary effects of disasters at the country level and key factors determining their final outcome in further detail, drawing implications for their potential evolution over time. It includes a discussion of indirect and secondary spillover effects across international borders.

Evidence on the indirect and secondary impacts of disasters

Post-disaster damage assessments

Many countries maintain records on disaster losses, collating data on the number of lives lost and people affected and the direct physical damage. However, few countries collect quantitative data on the scale of indirect losses. Moreover, in a significant share of developing countries even the data on physical losses are weak, presenting an incomplete and, sometimes, highly inaccurate record of events (Benson and Twigg, 2007). These deficiencies even in data on direct losses reflect a number of difficulties, including limited application of comprehensive national assessment guidelines, a dearth of trained assessors and a typical focus by assessment teams on that portion of damage that is eligible for public assistance, essentially relating to public infrastructure and a small fragment of private assets, such as low-income housing (ibid).

In view of such difficulties, data on ‘economic’ (direct) losses are only reported for about a third of disasters, and for just 25 per cent of drought events, in the global Emergency Events Database (EM-DAT) maintained by the Centre for Research on the Epidemiology of Disasters of the Université Catholique de Louvain, Brussels, the most comprehensive global disaster loss database in existence, (Loayza *et al*, 2009). No indirect losses or secondary impacts are reported. Data on global disaster-related economic losses as reported annually by both Swiss Re and Munich Re are also based solely on direct losses. Likewise, probabilistic catastrophe

risk models, the tool used to assess risk as a basis for designing disaster risk financing instruments, focus solely on direct losses.

With a view to improving disaster response, the international community has sought to address these deficiencies over a period of many years. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) originally developed comprehensive guidelines on disaster damage and loss assessment four decades ago and has been applying them ever since in the aftermath of major disasters. These guidelines cover general concepts and methodological framework. They also include detailed guidance on the estimation of direct and indirect losses and secondary effects in areas of housing and human settlements; education and culture; health; energy; drinking water and sanitation; transport and communications; agriculture; trade and industry; tourism; the environment; and gender (ECLAC and World Bank, 2003).

Over the past 20 years, the ECLAC guidelines have gradually been adapted for use by development partners elsewhere and combined with sector-specific needs assessments to determine recovery and reconstruction requirements in the aftermath of particular events. The World Bank Global Facility for Disaster Reduction and Recovery, for instance, lists 26 Post-Disaster Needs Assessments (PDNAs) on its website dating back to 2007, many of them involving the government in the affected country and a range of United Nations (UN) agencies, international financial institutions (IFIs) and bilateral development partners as well as the World Bank. These assessments include estimates of both direct and indirect losses, referred to in the reports as damage and losses respectively. Results from these assessments are presented in Table 1, providing direct and indirect loss data for a range of types of hazard in middle- and low-income countries across the globe.

Table 1: The direct and indirect impacts of selected disasters in developing countries

Damage and losses						
Country	Year	Disaster event	Damage (US\$ million)	Losses (US\$ million)	Total (US\$ million)	Ratio of damage to losses
Bolivia	2008	Flood	168	343	511	0.5
Philippines	2009	Earthquake	1,452	2,931	4,383	0.5
Myanmar	2008	Cyclone	1,754	2,302	4,056	0.8

Damage and losses						
Country	Year	Disaster event	Damage (US\$ million)	Losses (US\$ million)	Total (US\$ million)	Ratio of damage to losses
Moldova	2010	Flood	18	24	42	0.8
Cambodia	2009	Cyclone	58	74	132	0.8
Lesotho	2010-2011	Flood	34	32	66	1.1
Madagascar	2008	Cyclone	174	159	333	1.1
Haiti	2008	Hurricane	477	421	897	1.1
Yemen	2008	Tropical storm	875	763	1,638	1.1
Senegal	2009	Flood	56	48	104	1.2
Haiti	2010	Earthquake	4,526	3,278	7,804	1.4
Benin	2010	Flood	160	100	260	1.6
Namibia	2009	Flood	136	78	215	1.7
Pakistan	2010	Flood	6,496	3,560	10,056	1.8
Lao PDR	2011	Typhoon	44	22	66	2.0
El Salvador	2009	Tropical storm	211	104	315	2.0
Samoa	2009	Cyclone	212	98	310	2.2
Bangladesh	2007	Cyclone	1,158	517	1,675	2.2
Central African Republic	2009	Flood	6	3	9	2.3
Togo	2010	Flood	30	8	38	3.8
Lao PDR	2009	Earthquake	57	7	64	8.1
Indonesia	2009	Tsunami	2,061	234	2,294	8.8

Source: Data extracted from PDNA reports available at <http://www.gfdr.org/gfdr/node/118>

Note: Disaggregation of damage and losses is not readily available in PDNAs for the 2008 floods in India, the 2009 floods in Burkina Faso, the 2009 earthquake in Bhutan and the 2008-11 drought in Kenya.

It should be noted that estimates of direct losses (damage) in the above table are based on the replacement cost of damaged and destroyed infrastructure and assets at their original location and to original specifications. The PDNAs also include separate data on reconstruction costs, which take into account changes in location and specification, in part to increase disaster resilience, and changes in service provision as envisaged in each reconstruction plan.

One of the most striking observations from the data reported in Table 1 is the considerable variation in the ratio of direct to indirect losses. No clear conclusions can be drawn about the expected ratio according to basic parameters such as type of hazard, its predominantly rural or urban area of impact or level of economic development of the affected country. In terms of type of hazard, for instance, both floods and earthquakes appear at both ends of the range of damage to loss ratios. Similarly, low and middle-income countries, larger- and smaller-scale disaster events and geographically relatively larger and smaller countries are scattered across the ratio range.

It could be surmised that the absence of any pattern reflects the importance of additional country-specific factors in determining the consequences of a particular disaster event. More realistically, there is likely to be a huge margin of error associated with much of the data, in particular pertaining to the estimates of indirect losses, making it impossible to draw any robust conclusions whatsoever. Damage assessments are typically completed within a few months following a disaster, when direct physical losses are known but the level and nature of indirect losses (and secondary effects) are largely conjecture. Some indirect effects may not be apparent yet whilst the likely extent of others is as yet unclear, linked into factors such as the speed and scope of the relief, early recovery and reconstruction efforts (see below). Moreover, assessment teams may simply have insufficient time to capture all indirect losses; their estimates will be biased by decisions relating to the focus of attention in determining losses; and they face challenges in valuing indirect losses. There may be a number of intangible losses, for instance relating to well-being and the quality of life, and the interplay of disasters and concurrent economic and social trends, cycles and shocks also needs to be taken into account.

The process by which physical disaster losses result in indirect losses is easily grasped and on some levels quantification of indirect losses is far less important than a strong qualitative understanding of causalities and linkages. However, their quantification is highly relevant in determining the case for greater investment in disaster risk reduction and, in many cases, important ammunition towards this end. As such, considerable effort is required to improve the quality and comprehensiveness of data on indirect losses, preferably based on assessments undertaken several years after the occurrence of an event. Such reviews are also important in strengthening understanding of determining factors, including the role of public and private actions in the aftermath of a disaster.

Estimates of the wider secondary impacts of a disaster are also subject to considerable uncertainty in the immediate wake of an event because they stem directly from estimates of direct and indirect losses in conjunction with macroeconomic forecasts established prior to the disaster. At least under the ECLAC methodology, they only capture the macroeconomic effects assuming no modification in current public policies and programmes, providing 'officials with a tool for reorienting policies and plans in light of post-disaster reconstruction needs' (ECLAC and World Bank, 2003:16). Again, subsequent review several years later would be extremely useful.

Additional efforts are required to capture the consequences of small-scale, highly localised events. In many countries these are grossly unreported, a significant oversight in nations where such events occur with a high annual frequency and thus where they may have a substantial cumulative impact. The DesInventar methodology has been developed to address this issue. Originally created for application in Latin America and the Caribbean, the approach has since been introduced in a few countries beyond the region. Further expansion is required, however, together with efforts to improve the reliability of the data collected.

Modelling indirect losses and secondary effects at an individual country level

Various modelling techniques can be applied to help strengthen the assessment of indirect losses resulting as a consequence of a disaster at an individual country and sub-national level. They include input-output matrices, social accounting matrices (SAMs) (like input-output matrices capturing forward and backward linkages in the productive sectors with the additional incorporation of income and final expenditure effects), computable general equilibrium (CGE) models and various economic forecasting tools.

Application of SAMs to the analysis of the indirect consequences of disasters can be dated back at least as far as 1974, to a study by Cochrane (1974) exploring the potential consequences of an earthquake in the San Francisco area of the USA. The technique has also been applied to at least one cross-country analysis, based on highly aggregated SAMs with just one sector for each principal account, to explore the impact of 184 major disaster events across a range of countries, finding that meteorological disasters (defined as storms) have the highest impact multiplier of 2.02 (Okuyama and Sahin (2009). Nevertheless, application of input-output matrices and SAMs to the analysis of disasters has been extremely

limited and, moreover, largely undertaken in the context of developed nations, in particular the USA and Japan (Benson, 2003; IPCC, 2012). CGE models have been slightly more widely applied, but still primarily in the context of developed countries in part because they are extremely data intensive.

Similarly, there have been only limited attempts either by governments or IFIs to explore the consequences of disaster scenarios via econometric forecasting models, even as one-off exercises. A notable exception entailed the replacement of smoothed average rainfall with inter-annual variations in rainfall, based on historical records, in the World Bank's macroeconomic forecasting model for Ethiopia (World Bank, 2006). This adjustment resulted in a doubling of the predicted growth and poverty reduction returns to investments in irrigation, suggesting that greater consideration of the consequences of potential hazard events as part of economic forecasting exercises could be important in guiding the pattern of allocation of investment resources towards a more hazard-resilient outcome.

Assessing impacts on the poor

One of the most critical aspects of a disaster concerns its impacts on the poor and near poor. Disasters can have potentially severe consequences for these groups, trapping poor households permanently in poverty whilst hurtling the near poor intermittently below the poverty line. Disasters can even perpetuate issues of poverty across generations, for instance via the long-term consequences of their more immediate impacts on nutritional intake and schooling. As the World Bank and UN, (2010: 46) state 'malnourished children become less productive adults: their lower body mass makes manual labour less productive, and their lower cognitive skills make skilled work more difficult'.

Somewhat surprisingly, however, there has been very limited quantitative analysis of disasters and poverty, in terms either of the consequences of disaster events for the poor and near poor or of the implications of their potential risk-averting behaviour for long-term earnings. Limited snapshot information is sometimes available in the immediate aftermath of a disaster. However, data on longer-term consequences are rarely collated. Standard household surveys, for instance, do not typically cover hazard risk or disaster impacts (Fuente *et al*, 2008). There are additional challenges in disentangling chains of causality (*ibid*). For instance, limited

education contributes to poverty and, thus, hazard vulnerability whilst disaster events, in turn, can reduce the quality and length of schooling (Benson, 2010).

Results of the limited analyses that are available are unsurprising. Rodriguez-Oreggia *et al* (2010), for instance, found that municipalities that are affected by disasters in Mexico experience a significant increase in poverty and a decline in their human development index. According to this analysis, on average disasters set human development back two years and increase extreme (food) poverty by 3.6 percentage points, capacities poverty by 3 percentage points and assets poverty by 1.5 percentage points. Meanwhile, Alderman *et al* (2006)² determined that children who were malnourished during the 1982-84 drought in Zimbabwe suffered a 7 percent loss in (extrapolated) lifetime earnings; and de Janvry *et al* (2006)³ found that children withdrawn from school during droughts in Central Mexico over the period 1998 to 2000 were around 30 percent less likely to resume their studies. Field research in Nepal explored the channels through which disasters impact on school attendance in more detail, finding that they physically prevent children from reaching schools; reduce household capacity to meet the cost of school fees and stationary; result in the transfer of children into income-generating activities to supplement household earnings; and result in increased (adult) male migration, requiring children to stay at home to help with domestic and agricultural work (Gautam and Oswald, 2008)

Investigating local impacts

Similarly, there has been very limited analysis of the longer-term consequences of a disaster for directly-affected local economies. As already noted, whilst a disaster may have no discernible impact on national macroeconomic indicators as losses in one part of the country are offset by gains elsewhere, the effects of a disaster may be felt at the local level long beyond the completion of the programme of reconstruction.

The few studies that do exist suggest that such impacts can be significant, warranting much further examination. Du Pont and Nol (2012), for instance, constructed a synthetic counter-factual dynamics model for the Kobe economy, finding that although the earthquake had no long-term impact on the size of the population, per capita GDP was 500,000 yen or 13

² Cited in World Bank and UN (2010)

percent lower in 2007 than it would have been had the earthquake not occurred. As the authors point out, this long-term impact was identified in the context of a wealthy region of a developed country, with considerable fiscal resources and speedy reconstruction, implying that disasters could have an even more detrimental long-term impact in a less developed nation.

Underlying determining factors

Fiscal management of disasters

At first glance, the fiscal consequences of disasters seem one of the easier indirect and secondary impacts to assess. Disasters place additional budgetary demands on governments whilst simultaneously resulting in a possible decline in public revenue, potentially resulting in widening fiscal deficits and increased public debt. Analysis of panel data for 138 countries over the period 1985 to 2007 undertaken by Lis and Nickel (2009) and focusing on climatological hazards confirmed the fiscal vulnerability of developing countries to extreme weather events, be it relatively modest, as defined in terms of the nominal general government budget balance as a percentage of GDP. The same analysis revealed that developed countries are more robust. A second study using a panel vector autoregressive model to assess the impact of major geological, climatological and other types of natural and technological disasters on government revenue and expenditures using annual data for high and middle-income countries over the period 1975 to 2008 also found that, on average, fiscal deficits increase after climatic disasters but that they only expand in lower-middle-income countries in the event of other types of disaster (Melecky and Raddatz, 2011). The results indicated that climatic disasters result in a 15 percent increase in expenditure and a 10 percent decline in revenue, both expressed as a share of government deficit, from their trends over a cumulative ten-year period following an event.

Any analysis of the impact of disasters on fiscal balances is complicated, however, by the fact that ultimately governments can choose quite how much they want to spend on disaster response and when. These decisions have implications, in turn, for the resulting scale of any observed fiscal deficit and also for the wider economic impacts of a disaster. Indeed, the ultimate scale and nature of total indirect losses and secondary effects is crucially dependent on the scale and timing of availability of funding for public and private relief, early recovery and reconstruction efforts and also on the sourcing of this funding. Recent theoretical econometric

³ Cited in World Bank and UN (2010)

modelling by Hallegatte *et al* (2007) suggests that the economic impacts of disasters, as defined in terms of GDP, are much higher in countries where public (and private) reconstruction resources are limited and thus where reconstruction is spread over an extended number of years. In the same vein, Noy and Vu (2010) found tentative evidence that regions in Vietnam with a higher level of development and thus, they surmise, greater access to reconstruction funds will experience faster short-term growth following a disaster, based on empirical analysis using the Blundell–Bond General Method of Moments.

Adequate availability of financing for reconstruction is also essential in ensuring that opportunities to upgrade capital are seized (Cuaresma *et al*, 2008; Hallegatte and Dumas, 2009) and that ‘build back better’ principles are followed, reconstructing to higher standards of hazard resilience. These latter considerations are a helpful reminder that it is not just about speed though: a more sedate reconstruction process may be better than an extremely rapid one, amplifying short run adverse consequences of the event but cancelling them out through long-term productivity gains.

There are a range of instruments that governments can select to finance their share in the response efforts. They include *ex ante* tools in the form of insurance, catastrophe bonds, reserves and contingent loans; and a range of *ex post* instruments, including post-disaster short and medium-term reallocations of budgetary resources, tax increases, government borrowing and deficit financing. These various sources can be mobilised at varying speed and can generate varying levels of resources.

The actual basket of instruments used in response to a particular event is in part determined by the scale of the event. Prescribed good practice recommends a layered approach (see, e.g, Cummins and Mahul, 2008). Risks associated with high-frequency, lower-cost events occurring on a near-annual, recurrent basis should be met via regular annual budget allocations. As the costs increase, post-disaster reallocations of budgetary resources may be appropriate, potentially coupled with government borrowing including via contingent credit arrangements. Low-frequency, high-cost events should be transferred to third parties via a range of risk transfer tools.

The role of international aid

In a developing country context, the scale and timing of international flows of assistance are also relevant in determining the pace of early recovery and reconstruction and thus the nature and level of indirect losses and secondary effects. However, international grant assistance accounts for a very small proportion of disaster response spending globally, with a significant share focused on major events (Benson and Mahul, forthcoming). This pattern of behaviour is confirmed by Becerra *et al's* (2010) analysis of 138 large disaster events over the period 1970 to 2008. This analysis finds that although disasters increase official development assistance significantly, compared to pre- disaster flows, in the year of a disaster and for at least the following six years, the size of the flow is related to the scale of the disaster event and typical surges are small relative to the scale of the affected economy or estimated direct economic damage. Instead, the majority of early recovery and reconstruction costs are typically financed domestically.

Moreover, post-disaster assistance is not necessarily additional. Instead, it may displace short- to medium-term flows of funding for development. In support of this hypothesis, Powell and Bobba (2006) found no evidence that natural disasters increase flows of international aid in the study to determine the pattern of bilateral and multilateral aid flows, using a data set database organized both by recipient and donor for the period 1970-2003. Meanwhile perhaps reflecting extensive reallocations post disaster, one of Becerra *et al's* (2010) most robust results is that a higher initial (pre-disaster) aid level will lead to a lower aid surge.

In reality, many developing countries rely heavily on post-disaster government budget reallocations, both for immediate relief and early recovery needs and for longer-term reconstruction, seeking to remain broadly within existing budgetary envelopes and limiting increases in their fiscal deficits (see, e.g., Benson, 2010 (ESCAP); World Bank, forthcoming). Some level of reallocation for lower levels of risk is likely to be cost-effective. However, widespread, often default-setting, reliance on this source of financing derails existing investment plans, with potential long-term consequences for rates of growth. It can also

exacerbate regional inequalities to the extent that local governments ultimately bear the cost of relief and reconstruction efforts, as already noted.

Many developing country governments, particularly in middle-income countries, urgently need to strengthen their disaster risk financing strategies, seeking to develop bundles of instruments that collectively balance opportunity costs associated with each instruments while also meeting relief, early recovery and reconstruction needs in a timely and efficient manner. Governments also need to consider redistributive effects across generations. They can select instruments that require them to meet contingent liabilities associated with disaster events before they occur, as they occur or after they occur, perhaps many years afterwards (Benson and Mahul, forthcoming), thereby directly influencing the spread of the cost of disaster response over time.

As part of this process, governments should consider adopting a countercyclical response to disasters, increasing total public expenditure in the aftermath of a disaster to support a more rapid recovery process rather than seeking to achieve pre-existing fiscal deficit targets. In the longer-term, a countercyclical approach may prove more cost-effective, spurring recovery, ensuring that sufficient funding is available to follow through on 'build back better' principles and stemming the extent of indirect losses and secondary effects occurring as a consequence of the disaster. In fact, a study by Melecky and Raddatz (2011) directly links its findings of a negligible decline in per capita GDP in the aftermath of climatological events and a countercyclical fiscal response to such disasters, arguing that the decline in GDP is negligible precisely because net public spending increases. Similarly, the study links its finding that geological disasters have larger adverse consequences on GDP to its finding that governments do not respond to such events using deficit financing. Along related lines, the study finds that countries with more financially developed markets accrue larger deficits in the aftermath of a disaster but suffer no significant loss in GDP. In contrast, countries with less well-developed markets, and thus less opportunity to borrow, experience GDP losses ranging between 2 and 10 percent. Countries with high levels of insurance penetration also suffer little economic decline but without engaging in deficit financing. The potential benefits of countercyclical spending in response to disasters emphasises the need to support countries in developing comprehensive disaster risk financing strategies.

Consumption and investment volatility

The impact of a disaster on levels of consumption and investment depends on a range of demand and supply factors, most importantly access to sufficient finance by the private sector and individual households to replace lost assets, continue to implement prior investment plans and maintain levels of consumption. The consequences, in turn, for levels of consumption and investment will help shape the pace of economic recovery and thus the scale and nature of other indirect and secondary effects of the disaster.

Access to formal credit in the aftermath of a disaster is in part dependent on the financial sector's capacity to bear the consequences of the event for its existing loan portfolio. Rescheduling of loans and possible defaults in the aftermath of a disaster can place considerable pressure on cash flows – and, in extreme cases, threaten the viability of lending institutions – leaving limited flexibility to provide fresh lending in support of the recovery process without public assistance.

Empirical research confirms that credit-constrained economies are likely to suffer more severe and more persistent effects of disasters on economic growth over a number of years. Based on a panel of data on natural disaster events at the country- year level for the period 1979 to 2007, McDermott *et al* (2011) found that a disaster event could completely wipe out economic growth for up to 3 years in a country with relatively low levels of financial development, with significant effects continuing ten years after the event. Meanwhile, based on an examination of household data after the 1995 Kobe earthquake in Japan, Sawada and Shimizutani (2008)⁴ found that even in a rich country, credit-constrained households experience significant reductions in consumption in the aftermath of a disaster.

Insurance can play a significant role in resolving post-disaster credit constraints. To date, private catastrophe insurance uptake is very low in many developing countries, reflecting a combination of demand and supply issues. While over 40 percent of direct disaster losses are insured in developed countries, usually through compulsory insurance, less than 10 percent of losses are estimated to be insured in middle-income countries and under 5 percent in low-

⁴ Cited in Dupont and Noy (2012)

income countries (Cummins and Mahul, 2008). However, insurance has been identified, correctly or otherwise, as a growth area ripe with opportunity by the climate change adaptation community. Moreover, uptake of insurance is credited not only with the capacity to smooth the impact of disasters on household and business income and expenditure and to facilitate a more rapid recovery but also, potentially, to break the poverty-vulnerability cycle by maintaining asset levels and incentivizing investment in risk reduction (Benson *et al*, 2012). Whether, in fact, it delivers along each of these lines is less clear, an issue currently being explored by a DFID-funded World Bank study (see Benson *et al*, 2012).

Remittances are already established as a key source of post-disaster financing for individual households. Total remittances sent home by migrants to developing countries were estimated to be three times the size of official development assistance in 2011. Moreover, flows are rising and are expected to increase by a further 65 percent or more between 2011 and 2014 alone.⁵ There is widespread evidence that these flows expand in the aftermath of a disaster, particularly in the context of low-income countries. For instance, based on cross-country regression analysis on 129 countries over the period 1970 to 2006 Mohapatra *et al* (2009) estimated that in countries where the emigrant stock is equivalent to around 10 percent of the origin country population, remittances increase by \$0.50 in the year of the disaster and by a further \$1.00 the following year for every \$1 incurred in direct disaster losses. These additional flows limit the adverse impact of disasters on levels of consumption and investment and ease potential balance-of-payments difficulties. They also have positive secondary consequences for beneficiary households. Mohapatra *et al* (2009), for example, cite evidence from Ethiopia showing that households that receive international remittances rely more heavily on cash reserves than the sale of productive assets during food security shocks, with fewer long-term welfare consequences.

Looking forward, there are potential innovative opportunities to capture migrant largesse more formally and perhaps even enhance it. For instance, there was some recent discussion in the aftermath of the 2010 Haiti earthquake about the issue of diaspora bonds for reconstruction purposes (see, e.g., World Bank and UN, 2010; Ketkar and Ratha, 2011). Diaspora bonds are already used by some governments for development purposes, allowing them to access a relatively cheap source of external borrowing in the form of patriotic nationals' wealth

accumulated overseas (Ketkar and Ratha, 2007). Their potential scope in raising resources for reconstruction would depend in part on the speed with which such bonds could be issued. There may also be some scope for the development of catastrophe insurance products aimed at developing country diaspora to provide more direct support to affected family members in their homelands in the aftermath of a disaster (Benson *et al*, 2012).

Prevailing economic fundamentals

In certain circumstances, prevailing economic fundamentals can influence the outcome of a disaster event. Using a theoretical non-equilibrium dynamic theoretical model with endogenous business cycles, Hallegatte and Ghil (2007) found that disaster-related GDP losses are higher when disasters occur during periods of expansions and all resources are already fully utilised. Conversely, during recessions shocks are mitigated by the existence of unused resources, particularly if disasters result in insurance payouts, flows of remittances and aid from overseas and increased government expenditure (see above). Based on an evaluation of disasters in a Keynesian framework and interpreting disasters as a negative shock to capacity and the subsequent reconstruction activity as a positive shock to demand, Tol and Leek⁶ (1999) reached the same conclusion.

In practice, the type of hazard experienced and nature of an economy may also play a role in determining the nature of interaction between prevailing economic fundamentals and the outcome of a disaster event. Climatological hazards could conceivably exacerbate recessions in agrarian economies, creating additional disequilibria by reducing the flow of inputs to agro-processing industries. Meanwhile, disasters sometimes have little consequence under either booming or struggling circumstances in a dual economy - that is, in an economy composed of both a traditional low labour productivity rural sector involving a high degree of self-provisioning and a largely unlinked 'modern' sector. In Mongolia, for instance, the livestock sector accounts for around a third of employment, largely on a subsistence basis. A dzud – a Mongolian term relating to winter climatic extremes associated with snowfall and temperature – occurred in 2009-2010 resulting in the death of 8.8 million livestock, equivalent to around a quarter of the

⁵<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20648762~pagePK:64257043~piPK:437376~theSitePK:4607,00.html>

⁶Cited in McDermott, Barry and Tol (2011). Available

<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20648762~pagePK:64257043~piPK:437376~theSitePK:4607,00.html>

country's livestock, a 17 percent contraction in agricultural GDP and capital stock losses equivalent to 4.4 percent of 2009 GDP (Benson, 2011). Yet this event had little impact, either positive or negative, on the wider economy.

Government policy response to prevailing macroeconomic fundamentals, as well as the fundamentals themselves, could also influence the level and nature of disaster response. Developing country governments may be even more inclined to rely on post-disaster reallocations rather than deficit financing when disasters occur during periods of economic recession, with subsequent secondary consequences for the pace and level of socio-economic development.

Better understanding of the role of prevailing macroeconomic fundamentals in determining the outcome of a disaster event is needed to support optimal policy response relating to decisions such as the sourcing, volume and nature of post-disaster response. For instance, such information could influence government action relating to level of spending on household transfers to affected families, both in the immediate aftermath of a disaster and during the recovery phase.

Shifts in vulnerability over time

The nature of vulnerability of a particular country to natural hazards can shift over time as a consequence of socio-economic change, in turn affecting the level and nature of indirect and secondary losses. Strong understanding and monitoring of these dynamics is important both in selecting mechanisms for strengthening resilience and in responding appropriately to individual disaster events. Bangladesh provides a case in point. Its economic sensitivity to extreme monsoon flooding declined significantly between the 1970s and 1990s due to a range of changes including the rapid expansion of much lower-risk dry season irrigated rice; internal market integration; increased private food imports during disaster years; a gradual growth in formal credit and remittance; and an expansion in the relatively flood resilience export-oriented garment industry (Benson and Clay, 2004).

Spillover effects

The indirect and secondary effects of a disaster can spill over across international borders, causing disruption elsewhere. These effects are primarily transmitted via its impact on the flow

of internationally-traded primary, intermediate and final goods and related price effects. With increasing integration of the global economy and rising disaster losses, there is evidence that spillover effects may be increasing. A recent study estimated that, depending on model specifications, major disasters reduced world trade between an average 1.2 and 4.0 percent over the 40-year period ending in 2003 and that the proportion of trade lost to disasters increased over the same period, despite a parallel expansion in world trade (Gassebner *et al*, 2006). The same study found that the less democratic and smaller a country is, the more trade is lost. Such effects can lead to balance of payments consequences and exchange rate pressures both for disaster-affected countries and their major trading partners, as well as potential consequences for government revenue deriving from import and export taxes. In extreme cases, countries could even lose their foothold in a particular export market.

Disasters also have potential spillover effects for productivity where linked into cross-country vertical supply chains and just-in-time supply chain management practices. Indeed, such effects may emerge as an increasingly significant issue in the context of an anticipated increase in mega-disasters (see below), to the extent that these disasters occur in global manufacturing hubs. The 2011 Thai floods provide some indication of the scale of potential disruption. Thailand occupies an important position in the global manufacturing supply chain and the floods therefore resulted in severe disruption to international supply chains.

Contraction in Japan's GDP and export growth in the last quarter of 2011, for example, was in part blamed on acute shortages of Thai-made parts for Japanese exports.⁷ Ironically, several Japanese companies that had recently relocated their production to Thailand in the wake of the Great East Japan earthquake and tsunami were also affected by the floods.

The consequences of disasters can be spread globally via their impacts on prices as well. For instance, Hurricane Katrina, affecting the Gulf Coast of the USA in 2005, led to a significant rise in world oil prices (Hallegatte and Przyluski. 2010). Meanwhile a rapid increase in world rice prices in early 2008, in turn feeding into a wider food price crisis with particularly severe consequences for the poor, was in part linked to a series of pest outbreaks and natural hazard events in a number of major rice-producing countries (IRRI, 2008). The price of Thai rice, 5 per cent broken—a popular export grade from the world's leading rice exporter and thus a good indicator of general rice price trends— increased almost three-fold between late 2007 and April

⁷ <http://blogs.worldbank.org/prospects/node/1076>

2008, to a high of around US\$1,000 per tonne. Fears of another sharp rise in rice prices emerged in 2009, this time linked to a series of storms in the Philippines and drought in India, but proved unfounded. More recently, severe flooding across Southeast Asia in September and October 2011 inundated an estimated 6 percent of the region's total rice area but potential price effects were avoided by bumper harvests in India and a relaxation of Indian rice export barriers, emphasising the importance in viewing potential consequences of disasters against a backdrop of prevailing circumstances.

Future trends in direct and indirect losses and secondary effects

Direct disaster losses have gradually increased over many decades. The 1990s saw a continuation in this trend, with a relatively steady upward increase in annual losses excepting the spike in 1995 (the year of the Kobe earthquake). However, the first decade of the twenty-first century was characterised by an apparent increase in volatility in annual losses as well as an underlying upward trend, reflecting the periodic occurrence of a succession of mega-catastrophes. In 2011 all-time record global direct disaster losses were reported, in particular reflecting extensive losses in Japan, New Zealand and Thailand.

A continuing rise in the frequency of mega-catastrophes is anticipated over the coming decades. This is partly due to anticipated growth in exposure as economies and populations expand. It is also linked, less intuitively, to better protection as countries develop. As a consequence of this protection, higher-frequency, lower-intensity hazard events should cause less damage but disasters in excess of hazard-protection design standards will occur periodically, causing excessive losses. Average disaster losses could also conceivably increase (Hallegatte, 2011).

Developed nations may be able to raise the financing required to recover from extreme events relatively easily. For instance, Japan chose to finance two thirds of its US\$144 billion on-budget financing (as announced as of late 2011) in support of the 2011 Great East Japan earthquake and tsunami recovery efforts via the issue of reconstruction bonds (Benson and Mahul, forthcoming). However, in less financially developed countries with tight fiscal and monetary constraints, the scale of direct losses could overwhelm public, private and household financing capacity, in turn triggering an exponential increase in indirect losses relative to direct losses.

Exacerbating these issues, there is a possibility that insurance cover could ultimately contract in a few decades time. Currently, the international community, led by the IFIs, is doing much to encourage greater use of instruments to transfer both sovereign and individual risk. Arnold (2008), though, notes that a United Nations Environment Programme Finance Initiative reports that by 2025 insurers may withdraw from some catastrophe insurance markets as the risk changes, becoming too high relative to the pool of premiums available.

At the same time, periodic extreme losses need to be set against rising productivity gains. In some countries, the very facets of geography that offered potential cost-savings and therefore originally attracted investment to a particular area also increase the likelihood and severity of natural hazard events – namely, proximity to rivers, coasts and low-lying flat land. These centres of investment will continue to attract both migrants and new businesses, in part encouraged by improvements in hazard protection. As Hallegatte (2011) argues, increasing losses may even be desirable from a long-term economic growth perspective, provided that human losses can be avoided and affected populations have sufficient financial resources, including access to assistance, post disaster. Based on the findings of his theoretical modelling, Hallegatte proposes that public action to manage risk should aim at managing, rather than reducing risk, thereby limiting disaster losses while making sure that ‘the worthwhile risks that yield large benefits’ are taken (ibid: 17). This approach places emphasis back on disaster financing instruments, highlighting the importance of developing sound disaster risk financing strategies while also, based on the above concerns, seeking to ensure that excessive reliance is not placed on insurance.

However, the disaster risk management agenda and related strategies and instruments should not become overly preoccupied with mega-disasters at expense of more frequent, localised event. The latter still cause extreme hardship for many households in the developing world and wider macroeconomic and budgetary consequences for their governments.

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