Chapter 5
The Resilience Challenge
Business investments are made taking into account a variety of risks, including disaster risk. However, while immediate risks to assets and operations may be considered, it is equally important for investors to be aware of the economic resilience of the country they are investing in.

Businesses are more likely to recover faster in a country where governments have the capacity to invest in recovery or where they have risk financing measures in place that cover most contingencies.

Major losses can challenge the macroeconomic stability of even high-income countries. Given that macroeconomic stability is considered a basic requirement of a country’s competitiveness, countries need to recognise the potential macroeconomic implications of disasters. Currently, some countries that can least afford to lose investment stand to suffer the highest disaster losses.

High losses and potential fiscal gaps can result in cumulative macroeconomic effects over time with severe implications for a country’s long-term economic and fiscal resilience.

5.1 Threats to economic resilience

Direct losses from major disasters trigger indirect losses and wider impacts that can challenge the macroeconomic stability of even high-income countries. A country wishing to promote its competitiveness and strengthen economic sustainability should recognise the potentially significant macroeconomic implications of disasters.

Risk refers to the probability of a given magnitude of loss in a given period of time. Resilience refers to the capacity of a country’s economy to absorb losses and recover. How quickly an economy recovers and how quickly a business recovers are clearly interrelated. But businesses are more likely to recover faster in a country where governments have the capacity to invest in recovery or where they have risk financing measures in place that cover most contingencies.

Figure 5.1 Reported disaster losses and GFCF in Mozambique, 1993–2011

(Source: UNISDR, based on national disaster loss data bases, EMDAT and World Bank indicators)
Figure 5.2 Annual average losses from earthquakes (top) and cyclonic winds (bottom) compared with gross fixed capital formation

1 = 10 - 30%
Philippines, Solomon Islands, Tonga, Trinidad and Tobago

2 = 1 - 10%
Afghanistan, Antigua and Barbuda, Azerbaijan, Barbados, British Virgin Islands, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Georgia, Greece, Grenada, Guatemala, Honduras, Iran (Islamic Republic of), Japan, Kyrgyzstan, New Caledonia, Nicaragua, Pakistan, Papua New Guinea, Peru, Puerto Rico, Saint Vincent and the Grenadines, Samoa, Taiwan Province of China, Tajikistan, Turkey, Uzbekistan, Vanuatu

3 = 0.1 - 1%
Albania, Algeria, Argentina, Armenia, Aruba, Austria, Bahrain, Bangladesh, Belize, Bhutan, Bolivia (Plurinational State of), Brunei Darussalam, Bulgaria, Cayman Islands, Comoros, Croatia, Cuba, Cyprus, Djibouti, Egypt, Fiji, Germany, Hungary, Iceland, Indonesia, Iraq, Israel, Italy, Jamaica, Jordan, Kazakhstan, Kuwait, Lebanon, Liechtenstein, Malaysia, Malta, Mexico, Monaco, Montenegro, Morocco, Nepal, Netherlands, New Zealand, Oman, Palau, Panama, Qatar, Republic of Moldova, Saint Lucia, San Marino, Singapore, Slovakia, Slovenia, Switzerland, Syrian Arab Republic, The former Yugoslav Republic of Macedonia, Tunisia, Turkmenistan, United Kingdom of Great Britain and Northern Ireland, United Arab Emirates, United States of America, Venezuela (Bolivarian Republic of), Yemen

1 = 1 - 10%
Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Cayman Islands, Comoros, Dominica, Fiji, French Polynesia, Honduras, Hong Kong Special Administrative Region of China, Jamaica, Japan, Macao Special Administrative Region of China, Mauritius, Mexico, Micronesia (Federated States of), Palau, Philippines, Puerto Rico, Republic of Korea, Samoa, Taiwan Province of China, Tonga

2 = 0.1 - 1%
Bangladesh, British Virgin Islands, Brunei Darussalam, China, Cuba, Dominican Republic, El Salvador, Grenada, Guatemala, Madagascar, Mozambique, New Caledonia, New Zealand, Nicaragua, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Solomon Islands, Trinidad and Tobago, United States of America, Vanuatu, Venezuela (Bolivarian Republic of)

3 = 0.01 - 0.1%
Australia, Cambodia, Canada, Costa Rica, Guyana, Haiti, India, Indonesia, Lao People’s Democratic Republic, Malawi, Malaysia, Nepal, Oman, Pakistan, Panama, Papua New Guinea, South Africa, Sri Lanka, Suriname, Swaziland, Viet Nam, Zimbabwe

(Source: UNISDR, based on GAR global risk model)
Box 5.1 Estimating a government’s direct burden

The GAR13 model also takes into account losses to produced capital stock under government responsibility. These include government buildings and public structures as well as housing for low-income communities. These types of losses are here defined as ‘fiscal losses’, as they represent the sovereign or fiscal risk of a government in case of a disaster. They are calculated as part of total annual average losses to buildings, both public and private.

As infrastructure replacement costs are likely to constitute an important part of a government’s direct burden, fiscal losses presented here are likely to be underestimated. Nevertheless, they provide an important reference for governments. For example, fiscal losses from a 1 in 250 years return period earthquake can amount to more than US$9 billion for the Philippines and US$3 billion for Colombia. China and Mexico both face fiscal losses from earthquakes of about US$4 billion, whereas fiscal losses from cyclonic wind damage would amount to US$17 billion for China and more than US$13 billion for Mexico.

The scale of these losses is better understood when comparing them with national or government revenue, i.e. a country’s income from taxes and non-tax sources. National revenue can be seen as a proxy for a country’s ability to buffer losses. Figure 5.3 shows probable maximum fiscal losses from earthquakes compared with national revenue. In the case of the Philippines, losses amount to about 27 percent of government revenue, whereas for the Dominican Republic and Bhutan, probable maximum fiscal losses may exceed 13 percent of their revenue. The Philippines displays an equally significant fiscal vulnerability to wind damage, highlighting how losses can easily exceed government revenue, potentially resulting in an increased debt burden.

Figure 5.3 Fiscal probable maximum losses (PML) from earthquakes with a 250 years return period compared with national revenue

1 = 20 - 40%
Philippines

2 = 10 - 20%
Afghanistan, Bhutan, Dominican Republic

3 = 1 - 10%
Armenia, Azerbaijan, Bangladesh, Bulgaria, Barbados, Colombia, Costa Rica, Fiji, Jamaica, Jordan, Japan, Kazakhstan, Kyrgyzstan, Lebanon, Morocco, Pakistan, Peru, Republic of Moldova, Saint Vincent and the Grenadines, Trinidad and Tobago, Zambia

3 = less than 1%
Austria, Benin, Burkina Faso, Bahrain, Bahamas, Belarus, Bosnia and Herzegovina, Canada, Chile, China, Cyprus, Denmark, Egypt, Estonia, Finland, France, Croatia, Hungary, India, Ireland, Israel, Kenya, Cambodia, Kuwait, Liberia, Lesotho, Macao Special Administrative Region of China, Madagascar, Maldives, Malta, Mauritius, Nigeria, Netherlands, Norway, New Zealand, Poland, Portugal, Qatar, Republic of Korea, Saint Kitts and Nevis, Seychelles, Singapore, Sierra Leone, Slovakia, Slovenia, South Africa, Sri Lanka, Thailand, The former Yugoslav Republic of Macedonia, Togo, Uganda

(Source: UNISDR, based on GAR global risk model and World Bank data)

(Source: UNISDR)
A first approach to resilience is to look at a country’s capacity to invest. Gross fixed capital formation (GFCF) is a metric that represents annual public and private investment in a country. Some countries that can least afford to lose investment are losing the most. For example, in Mozambique, the value of annual reported disaster losses surpassed GFCF three times during the period 1993–2011. In each episode, investment not only slowed down in the country but actually reversed. In 2011, this value represented 12 percent of Mozambique’s capital formation, in El Salvador, 8 percent; and in both Honduras and Nicaragua, about 6 percent.

Figure 5.2 below highlights the proportion of GFCF at risk from both earthquakes and cyclonic winds. When annual average losses (AAL) represent a high proportion of GFCF, this implies that it will take longer for lost capital to be replaced by new investment and thus recovery slower.

For example, Japan not only has a high absolute AAL, this also represents a high proportion of its total GFCF. This means that losses cannot be easily replaced by the formation of new capital stock. In general, countries with sluggish growth and investment will find it more difficult to replace lost capital stock. In these countries, to protect economic growth, investment in disaster risk reduction is extremely important.

In contrast, countries such as the United States of America or China, which also have high absolute levels of AAL, have much higher rates of capital formation. This means that they will be able to replace lost capital more quickly and have a shorter recovery time.

A second approach to economic resilience is to estimate fiscal losses, which are disaster losses that governments are responsible for. As Box 5.1 shows, these losses can challenge the macroeconomic stability of even high-income countries. Macroeconomic stability is considered a basic requirement of a country’s competitiveness (WEF, 2012); countries therefore need to recognise the potential macroeconomic implications of disasters.

### 5.2 The financing gap

A country’s economic resilience depends to an important extent on whether a government is able to absorb losses. Assessing the fiscal capacity of a country is therefore critical to knowing whether it will be in the position to provide timely relief, invest in the required reconstruction and buffer economic downturns to avoid major and long-term macroeconomic impacts.

Economic resilience also depends on whether a government is able to finance recovery and reconstruction through a broad array of public and private mechanisms, including budget reallocations, tax increases, reserves, domestic or external borrowing, international assistance, insurance and reinsurance payouts, and market mechanisms such as catastrophe-linked securities (Mechler et al., 2006).
The scale of a government’s fiscal deficit or financing gap following a disaster depends on how explicit and implicit the liabilities of governments are defined. The Government of Colombia, for example, has recognised this, and has embarked on an ambitious effort to fully assess contingent liabilities arising from disaster risk (see Chapter 15 of this report)—this initiative is part of its overall management strategy for government contingent liabilities (Government of Mexico and World Bank, 2012).

Basing its analysis of liability on GAR11’s examination of Colombia’s probable maximum losses from disasters (UNISDR, 2011), the government has found that disasters associated with natural hazards are the second most important source of its contingent liabilities, after those associated with legal proceedings (see Table 5.1).

Based on this analysis, the Colombian Government’s new disaster risk financing strategy will include risk transfer solutions for potentially affected infrastructure and low-income housing as well as a strong retention strategy via reserve funds (Government of Mexico and World Bank, 2012).

### Table 5.2 Liabilities of a national government (items that can be related to risk from physical hazard appear in red)

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Direct: obligation in any event</th>
<th>Contingent: obligation if a particular event occurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit: Government liability recognized by law or contract</td>
<td>Foreign and domestic sovereign borrowing, expenditures by budget law and budget expenditures</td>
<td>State guarantees for non-sovereign borrowing and public and private sector entities, reconstruction of public infrastructure</td>
</tr>
<tr>
<td>Implicit: A “moral” obligation of the government</td>
<td>Future recurrent costs of public investment projects, pension and health care expenditure</td>
<td>Default of subnational government and public or private entities, disaster relief</td>
</tr>
</tbody>
</table>

(Source: Mechler et al., 2009)

### Figure 5.4 Loss exceedance curve for Honduras

(Source: UNISDR, adopted from CIMNE et al., 2013b)
In many countries, following a disaster, implicit liabilities bring uncertainty to the national account when reconstruction and disaster relief expenditure have to be accommodated (see highlights in Table 5.2). For example, many governments act implicitly as ‘insurers of last resort’ for low-income households even if this responsibility is rarely enshrined in law. This kind of ad hoc compensation provides disincentives for risk reduction. Worse, ‘compensation inflation’ can occur when households expect at least the same level of compensation as provided in previous disasters, which increases the government’s fiscal burden (World Bank, 2012b). Establishing an ex-ante legal framework is needed to decrease the level of fiscal uncertainty and ensure clear incentives for risk reduction.

Based on different risk metrics and criteria for measuring government fiscal capacity, a number of examples illustrate the potential scale of these financing gaps.

In Honduras, analysis based on results from a hybrid loss exceedance curve (see Chapter 4 of this report) shows significant losses even from frequently recurring events (Figure 5.4).

These results enabled an analysis of anticipated relief obligations of the government and its available sources of funding, illustrating the financial vulnerability of the Honduran Government to disaster risk (Figure 5.5).

The analysis shows that the government depends largely on traditional sources to cover for losses from frequently occurring small to medium-sized floods and storms (Hochrainer et al., 2013). However, for events with a relatively low return period of one-in-33 years, the government would still face a significant financing gap with potentially significant economic development setbacks, rendering it unable to provide timely relief and reconstruction efforts (Ibid.).

Another case in point is Madagascar, where a financing gap would appear from any event more severe than a one-in-23 year cyclone (Figure 5.6). And losses from one-in 100 year events could cause financing gaps of almost US$1 billion (Hochrainer, 2012). These estimations were based on
optimistic scenarios of resource availability; other scenarios showed that the Government of Madagascar would be challenged to cover losses from even annual events (Ibid.).

This information is useful in two ways. First, it indicates what scale of disaster would exhaust and exceed a country’s domestic resources (taxes and budget diversion) and external resources (largely new debt). Second, based on the analysis of impacts from disasters for selected return periods, such as a one-in-100 year event, information on the monetary scale of resources and gaps can be used to develop risk financing instruments and negotiate appropriate premiums.

The Inter-American Development Bank’s disaster deficit index (DDI) highlights resource implications

**Figure 5.6** The fiscal gap for cyclone exposure in Madagascar

![Graph showing fiscal gap for cyclone exposure in Madagascar.](Source: Hochrainer, 2012)

**Figure 5.7** Countries’ ability to absorb the losses of a one-in-100 year event (2008 data)

![Graph showing countries’ ability to absorb losses of a one-in-100 year event.](Source: UNISDR, based on IADB, 2010 ERN-AL, 2011 and CIMNE et al., 2013b)
of major disasters in eight countries in Latin America and the Caribbean. The DDI captures the ratio of resource demands incurred by disasters to a country’s availability of funds to cover these demands.

Figure 5.7 shows the results in the case of a one-in-100 year disaster, with any value above 1 on the DDI indicating a financing gap. For example, the DDI indicates that despite an estimated PML of more than US$4 billion, Mexico is well positioned to cover these losses with available resources. In contrast, Honduras would be seriously challenged in spite of a much smaller PML.

The Philippines also has consistently experienced financing gaps owing to disasters since 2000 (Figure 5.8). Although the Philippines has financed part of those gap by domestic and foreign credit, in many countries, sovereign risks are likely to limit borrowing capacity.

The fiscal gap may be even greater in the case of low-income countries and others with high debts and a constrained fiscal space. Nepal, for example, would be unable to finance the costs of even a one-in-20 year event, and that gap would be greater than US$2 billion (Figure 5.9).
5.3 Macroeconomic effects

Disasters can negatively impact the economic development of any country, but for smaller economies that are heavily dependent on single economic sectors, these impacts are likely pervasive. Direct and indirect losses can result in macroeconomic effects that cumulate over time.

Although countries with fiscal gaps may have more difficulty recovering after a disaster, there is less certainty regarding longer-term macroeconomic impacts (World Bank, 2011). Some studies show that disasters have no long-term effect on economic performance or, on the contrary, either owing to inflows of resources for reconstruction or to the creative destruction of obsolete capital, may even contribute positively to the economy (Albala-Bertrand, 1993 and 2006; Skidmore and Toya, 2002). Reconstruction spending may give demand-lacking economies a temporary boost.

However, while these positive effects may be possible in competitive and resilient economies with high levels of GFCF and without financing gaps, this is less likely in countries with low levels of GFCF and with large gaps. Numerous studies indicate that disasters tend to impact negatively on economic development (Mechler 2004; Hochrainer, 2009; Crespo Cuaresma et al., 2008; Noy, 2009). In general, larger and more diversified economies are likely to be

\[\text{Figure 5.10 Simulations of GDP growth and tropical cyclone exposure}\]

(Source: Hsiang and Jina, 2012)
more resilient than smaller economies, heavily dependent on single economic sectors (UNISDR, 2009 and 2011; Gencer, 2012). In less resilient economies, the wider impacts of disasters are more likely to be pervasive.

Although further research is required to reconcile the results from different economic models, recent studies show that in the medium (Hochrainer, 2009) or long term (Hsiang and Jina, 2012), countries that have experienced intensive disasters may never recover this lost growth. For example, countries affected by tropical cyclones experience lower GDP growth in the 15 years that follow compared with the estimated growth that would have occurred without cyclone impacts. In countries with frequent severe cyclones—such as Madagascar and the Philippines—and large fiscal gaps, growth will be lower over several decades (see Figure 5.10). Countries with less frequent and severe cyclones—such India or the United States of America—also experience lower growth, but the divergence is far less.

New simulations of the impact of disaster risk reduction measures on economic growth also show useful results. In Pakistan, for example, an analysis of economic growth projections shows that although real GDP growth would be impacted by a major disaster event, investments in disaster risk reduction could significantly curtail this impact (Figure 5.11).

The impacts of disasters on economic growth over time can be understood when assessing potential mid- to long-term macroeconomic impacts. In Honduras, a one-in 100 year event could produce direct losses amounting to 33 percent of its GDP. Given its limited ability to finance this loss, the government also would have to prepare for further cumulative consequences over time, estimated at up to almost 24 percent of GDP over a period of 5 years (Figure 5.12).

Currently, national accounting does not adequately measure disaster impacts. On the contrary, accounting systems usually report reconstruction and relief spending, adding to GDP figures. Disaster risk may be included in new approaches to wealth accounting at the national level such as adjusted savings, to improve risk management and financing strategies in the future (Mechler, 2009).
Countries for which no data on gross fixed capital formation is available, and which were therefore not included in the following analysis, are: Anguilla, Democratic People's Republic of Korea, French Guiana, Guadeloupe, Martinique, Mayotte, Myanmar, Réunion, Turks and Caicos Islands, United States Virgin Islands.

Losses to other types of assets such as road or water infrastructure are not included.

World Bank data on national revenue from: http://data.worldbank.org/indicator/GC.REV.XGRT.GD.ZS?page=1

Countries for which no data on revenue is available, and which were therefore not included in the analysis, are: Aruba, Angola, Anguilla, Albania, Algeria, Argentina, Antigua and Barbuda, Australia, Belgium, Bolivia (Plurinational State of), Brazil, Botswana, British Virgin Islands, Brunei Darussalam, Burundi, Central African Republic, Cameroon, Cape Verde, Cayman Islands, Chad, Comoros, Congo, Cote d'Ivoire, Cuba, Czech Republic, Democratic Republic of the Congo, Democratic People's Republic of Korea, Djibouti, Dominica, Ecuador, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Faeroe Islands, French Guiana, French Polynesia, Gabon, Germany, Gibraltar, Guinea, Guadeloupe, Grenada, Guyana, Haiti, Iraq, Liechtenstein, Mauritania, Martinique, Mayotte, Micronesia (Federated States of), Monaco, Montenegro, Myanmar, Georgia, Ghana, Gambia, Guinea-Bissau, Greece, Guatemala, Hong Kong Special Administrative Region of China, Honduras, Indonesia, Iran (Islamic Republic of), Italy, Lao People's Democratic Republic, Libya, Lithuania, Luxembourg, Latvia, Mexico, Mali, Mongolia, Mozambique, Malawi, Malaysia, Namibia, New Caledonia, Niger, Nicaragua, Nepal, Oman, Panama, Palau, Papua New Guinea, Puerto Rico, Paraguay, Réunion, Russian Federation, Rwanda, Saint Lucia, Samoa, Senegal, San Marino, Sao Tome and Principe, Saudi Arabia, Solomon Islands, Somalia, Serbia, Spain, Sudan, Suriname, Sweden, Swaziland, Switzerland, Syrian Arab Republic, Tajikistan, Turks and Caicos Islands, Turkmenistan, Tonga, Tunisia, Turkey, Taiwan Province of China, Ukraine, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, United States Virgin Islands, Uruguay, Uzbekistan, Vanuatu, Viet Nam, Western Sahara, Yemen, Zimbabwe.

Information directly provided to UNISDR by JICA in support of the 2013 Global Assessment Report on Disaster Risk Reduction. The simulations were made using JICA’s “DR2AD Model”, an economic model that measures the social and economic impacts of disaster risk reduction investments and allows policy-makers to evaluate multi-index effects of these investments.


Businesses should be a strong proponent of such efforts as they promise a first step towards addressing hidden fiscal risks that can directly impact on their environment, as witnessed since the global economic crisis began in 2007. Businesses have begun to recognise this in accounting for natural capital\textsuperscript{vi}(WAVES, 2012), which—as discussed in the next chapter—is critical to national wealth, but are yet to fully embrace this as an opportunity.

Notes

\textsuperscript{i} Countries for which no data on gross fixed capital formation is available, and which were therefore not included in the following analysis, are: Anguilla, Democratic People's Republic of Korea, French Guiana, Guadeloupe, Martinique, Mayotte, Myanmar, Réunion, Turks and Caicos Islands, United States Virgin Islands.

\textsuperscript{ii} Losses to other types of assets such as road or water infrastructure are not included.

\textsuperscript{iii} World Bank data on national revenue from: http://data.worldbank.org/indicator/GC.REV.XGRT.GD.ZS?page=1


\textsuperscript{vi} http://www.wavespartnership.org/waves/private-sector%E2%80%99s-role-recognizing-value-natural-capital-focus.