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Understanding the Economic and Financial Impacts of Natural Disasters

*Charlotte Benson
and Edward J. Clay*



THE WORLD BANK



Disaster Risk Management Series

Understanding the Economic and Financial Impacts of Natural Disasters

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Charlotte Benson
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1818 H Street, NW
Washington, DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org
E-mail: feedback@worldbank.org

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Preface

Disaster prevention and mitigation are integral to development activities. In February 2000, the World Bank's Disaster Management Facility (now called Hazard Management Unit) initiated a three-year study on the economic and financial consequences of natural disasters, with the support of the U.K. Department for International Development (DfID), provided through its Conflict and Humanitarian Aid Department (CHAD) under the umbrella of the ProVention Consortium.

The principal researchers for this three-year study, which began in February 2000, were Charlotte Benson and Edward J. Clay of the Overseas Development Institute (ODI), London. Study team members from the World Bank's Disaster Management Facility included Alcira Kreimer, Margaret Arnold, Jonathan Agwe, Hager Ben-Mahmoud, Maria Eugenia Quintero, and Zoe Trohanis.

The study consists of a state-of-the-art review and three country case studies: on Dominica, a small island economy (Benson and Clay 2001); on disasters and public finances in Bangladesh (Benson and Clay 2002a); and on climatic variability in southern Africa, with a country study of Malawi (Clay and others 2003). This synthesis report draws together the new findings and evidence from the researchers' previous studies and from other relevant literature.

This report was prepared by Charlotte Benson and Edward J. Clay, with editorial assistance from Alice Baker on the appendixes. Among those who contributed to the three country studies were Enrique Blanco de Armas, Louise Bohn, Jim Dempster, P. Dalitso Kabambe, Franklyn V. Michael, Clement Peris, Alistair W. Robertson, and Hardwick Tchale. Mavis Clay provided editorial and bibliographical assistance.

The authors benefited considerably from comments on the draft of this report by Willy Aspinall (who also contributed box 4.1), Stephen Biggs, Hugh Brammer,

Paul Freeman, Rodney Lester, Simon Maxwell, John Roberts, Malcolm Smart, and Dirk Willem te Velde.

The study team extends its thanks to Nemat T. Shafik, World Bank Infrastructure vice president and head of network; Maryvonne Plessis-Fraissard, director of the Transport and Urban Development Department (TUD); and John Flora, former director of TUD, for supporting this study. We also thank country directors Caroline Anstey, Orsalia Kalantzopoulos, Darius Mans, Hartwig Schafer, Fred Temple, and Christine I. Wallich for their support and inputs to this report. They also provided detailed comments on the individual case studies, which were published as part of the Disaster Management Facility's Working Paper Series. The papers in this series can be accessed on the Internet at <http://www.worldbank.org/hazards>. The team also thanks World Bank staff who provided helpful contributions to the study, including Imtiazuddin Ahmad, Tercan Baysan, Bernard Becq, Sarwat Chowdhury, Robert Epworth, Arnaud Guinard, Rumana Huque, Reazul Islam, Kapil Kapoor, Chingboon Lee, Ashoka Mody, John Pollner, S.A.M. Rafiquzzaman, Constantine Symeonides-Tsatsos, and Claudio Visconti. Finally, the full cooperation extended by officials of the governments of Bangladesh, Dominica, and Malawi was essential to the successful completion of the country studies. They and the many others who provided information and advice are acknowledged in the country study reports.

There is scope for further work on the economic consequences of natural disasters, and it is hoped that this report will provoke discussion on both analytical and policy issues and will stimulate others to undertake further investigations. The authors, of course, accept full responsibility for all errors and omissions in this report. The opinions expressed are those of the authors and do not necessarily represent the views of the World Bank or the DfID.

Abbreviations and Acronyms

ADMARC	Agricultural Development and Marketing Corporation (Malawi)	HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
ADP	Annual Development Program (Bangladesh)	IADB	Inter-American Development Bank
CARICOM	Caribbean Community and Common Market	IBRD	International Bank for Reconstruction and Development
CDERA	Caribbean Disaster Emergency Response Agency	IDA	International Development Association (World Bank)
CHAD	Conflict and Humanitarian Aid Department (DfID, United Kingdom)	IDNDR	International Decade for Natural Disaster Reduction (United Nations)
CRED	Centre for Research on the Epidemiology of Disasters (Belgium)	IFPRI	International Food Policy Research Institute
DfID	Department for International Development (United Kingdom)	IFRC	International Federation of the Red Cross and Red Crescent Societies
DMF	Disaster Management Facility (World Bank)	IIASA	International Institute for Applied Systems Analysis
EC	European Commission	IMF	International Monetary Fund
EC\$	Eastern Caribbean dollars	IPCC	Intergovernmental Panel on Climate Change
ECCB	Eastern Caribbean Central Bank	IPG	international public good
ECLAC	Economic Commission for Latin America and the Caribbean	IRI	International Research Institute for Climate Prediction
EM-DAT	Emergency Events Database (CRED)	MFA	Multi-Fibre Agreement
ENSO	El Niño–Southern Oscillation	MFI	microfinance institution
ESCOM	Electricity Commission of Malawi	MTEF	medium-term expenditure framework
F\$	Fiji dollars	NGO	nongovernmental organization
FCDI	flood control, drainage, and irrigation program (Bangladesh)	NPG	national public good
FDI	foreign direct investment	O&M	operations and maintenance
GDP	gross domestic product	OAS	Organization of American States
GEF	Global Environment Facility	ODA	official development assistance
GIS	Geographic Information System	ODI	Overseas Development Institute (United Kingdom)
GNP	gross national product	OECD	Overseas Economic Cooperation Fund (Japan)

OECS	Organisation of Eastern Caribbean States	SOE	state-owned enterprise
PML	probable maximum loss	SRU	Seismic Research Unit, University of the West Indies, Trinidad
PRSP	poverty reduction strategy paper	Tk	taka (Bangladesh currency)
R&R	relief and rehabilitation	UNDP	United Nations Development Programme
RMSM	Revised Minimum Standard Model	UNISDR	United Nations International Strategy for Disaster Reduction
RPG	regional public good	WINCROP	Windward Islands Crop Insurance Ltd.
RS	Richter scale	WMO	World Meteorological Organization
SADC	Southern African Development Community	WTO	World Trade Organization
SAP	structural adjustment program	Z\$	Zimbabwe dollars
SARCOF	Southern African Regional Climate Outlook Forum		

Summary

The study described here examines the short- and long-term economic and financial impacts of natural disasters. It relies in part on in-depth case studies of overall sensitivity to natural hazards in the small island economy of Dominica; public finance consequences of disasters in Bangladesh; and the economic consequences of climatic variability and the use of climatic forecasting in Malawi and southern Africa. Policy implications are drawn, and, where appropriate, recommendations are made. Finally, directions for future research and cooperation are outlined.

Economic and Financial Impacts

Major natural disasters can and do have severe negative short-run economic impacts. Disasters also appear to have adverse longer-term consequences for economic growth, development, and poverty reduction. But negative impacts are not inevitable.

Vulnerability is changing quickly, especially in countries that are experiencing economic transformation—rapid growth, urbanization, and related technical and social change. In the Caribbean area and in Bangladesh, there is evidence of declining sensitivity to tropical storms and floods and increased resilience as a result of economic transformation and public measures for disaster reduction. The largest concentration of high-risk countries—which are increasingly vulnerable to climatic hazards—is in Sub-Saharan Africa. Risks emanating from geophysical hazards need to be better recognized in highly exposed urban areas across the world, as the potential costs are rising exponentially with economic development.

Natural disasters cause significant budgetary pressures, with both narrowly fiscal short-term impacts and wider long-term implications for development. Reallocation

is the primary fiscal response to disaster. Disasters have little impact on trends in total aid flows.

Public Policy Implications

A full reassessment of the economic and financial impacts of a major disaster should be made 18 to 24 months after the event. It should be taken into account in reviewing the affected country's short-term economic performance and the assistance strategy for the country.

Governments need appropriate risk management strategies for future disasters, including medium-term financial planning covering 8 to 10 years. The basis of funding has to be broadened, using a range of insurance and other mechanisms for different layers of loss.

Natural hazard risk management should be integrated into longer-term national investment policies and development strategies and appropriately reflected in the allocation of financial resources.

High-quality, reliable scientific information is a necessary condition for effective disaster risk management. The international community should support global and regional research and information systems on risk. It should also ensure that there are adequate complementary monitoring and dissemination programs at the national level. Priorities include climatic variability, regional and national flood forecasting, and geophysical hazards.

Economic Research on Natural Disasters

Vulnerability to natural hazards is determined by a complex, dynamic set of influences that include the country's economic structure, stage of development, and prevailing economic and policy conditions. To understand and

assess the economic consequences of natural hazards and the implications for policy, it is necessary to consider the pathways through which different types of hydro-meteorological (climate-related) and geophysical hazard affect an economy, the different risks posed, and the ways in which societies and economies adapt to or ignore these threats.

The eclectic approach adopted in this study, which employed largely qualitative methods, is particularly useful in exploring the many complex and dynamic pathways through which extreme hazard events influence an economy and its financial system, as well as for identifying areas and issues where further investigation, including quantification, would be worthwhile.

Introduction

Between the 1950s and the 1990s, the reported global cost of natural disasters increased 15-fold. Major natural catastrophes in the 1990s caused economic losses estimated at an average US\$66 billion per year (in 2002 prices). In 1995, the year of the Kobe earthquake in Japan, record losses of about US\$178 billion were recorded, the equivalent of 0.7 percent of global gross domestic product (Munich Re 2002).

Such widely cited figures have triggered a growing awareness of the potential damage from natural hazards. There is, however, less recognition of their broader macroeconomic significance and the problems they could pose for longer-term development. One reason is that assessments of the economic impacts of disasters have typically concentrated on the most easily measured direct losses—the financial costs of visible physical damage. This focus on losses arises from a drive to meet the short-term humanitarian needs of affected people in the aftermath of a disaster and from pressures to rapidly determine replacement investment requirements and the extent of insured losses. It also reflects the practical difficulties of isolating and measuring the indirect and secondary impacts that result as the effects of a disaster shock spread through the economy. Such impacts may affect, for example, flows of goods and services, the balance of payments and government budgets, and, ultimately, economic growth, income distribution, and the incidence of poverty.

A further limitation of the existing body of evidence is that most of the relatively few studies to have examined indirect and secondary effects focus on the impact of a single, recently occurring event. The longer-term, cumulative effects of a series of disasters on a particular country's development are more difficult to determine and are typically ignored, apart from speculative comments. Yet in reality, most disasters, being linked

to atmospheric and hydrological processes, are recurrent events, striking a country at infrequent intervals. Such recurrent shocks can have cumulative effects on both the rate and the pattern of development (Benson and Clay 2000). By contrast, earthquakes and volcanic eruptions, which are very uncommon and better fit the idea of a one-off catastrophic event, accounted for only 11 percent of reported natural disasters in the 1990s (IFRC 2002). The potential differences in the economic consequences of these different types of natural hazard are examined in this study.

These biases and limitations of economic assessment have severely restricted the information available to policymakers on the nature and scale of the vulnerability of many economies to natural hazards. This lack of information may in turn have contributed to what many see as a widespread failure to address natural hazards as a possibly serious threat to sustainable development, and a general lack of appreciation of the potentially high economic and social returns to disaster reduction. Clearly, how disasters are conceptualized and impacts are assessed within the framework of economic analysis merits fuller and more systematic review. This investigation seeks to contribute to knowledge of these issues and to understanding how they can be analyzed.

Objectives

The broad objectives of the study are to increase understanding of the wider economic and financial impacts of natural disasters through detailed analysis of the impacts of disasters, the factors determining the vulnerability of hazard-prone economies, the opportunities for improving the management of risk, and the hindrances to the adoption of such measures. The study

focuses primarily on experiences in developing countries. The findings are intended to contribute to the development of guidelines on the assessment of vulnerability to natural hazards from an economic perspective. It was recognized at the outset that the subject is complex and multifaceted and that the study would probably identify many areas that are beyond its scope but are worthy of future, separate research.

The investigation adopts a country case study approach for exploring economywide disaster impacts. In doing so, it builds on previous research and evaluations by the primary investigators, including work on drought in Sub-Saharan Africa (Benson and Clay 1998; Clay and others 1995; Thomson, Jenden, and Clay 1998) and studies of the impacts of disasters in five countries in the Asia and Pacific and the Caribbean regions: Fiji (Benson 1997a), the Philippines (Benson 1997b), Vietnam (Benson 1997c), Zimbabwe (Benson 1998), and Montserrat (Clay and others 1999). Three new country studies, on Bangladesh, Dominica, and Malawi, were completed for this study. This synthesis report thus reflects the findings and cumulative experience from undertaking, over a period of 10 years, eight country studies and regional investigations on the economywide consequences of natural disasters.

Selection of Countries and Issues for Investigation

The three case study countries were selected to represent a range of hazard experiences in economies of varying size and complexity in different regions of the world, as well as distinct but complementary methodological and policy issues. The study on Dominica, one of several highly hazard-prone small island Caribbean states, is an economywide exploration of the impact of disasters (Benson and Clay 2001). That on Bangladesh, a large, hazard-prone Asian economy, concentrates, in particular, on public finance (Benson and Clay 2002a). Malawi, a low-income southern African economy, is the subject of the third study, which focuses on the use of scientific information, particularly short-term climatic forecasting, in disaster mitigation and the value of this information from an economywide and sectoral perspective (Clay and others 2003).

Dominica: Natural Disasters and Economic Development in a Small Island State

The study of Dominica explores the overall vulnerability of an economy to natural hazards. It considers the complexity of the factors determining broad sensitivity and the dynamic nature of that sensitivity, focusing on the disaggregated impacts of natural hazards on different sectors of the economy. Dominica offers an interesting case that exemplifies the experience of many small, open island economies. Such economies face special disadvantages associated with their size, insularity, and remoteness (Briguglio 1995), which make them highly sensitive to economic shocks in any form, including natural hazards. Indeed, they are often perceived as being among the countries of the world most vulnerable to natural hazards.¹

Bangladesh: Natural Disasters and Public Finance

Disasters can have potentially significant implications for public finance, increasing expenditure and simultaneously reducing domestic revenue, in turn resulting in increased domestic or external borrowing, substantial alterations to existing investment, and recurrent expenditure plans or monetary expansion. Natural hazards also impose additional pressures on public finances to the extent that governments undertake mitigation and preparedness measures.

Data on aggregate revenue and expenditure typically do not reveal the severity of the budgetary impact of disasters, as previous work by the principal researchers has clearly shown. The public financial consequences of natural disasters are seldom explored systematically, except in the narrow context of a single major disaster.² After examining these issues for the open, structurally less complex Dominican economy, it was decided that this theme should be the central focus of the case study of Bangladesh, with the aim of shedding more light on these issues.

Malawi and Southern Africa: Climatic Variability and Economic Performance

The extreme regionwide drought in southern Africa in 1991/92 was quickly followed by further droughts in 1993/94 and in 1994/95. These droughts were associated

with an extended and intense El Niño event—a reversal of ocean currents across the southern Pacific that is associated with extreme global climatic effects.³ The droughts had severe impacts on agriculture, as well as wider social and economic consequences. The concern engendered by these experiences, as well as awareness of the scientific evidence linking events in southern Africa to global climatic variability and, possibly, to climatic change, created a widespread sentiment in favor of strengthening climatic forecasting and promoting the use of the information to support food security and improved management of agricultural and other renewable natural resources throughout the region. It was also envisaged that climatic forecasting and information could help improve resilience to longer-term global climatic change and to the likely associated increase in the frequency and severity of extreme events. Recognition of the severity of the economic impacts of drought simultaneously heightened interest in taking the risks of climatic shocks into account in the management of national economies and in structural adjustment programs (Benson and Clay 1998).

The third case study therefore focuses on Malawi and on the wider southern African area. It reassesses, in the light of experience during the 1990s, the economic consequences, on both regional and country scales, of climatic variability, and it examines the status of and prospects for climatic research and forecasting as they relate to these levels. It reviews the range of potentially useful products in the light of recent experience, examines meteorological and other institutional capacity to utilize fully the potential of forecasting knowledge and expertise, and assesses the financing issues posed by strengthening climatic forecasting.

Concepts and Definitions

Natural disasters are an area of multidisciplinary research and policy analysis. A problem of discourse arises because basic terms in the language of disaster research and practice seem to be common to the various disciplines but in fact often reflect subtle differences in conceptualization by natural scientists, social scientists, and practitioners. This problem of discourse is typical of most

development issues (Apthorpe 1984; Harriss 2002). It is therefore necessary, at the beginning of an investigation that covers the less explored aspects of natural disasters as an economywide or macroeconomic phenomenon, to state clearly what the authors mean by the use of specific terms and concepts. The report seeks to adopt widely accepted definitions of key concepts (hazard, disaster, vulnerability, risk), but this is not always possible where there is no agreed standard usage.

A *natural hazard* is a geophysical, atmospheric, or hydrological event that has potential for causing harm or loss. Usually, these events are both uncommon and extreme, in the perspective of the range of natural phenomena such as rainfall, tropical storms, flooding, and seismic tremor or earthquake. Hence, there is a need to determine *risk*. This is understood to be “a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence” (Royal Society 1992: 4).

A *natural disaster* is the occurrence of an abnormal or infrequent hazard that affects vulnerable communities or geographic areas, causing substantial damage, disruption, and perhaps casualties and leaving the affected communities unable to function normally. From an economic perspective, a disaster implies some combination of *losses*, in human, physical, and financial capital, and a *reduction* in economic activity such as income generation, investment, consumption, production, and employment in the “real” economy. There may also be severe effects on financial flows such as the revenue and expenditure of public and private bodies (Benson and Clay 1998). The losses in *stocks* of capital and inventory and the reductions in short-term economic *flows* are sometimes confounded in reporting the costs of disasters.⁴ Stock losses and short-term flow effects may be so extreme as to alter the medium-to-longer-term trajectory or development path of an enterprise, region, or national economy.

Vulnerability is the potential to suffer harm or loss, expressed in terms of sensitivity and resilience or of the magnitude of the consequences of the potential event.⁵ The *sensitivity* of economic behavior to a disaster shock is reflected at a macroeconomic or sectoral level in the deviation of economic aggregates from the

trends that were expected without taking the effects of the event into account. Because economic activity is sensitive to many influences, including other sources of shock, in practice it can be difficult to identify precisely the impacts of a specific disaster or disasters. The primary objective of our studies has been to isolate and understand these short- and long-term consequences of natural disasters.

Resilience is the speed of recovery of economic activity, which may involve repair and replacement of lost and damaged capital. People seek to *cope with* shocks within a range of responses that will not jeopardize their survival or lifetime aspirations. Communities and formal public and private institutions seek to *manage* the effects of a shock without jeopardizing their envisaged longer-term plans.

The disaster management literature commonly distinguishes between *rapid-onset* disasters such as storm surges and earthquakes, which cause immediate loss and disruption, and *slow-onset* events, notably drought. In our empirical investigations of economic consequences, we have found it useful to distinguish *hydro-meteorological hazards* (atmospheric or climatic hazards and the related riverine and coastal hydrological hazards) from *geophysical hazards* because of the different character of the risks involved.⁶

Hydro-meteorological hazards present threats of varying intensity that are usually recognized at a local or national level, and there is consequently some form of *adaptation* in economic behavior and in the technology in which capital (productive capital, housing and habitat, and infrastructure) is embodied. The economic and the wider social consequences of individual hydro-meteorological events appear to be susceptible to investigation for most lower- and middle-income developing countries. By contrast, potentially catastrophic geophysical hazards may occur very rarely. Even in high-risk geographic regions, there may have been no extreme event in living memory or perhaps within the historical record. Consequently, such hazards pose quite different problems of risk perception and economic behavior. But a global phenomenon—satellite television and increasingly widespread availability of media information—may be changing perceptions of risk associated with these types of hazard, too.

Method of Investigation

Isolation of the economic impacts of natural hazards from other internal and external factors poses considerable methodological difficulties. The study adopts an eclectic approach, employed in previous work by the authors, that involves the construction of a historical narrative of disasters for the case study country or region. Disasters are not treated as “black box” economic shocks. Rather, care is taken to establish, through close consultation with scientists in relevant fields, the precise nature of each hazard type, including the frequency and characteristics of extreme events. A mixture of formal quantitative and qualitative analysis is employed to examine the economic impacts of natural hazards at an economywide level (Benson 1997a, 1997b, 1998; Benson and Clay 1998). The quantitative investigations are partial, involving a combination of regression analysis, the use of charts to examine movement around trends, and “before-and-after” comparison of disaster impacts and of forecast and actual economic performance. The implied null hypothesis is that there is no direct link between disaster shocks and the relevant aspect of economic performance. Such analysis cannot always be definitive, but the results at least provide a basis for further reflection and investigation. If impacts are not apparent at an aggregate level, the analysis moves on to consider possible effects within the composition of the relevant economic indicator. A qualitative political-economic analysis is also employed in a complementary way to place quantitative results within the specific economic and social policy context of each case study country. Where similar qualitative results repeatedly emerge from previous and current studies, this is taken to be preliminary evidence of a more general finding about the economic consequences of natural disasters.

The country studies were constrained by the very limited resources and time available and, in some respects, by substantial data limitations. Moreover, the deliberately simple methodological approach, which is, after all, only an extension of the approach typically employed in looking at a single shock, relied heavily on judgment. And, most obviously, it was necessary to select the “major” natural hazard events to be included in the analysis.

For each case study, a country visit was made to collate data and conduct interviews with selected current and former officials and administrators; representatives of civil society and private sector managers who had been involved in specific hazard events; and environmental scientists with direct experience of the country. Interviewees were also consulted about the selection of

“major” hazard events. Relevant country program officers at the World Bank in Washington, D.C., were contacted and were met, where possible. The case studies also entailed a review of the available official documentation and the recent literature. As noted in the Preface, local researchers or researchers in the region contributed to each of the country case studies.

Disasters and the Macroeconomy

This chapter explores the overall vulnerability of an economy to natural hazards. Case study evidence about the dynamics of vulnerability leads to a more general discussion of the sources of vulnerability. The macroeconomic impacts of disasters are then reviewed in terms of short-term and long-term effects. The impacts of disasters on development strategies are considered, and, finally, lessons are drawn.

The Dynamic Nature of Vulnerability

The vulnerability of an economy to natural hazards depends on a complex set of influences. This section briefly presents evidence from the three country cases, which typify more general country situations. The cases highlight the dynamic, rapidly changing sensitivity of economies to natural hazards in the present era, focusing on the interaction of developmental, economic, and societal factors with natural hazards. Some common influences are at work, along with country- and region-specific factors.⁷ In addition, in the longer term, climatic change is altering the frequency and intensity of hazard events, with implications for the scale and nature of vulnerability. This is an issue that the case study findings suggest should be explored separately.

Dominica

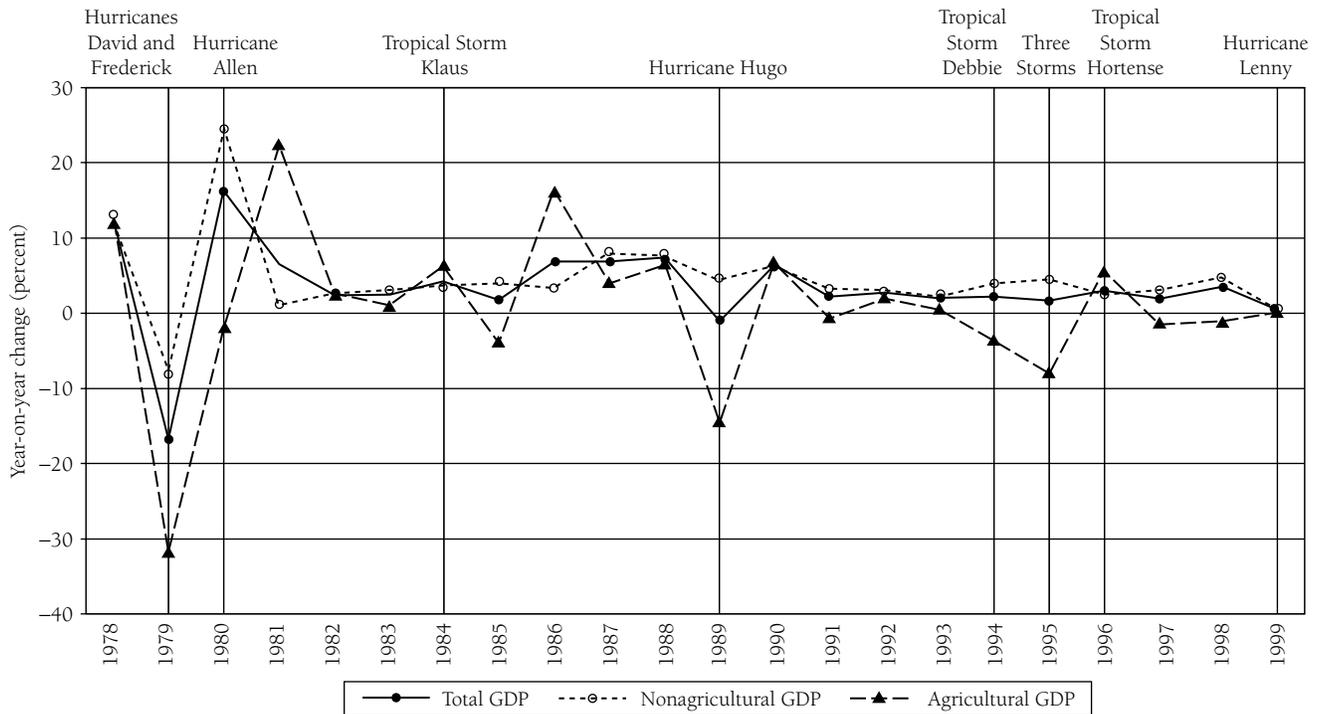
Dominica, a small Caribbean island, is susceptible to a wide range of natural hazards. The most common, most probable, and historically most significant are extreme climatic events: tropical storms and hurricanes. The series of disasters since 1978 includes Hurricane David, an extreme Category 4 storm with sustained winds in excess of 210 kilometers per hour, and Hurricane

Frederick, both in 1979; Hurricane Allen in 1980; Hurricane Hugo, another Category 4 storm, in 1989; the cumulative impact of three tropical storms in 1995; and Hurricane Lenny, also Category 4, in 1999. Hurricane David directly hit the island and was extremely devastating, having severe environmental and demographic consequences. Landslides triggered by storms are common in Dominica and can cause substantial economic damage, as well as potential loss of life.

There are geophysical hazards, too. Although there has been only one volcanic eruption in Dominica's recorded history, the island is now experiencing a period of increased seismic activity. The risk of volcanic activity remains relatively high, particularly in the south of the island, where the capital city and most of the key infrastructure are located.

Dominica's small, very open economy still relies heavily on a single export crop, bananas, which represented a third of total merchandise export earnings in 1997. Although agriculture's share of gross domestic product (GDP) fell from 37 percent in 1977–78 to 20 percent in 1997–98, it remains the main productive sector and is the principal source of livelihoods. Despite some growth in the nonagricultural private sector since the mid-1970s, other private sector activity remains small. Between 1997 and 1998, manufacturing output rose from 3.9 to 8.2 percent of GDP, and there has been promising growth in the offshore financial services industry. Along with tourism, which by the late 1990s accounted for an estimated 35 percent of external earnings, these activities have helped meet the substantial deficit in the external visible trade account.

The close association between the fluctuations in Dominica's banana exports, the country's agricultural, nonagricultural, and total GDP, and the incidence of severe storms demonstrates the substantial impact that

Figure 2.1 Dominica: real annual fluctuations in agricultural, nonagricultural, and total GDP, 1978–99

Source: Benson and Clay (2001); reprinted from Kreimer, Arnold, and Carlin (2003).

natural hazards have had on the island's economic performance since 1978, as shown in figure 2.1. The analysis also suggests, however, that the economy is becoming relatively less sensitive to extreme climatic events. These shifts in vulnerability to natural hazards are related both to increasing development and capital investment in the island and to changes in the structure and composition of economic activity. The economy was most vulnerable to extreme climatic events in the years 1975–85, shortly before and after Independence in 1978.⁸

Beginning in the 1950s, bananas, grown largely by smallholders, had progressively displaced plantation tree crops as the principal commodity exported to the United Kingdom and then to the European Union under a preferential access agreement. These changes in the type and structure of production increased the overall vulnerability of both the agricultural sector and the wider economy to natural hazards.

Hurricane David and, in rapid succession, Hurricanes Frederick and Allen demonstrated that vulnerability, causing severe damage to banana plantings. Yet the hurricanes led directly to an increase in the share

of bananas in total agricultural output because banana cultivation offered a fast, low-investment means of restoring agricultural livelihoods in an assured export market.⁹ The rapid recovery in export production after Hurricane Hugo in 1989 again demonstrated the resilience of the banana economy. In this case, the compulsory WINCROP banana crop insurance scheme (described in box 5.1 in chapter 5), which was introduced in 1987–88 by the banana marketing boards of four Windward Island states, helped encourage replanting of bananas by offering partial financial protection in the event of a disaster. The dominance of bananas in Dominica, and of similar monocrop agricultural sectors in other small island economies, exemplifies a progressive adaptation to a specific external economic environment and is often accompanied by institutional innovation.

The wider economy's vulnerability to natural hazards has changed over the past two decades as a consequence of changes in the sectoral composition of GDP—a development accelerated by the World Trade Organization (WTO) process. From the mid-1990s on, external factors resulted in a decline in export-oriented banana

production, as real prices fell and guaranteed preferential access to the European market ended. Counter-intuitively, the resulting more diversified agricultural sector is more sensitive to both natural hazards and other risks. But agriculture's share of GDP has been declining; by 1997 it had dropped to only 19 percent, half its 1977 level, while manufacturing, tourism, and financial services grew and increased their share of GDP. The services sectors are less sensitive to anything short of a catastrophic event, such as Hurricane David, and so their growth implies a reduction in the vulnerability of the economy as a whole.

The development of the island's infrastructure shows how long-term changes in vulnerability are linked to overall levels of development and to changes in the structure and composition of economic activity. Between 1950 and 1978, Dominica was transformed from an underdeveloped plantation-cum-subsistence colony into an independent, middle-income economy. Key to this achievement was rapid development of infrastructure. Because of the severe financial constraints, this development took place at the lowest possible construction costs. The investments followed more than 20 years without any major hurricane impacts. As a result, adequate disaster mitigation was not built into the construction design, and this omission had devastating consequences when Hurricane David struck.¹⁰ All the key infrastructure systems were devastated. Except for airports, these systems were again partly disrupted by Hurricane Lenny in 1999. Their vulnerability to natural hazards now varies, reflecting the amount of hazard mitigation investment that has taken place and the associated practical and funding issues.¹¹

Dominica is part of the Eastern Caribbean dollar (EC\$) area. The currency is carefully and conservatively managed by the Eastern Caribbean Central Bank (ECCB). That framework of monetary stability reduces financial uncertainty for the private sector and lessens the potential destabilizing financial impacts of a disaster shock (see chapter 3).

Bangladesh

Most of Bangladesh's densely settled population of 130 million people lives in the delta of the great Ganges and Brahmaputra river systems and is at significant risk

from multiple forms of natural hazard. Riverine floods, tropical cyclones (sometimes accompanied by devastating storm surges), flash flooding, erosion, and drought have caused severe economic and social disruption and considerable loss of life in recent decades. Furthermore, Bangladesh is in a zone of very high seismic activity.

A decade of severe disasters began in the mid-1960s. In November 1970 a catastrophic cyclone killed over 300,000 people, and in 1971 came the War of Independence and its aftermath, when 12 million people were displaced. These events resulted in massive damage to infrastructure and institutional disruption. The decade culminated in 1974–75 with a famine linked to extreme floods, hyperinflation, and a bloody political crisis. These events created a worldwide perception in the mid-1970s of Bangladesh as not just a disaster-prone country but, in the insensitive words of the U.S. secretary of state at the time, a nonviable “basket case.”

With no further major disasters, the Bangladesh economy recovered rapidly in the late 1970s. Annual growth of per capita GDP averaged 1.7 percent in the 1980s and 3.3 percent in the 1990s; the latter rate reflected both higher GDP growth and declining population growth. At the same time, the structural composition of the economy has changed: agriculture's share of GDP has declined, while the industrial and services sectors have expanded, resulting in a sharp shift in the composition of the country's exports. A gradual process of structural adjustment and trade liberalization, along with more disciplined monetary management, resulted in the 1990s in an inflation rate that stayed in the single digits and an annual current account deficit below 2.5 percent of GDP. The reforms have also helped increase private sector development and foreign direct investment (FDI). Fiscal policy has been less successful: the country has had large fiscal deficits, a low tax-to-GDP ratio, and relatively poor-quality public spending.

A simple assessment of the sensitivity of Bangladesh's economic performance to major disasters, as measured by fluctuations in GDP and in growth rates of agricultural and nonagricultural sector products, highlights some key issues:

- In the period 1965–75, extreme volatility in the still largely agricultural economy was clearly linked to catastrophic natural disasters.

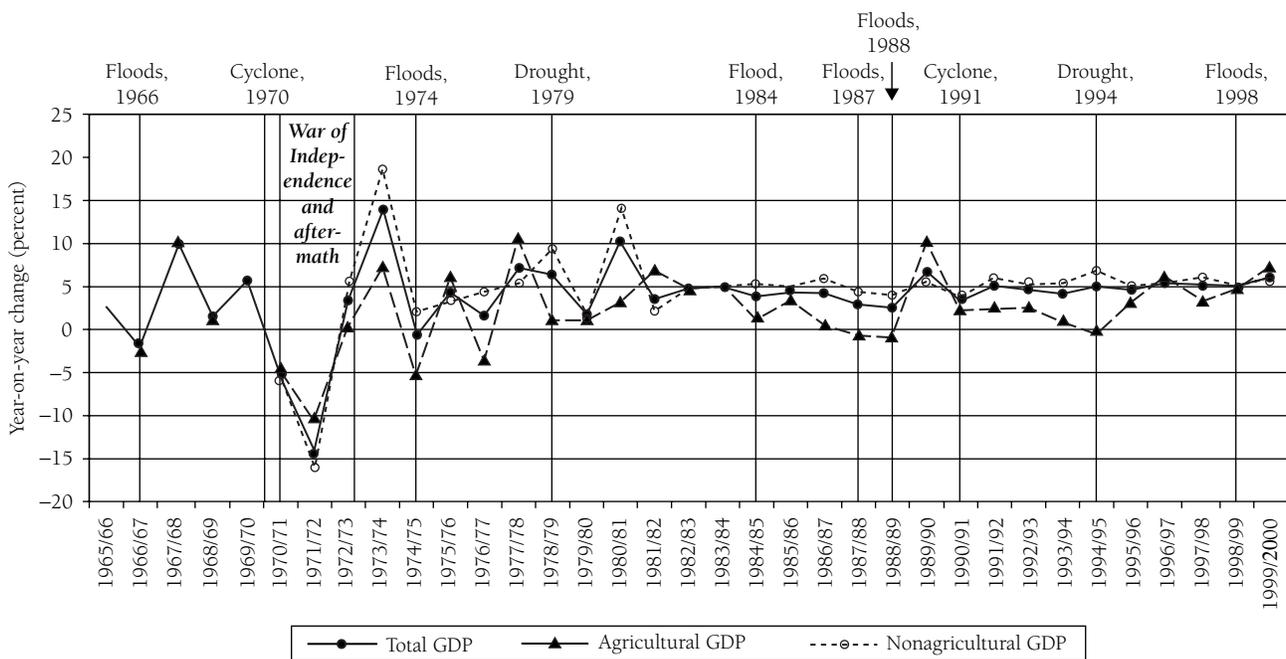
- With the notable exception of the 1998 floods, major disasters have led to downturns in the agricultural sector's annual rate of growth.
- The short-term impact of disasters on the nonagricultural sector is much less significant, but the longer-term impacts of disasters are not reflected in interannual fluctuations. If resources are diverted from productive investments to disaster response, the pace and nature of development will be adversely affected.
- The sensitivity to natural hazards of both the agricultural and the nonagricultural components of GDP appears to be declining over time, suggesting greater resilience (figure 2.2).

The improvement in the economy's resilience is partly attributable to structural change in the agricultural sector. Following the 1987 and 1988 floods, a relaxation of restrictions on private agricultural investment and on imports of equipment—initially, to encourage recovery—was associated with a rapid expansion of dry-season (winter) irrigated rice, displacing highly flood-prone deep-water rice and jute and carrying a much lower risk. Increased rice production and liberalization of

the external and domestic grain trade have also played a role. As Bangladesh approached self-sufficiency in rice, internal prices for this national staple displayed reduced seasonal volatility and moved closer to import parity price levels with the liberalization of the grain import trade. After the floods of 1998, large-scale private sector imports covered the greater part of the temporary food gap, limiting pressures on prices and public finance (del Ninno and others 2001).

Investment in structural flood control has been another factor contributing to increased resilience. Urbanization is rapidly creating large urban and periurban zones, and the capital, Dhaka, is becoming a sprawling, minimally planned megacity with weak, overstretched infrastructure. However, since the severe floods of the late 1980s, there has been a de facto shift of flood control investment and operations and maintenance (O&M)—the main area of public expenditure on disaster mitigation—from rural and agricultural to urban and industrial protection. These changes in priority have met with some success. The 1998 floods, of longer duration and with higher river levels than those of 1987 and 1988,

Figure 2.2 Bangladesh: real annual fluctuations in agricultural, nonagricultural, and total GDP, financial years 1965–2000



Source: Benson and Clay (2002a); reprinted from Kreimer, Arnold, and Carlin (2003).

did not severely affect the Greater Dhaka metropolitan area or some secondary towns that had received enhanced protection.

Changes in the composition of productive activity have also altered the vulnerability of the economy. Rapidly expanding, export-oriented garment manufacture has been the primary motor of export growth, as inward FDI and some local industrialists exploited the trading niche offered by the Multi-Fibre Agreement (MFA). During the 1998 floods, there was some disruption of supply and export chains, but the industry, which was largely based in urban zones less affected by flooding, proved resilient. Again, however, it appears that the risks have changed rather than being simply reduced. The industry's markets are far from assured and could be lost if there were a major disaster-related disruption. Manufacturing in coastal Chittagong is potentially exposed to an extreme cyclone and storm surge, such as the one in 1991. Building standards in new industrial and commercial developments (with short life expectancies) and in rapidly expanding housing largely ignore seismic hazard.

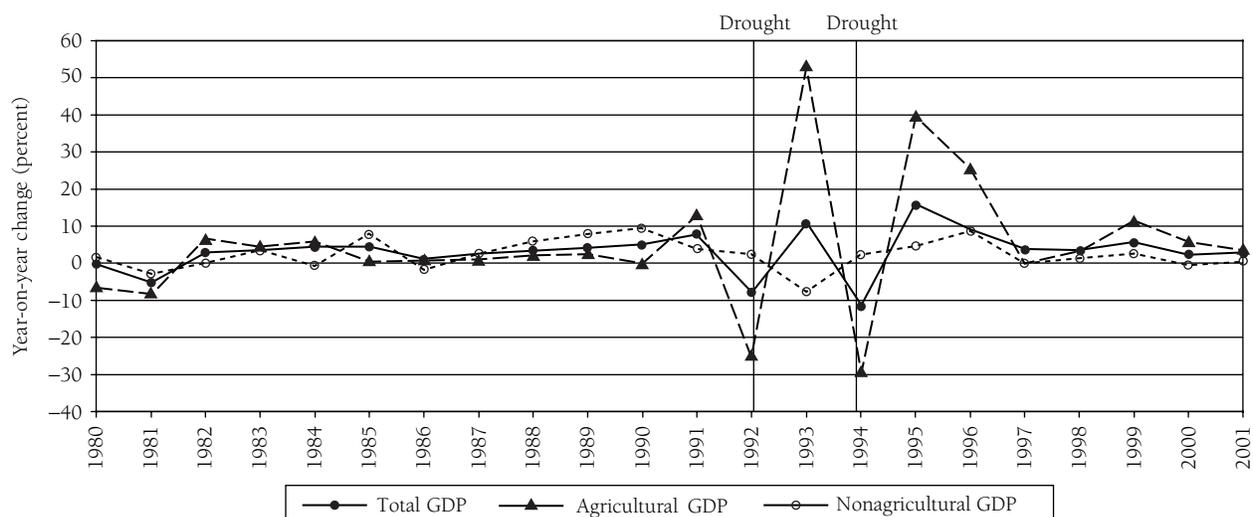
The financial system has seen some major developments too, including important innovations, that again have strengthened resilience to natural hazards. After the chaotic hyperinflation that contributed to the famine of 1974, the government has maintained relative

financial stability in the aftermath of subsequent disasters. Remittances by Bangladeshis working abroad have played an important role in financing economic growth and in providing postdisaster financial support; these remittances increased by 18 percent in the financial year that included the 1998 floods. Finally, Bangladesh has been a leader in developing microfinance for the rural poor and, more recently, the urban poor. Microfinance had a significant, although still limited, role in enabling the poor to cope with the costs of the 1998 floods (del Ninno and others 2001). The central bank was able to protect this important financial sector through massive refinancing.

Malawi

On current evidence, since around 1999 some countries in southern Africa have experienced increased economic volatility linked with climatic variability (figure 2.3). This apparent increase in vulnerability has occurred during a period of complex, interacting developments in the region. Some of these developments have been positive—for example, the political reintegration of South Africa and the end of the conflict in Mozambique. Others are negative, such as the increasing problems with governance in Malawi, Zambia, and Zimbabwe and

Figure 2.3 Malawi: real annual fluctuations in agricultural, nonagricultural, and total GDP, 1980–2001



Source: Clay and others (2003); reprinted from Kreimer, Arnold, and Carlin (2003).

the HIV/AIDS epidemic, which undermines capacity to cope with shocks. Malawi provides an illustration of these trends.

Malawi, a small, landlocked country, had a population of 10.8 million in 2000. It is one of the poorest countries in Africa, with per capita GDP of US\$170 in 2000. Health and social indicators are among the lowest anywhere, and Malawi is one of the countries most severely affected by HIV/AIDS. The loss of human capital and the prevalence of ill health among the economically active population are probably making the country more disaster-prone.

Malawi still has a largely rural economy; 89 percent of the economically active population is classified as rural. Agriculture accounted for about 40 percent of GDP in 2000, compared with 44 percent in 1980. The share of agriculture in GDP, which had been declining, rose again in the 1990s as the industrial sector stagnated and the public services sector contracted. Export earnings are dominated by agricultural commodities—largely, rainfed tobacco—making the economy sensitive to climatic variability and commodity price shocks.

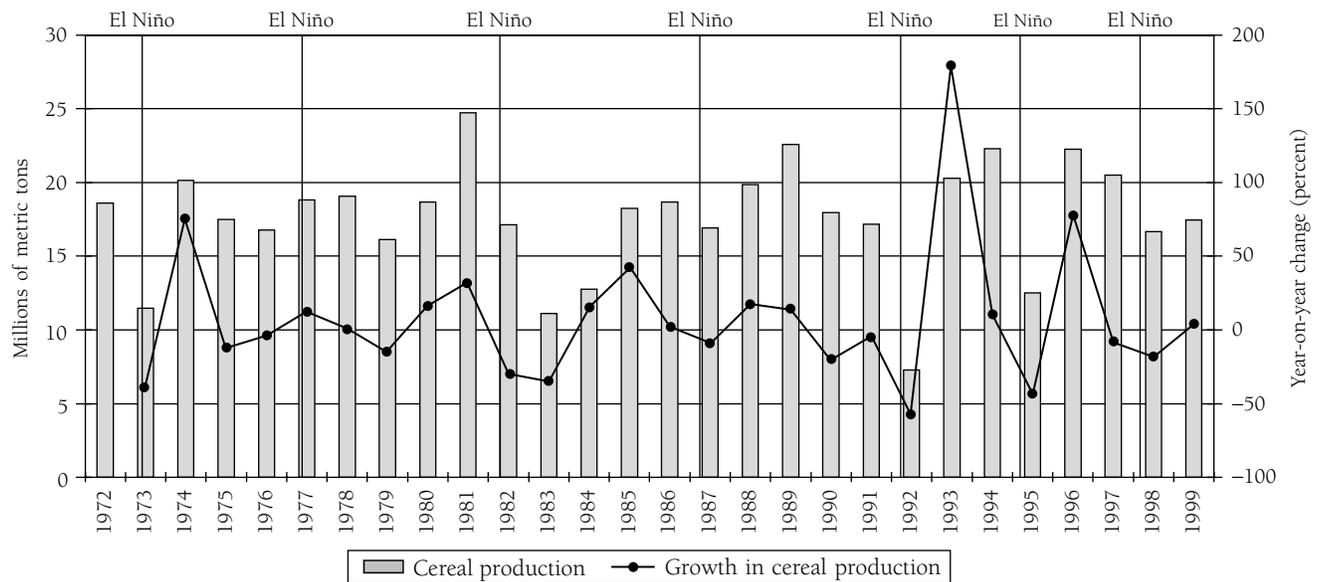
Despite internal liberalization and reductions in tariffs, the economy has become relatively less open over time. Exports as a proportion of GDP declined from 28 percent in 1980 to 24 percent in 2000, and imports as a share of GDP decreased from 43 to 40 percent.

The main source of natural hazards is climatic variability. The principal food staple, rainfed maize, which accounts for over 70 percent of energy intake, is extremely sensitive not just to drought or low rainfall but also to erratic rainfall during the growing season and to abnormally high rainfall. There were only two clearly defined droughts in the 20th century—one associated with the famine of 1949 and the other in 1991/92, when maize production fell by around 60 percent. But relatively unfavorable conditions such as the sparse and erratic rainfall in 1993/94, the extremely high rainfall in 2000/01, and locally erratic rains in 2001/02 pose increased food security threats and wider economic threats to a more vulnerable, less resilient economy.

Riverine flooding is an annual, relatively predictable hazard in the southern districts, where population density is lower. Even in 2001, flooding did not have a widespread, catastrophic impact. There are apparently no other significant natural hazards.

At least six factors are contributing to increasing economic sensitivity in Malawi:

- *Unsustainable agricultural practices.* The stagnation in cereal production over more than two decades is a problem throughout southern Africa (figure 2.4). It has been linked with failure to follow cropping patterns that maintain nutrient levels and to compensate for lost nutrients with increased fertilizer applications. Demographic pressures are contributing to the decrease in the size of smallholdings, but other factors must be invoked to explain why smallholder farmers are unable to address technical constraints.
- *Structural change in agriculture.* Structural change has been brought about by deliberate land redistribution and by economic processes, both of which are influenced by policy. The decades-long marginalization of the small farmer and the switch in the 1990s toward encouraging small farmers to take up tobacco production have increased volatility. Meanwhile, attempts to establish a viable credit system, input supply, and supportive marketing structure for smaller producers have not been fully effective.
- *Institutional weaknesses in agriculture.* Institutional weaknesses reflect the shortcomings of many sectoral and structural adjustment programs. Previously dominant or monopolistic parastatal marketing, credit, and input supply organizations have been weakened, but effective and efficient commercial enterprises have not emerged to fill the gap. The regional crisis of 2002 confirms that too little has been achieved.
- *Political instability.* Since the early 1990s, political instability and governance problems have weakened the government's capacity to manage the fiscal and monetary aspects of shocks (see chapter 3).
- *Short-term variability in external aid levels.* Donors' country-specific policies—which are influenced by political and governance issues, as well as by directly economic and humanitarian considerations—have been an important factor in the volatility of public finances.
- *The effects of HIV/AIDS on human resources.* The effects of HIV/AIDS are insidious, and although much discussed, they are only gradually being understood, quantified, and seriously addressed. The loss of human capital and the incidence of ill health among the

Figure 2.4 Southern Africa: cereal production and El Niño events, 1972–99

Source: Clay and others (2003).

economically active population are undermining coping strategies and making the country more disaster-prone (Haacker 2002).

Extreme events such as the 1991/92 drought in southern Africa (see figure 2.4) and the floods in Mozambique in 2000/01 frequently evoke warnings about the effects of climatic change. There is as yet no conclusive evidence that Malawi, southern Africa as a whole, or other regions of Sub-Saharan Africa are experiencing either more frequent extreme events or long-term aridification (Hulme and others 2001), but both are anticipated for parts of southern Africa as a consequence of climatic change (IPCC 2001; Fischer, Shah, and Van Velthuisen 2002).

Comparison of the Experiences of the Case Study Countries

The three case study countries demonstrate striking contrasts, not just in their increasing or decreasing vulnerability but also in the changing forms of vulnerability. These developments belie somewhat simplistic notions of general and rapidly increasing vulnerability to natural hazards associated with global economic growth

and climatic change. In Bangladesh and Dominica, sensitivity to climate-related hazards seems to have peaked in the 1970s, but Malawi and some other southern African economies are currently showing increasing sensitivity. By contrast, risks emanating from geophysical hazards appear to have risen with urbanization and with the growth of the secondary (industrial) and tertiary (services) sectors in both Bangladesh and Dominica.

Overview of the Factors Determining Vulnerability

Economic vulnerability is not a static condition that reflects location-specific environmental hazards. The scale and nature of the economic impacts of a natural hazard event depend, as well, on influences that are time-specific. The country studies, and evidence from earlier case studies, highlight five basic factors that determine broad macroeconomic vulnerability to natural hazards:

- The type of natural hazard
- The overall structure of an economy, including natural resource endowments

- The geographic size of a country
- The country's income level and stage of development
- Prevailing socioeconomic conditions, including the policy environment and the state of the economy.

Each of these influences is considered in greater detail in the sections that follow.

There are also other factors affecting vulnerability. Vulnerability is time-dependent; the country's stage of socioeconomic development matters, as does its state of technical and scientific advancement. For example, since the early 1990s, considerable advances have been made in seasonal climatic forecasting for southern Africa and other regions of Sub-Saharan Africa. This information can be used to inform private and public decisions on the management of water resources, the choice of crops, and the level of grain exports and imports, and these decisions in turn alter the relationship between climatic variability and economic performance.

The application of technical and scientific developments in economic activity can affect vulnerability. For example, flood-tolerant cultivars used in deep-water rice cultivation in South and Southeast Asia have gradually been displaced by shorter-stemmed cultivars that require more controlled water management (often, through irrigation) but also permit more intensive production. In Bangladesh this intensification, which is associated with a switch to dry-season, irrigated, high-input rice, has reduced overall variability in crop production and vulnerability to climatic hazards.

As discussed in the country studies, disaster management, narrowly defined in terms of specific mitigation, preparedness, and postdisaster responses, also contributes to determining the level and nature of vulnerability.

Another critical factor is environmental change. In Bangladesh the destruction of the Sundarbans mangrove forests may affect the impact of cyclones. Upper riparian water management and use may alter the risks of extreme flooding and the consequences of drought. Deforestation also probably increases the risks of landslides, which could be triggered by climatic or seismic events, as seen in Dominica. In Malawi farming practices and social pressures on wasteland and forestland accelerate soil erosion and increase sensitivity to climatic extremes. Global climatic change could also alter the frequency and scale of climatic hazards.

Natural Hazards

The inductive nature of case study investigation gives rise to preliminary findings and hypotheses that need to be more widely explored. The authors' earlier study of drought in Sub-Saharan Africa (Benson and Clay 1998) suggested the hypothesis that vulnerability is linked in a nonlinear way with development from a simpler economic structure to a more complex one characterized by increasing intersectoral linkages and integration of financial flows. Further investigations, reported in this study, lead to a second hypothesis: that the changing patterns of economic vulnerability differ for two broad types of hazard—hydro-meteorological (drought, flood, cyclones, and hurricanes) and geophysical. If that hypothesis is provisionally accepted, it will have important implications for further investigations and for disaster risk reduction policy.

Hydro-meteorological Hazards

Climatic variability and drought. Both abnormally low or erratic rainfall (usually characterized as drought) and abnormally high rainfall are likely to affect agricultural performance adversely. The effects of abnormally high rainfall may be less severe but are still serious for a highly vulnerable rural economy. Drought, in particular, can cause heavy crop and livestock losses over wide areas, often affecting several countries simultaneously (the *covariance* aspect of disaster risk), as happened in southern Africa in the early 1990s. Extreme climatic events may persist (*auto* or *serial correlation*); in the Sahel, there is a significant risk of a succession of very dry years. In southeastern Africa, extreme events occurring within a well-established, long quasi cycle of drier and wetter periods lasting approximately a decade may be amplified (as illustrated by drought in the early 1990s and floods at the turn of the millennium), or they may be dampened, as with drought in the 1970s. Such quasi-cyclical phenomena, which modify the potential impact of an event considered in isolation, have implications not only for agriculture but also for other water-related, hydrologically sensitive sectors of an economy, such as hydroelectricity and domestic water supply (Hulme and others 2001).

Riverine floods. Abnormally severe flooding is likely to damage infrastructure and productive capacity, as well as directly reduce output, particularly by destroying standing crops and by disrupting economic and social activity. These effects can be widespread, as in Bangladesh, or very restricted, as in Malawi.

Tropical cyclones and hurricanes. Tropical storms pose a considerable threat to human life, especially when associated with storm surges, and can have devastating impacts on the productive economy. The economic impacts may be less widespread than those of drought or riverine flood, but the storms can leave a path of destruction and disruption across a whole region, as in the case of hurricanes in the Caribbean. Storm impacts are likely to have a localized impact in larger economies (coastal Bangladesh and the Philippines) but to be overwhelmingly devastating for smaller economies (Dominica, Fiji, and Montserrat).

Severe storms are likely to be associated with and intensify localized hazards such as flash flooding and landslides. This happened with Hurricane David in 1979 in Dominica and Hurricane Mitch in 1998 in Central America (IFRC 1999).

Geophysical Hazards

Earthquakes can cause widespread destruction of infrastructure and other productive capacity over relatively large areas. These events have little impact on standing crops, except for localized losses resulting from landslides. The greatest risk of catastrophic macroeconomic consequences is when the event occurs in a major urban center or in the metropolis (e.g., Tokyo in 1923). The possibility of such an extreme outcome is, as with all hazards, in part a function of the economy's size; thus, a single volcanic eruption completely disrupted Montserrat's economy. Volcanic eruptions and tsunamis also usually have localized direct impacts.

Geophysical and Climate-Related Hazards Compared

The area of danger in a geophysical event is usually more restricted than for the most extreme climatic events. The other important difference between climate-related and geophysical hazards is the form of risk associated with events likely to cause severe economic impacts. In Dominica damaging storms have been 5- to 50-year events,

depending on their intensity. The droughts in Malawi and the extreme floods in Bangladesh during the 1980s and 1990s, which had clear macroeconomic impacts, were also 5- to 50-year events, according to level of severity. The recurrent nature of hazards leads to adaptations in economic and social activities, such as agriculture, housing, and water supply, at the micro and sectoral levels. The historical climatological and hydrological records also allow formal assignment of risks within probability bands that can be taken into account in larger-scale public and commercial investment and in production decisions. These risks, however, are nonrandom and are potentially subject to quasi-cyclical and secular change.¹² Consequently, experiences based on (climatically) relatively short periods may be profoundly misleading guides to the formation of expectations.¹³

By contrast, from the viewpoint of most public and private investment decisionmaking, geophysical hazards are to be regarded as random, stochastic events of uncertain and mostly low probability. Extreme geophysical events, with the potential to cause severe damage and disruption, are very rare—a 1 percent risk or less in any year. Even in relatively high-risk zones, the probability of there having been disastrous events within living memory or even in the historical record is low. Consequently, until the recent advent of rapid media dissemination of information about events elsewhere, risks had little effect on private or even public decisions about the location of activities or about construction standards for the built environment. Only formal regulation or risk assessments that are required for internationally funded investments are likely to introduce risk reduction into economic decisions. But on a global scale, the disaster-related costs of geophysical hazards are rising rapidly, and in countries with a significant risk, the potential cost is growing exponentially with economic development.

Economic Structure

The interaction between the types of natural hazard risk to which a country is exposed and the basic structure of its economy at a particular moment in time plays a significant role in determining broader macroeconomic vulnerability. The economic structure is reflected in the relative importance of the various sectors and subsectors; in patterns of ownership and systems of production;

in intersectoral linkages; and in the role and nature of productive capital.

Both the Dominica and Bangladesh cases show how reductions in broad macroeconomic vulnerability are related to structural change—specifically, to a relative decline in agriculture, commonly the most vulnerable sector. Even within the agricultural sector, however, various factors work to determine the precise nature and level of vulnerability. These include capacity to recover from a hazard event and the degree of resilience. Banana producers, for example, can suffer enormous damage as a consequence of disasters, but their capacity to recover has been strong, as is seen in the case of Dominica. The relative importance of different socioeconomic groups in production can also significantly influence vulnerability, as in Malawi and Zimbabwe (Benson 1998).

Dominica and Zimbabwe provide contrasting examples of the importance of intersectoral linkages in determining hazard sensitivity.¹⁴ Some countries have a high degree of dualism, with a large capital-intensive extractive sector that features significantly in the trade account but is weakly linked with other sectors of the economy. The effects of drought on the macroeconomy and on the trade account were modest in Zambia in the 1980s, before the collapse of copper mining, and in Botswana and Namibia during the 1990s.¹⁵

Stage of Development

Economic development is widely understood as a process of increasing complexity that is reflected in the growing proportion of GDP accounted for by the secondary and tertiary sectors of the economy. The stage of development of an economy, measured in terms of the degree of sectoral, geographic, and financial integration, levels of economic specialization, and government revenue-raising capabilities, is likely to influence vulnerability to natural hazards (Benson and Clay 1998).

Least-developed or simple, less complex economies are typically perceived as most vulnerable, even though their absolute losses as a consequence of a particular disaster may be small relative to the levels reported in developed countries. It is true that because of weak intersectoral linkages, a high degree of self-provisioning, and, often, poor transport infrastructure, the multiplier

effects from the immediately affected regions or sectors through the rest of the economy may be fairly limited, and much of the cost of relief and rehabilitation may be met through external grants and concessional assistance. Nevertheless, the physical impact of a disaster can be severe, causing widespread destruction and sometimes high loss of life, and disasters can exacerbate existing problems of indebtedness and poverty.

But economic growth and development per se may not reduce vulnerability. In Bangladesh and Dominica, for instance, development is altering sensitivity to natural hazards rather than reducing it. Poor and socially disadvantaged groups can become differentially vulnerable.¹⁶ Although this much-researched subject is outside the scope of this study, its importance should be fully acknowledged. Similar patterns may be mirrored at a macroeconomic level.

An economy at an intermediate stage of development is typically more integrated, sectorally and geographically, than a simple one, and this increases the multiplier effects of adverse performance in a particular sector or region. For example, climatic hazards may affect the growing manufacturing sector, as well as the agricultural and livestock sectors, particularly where, as is commonly the case, the initial growth of the manufacturing sector is based primarily on agroprocessing. Meanwhile, the government is likely to meet a larger share of the costs of relief and rehabilitation efforts itself rather than rely almost entirely on international assistance (see chapter 3). In such an economy, the financial sector is also likely to have a more important role in shaping the impact of a natural disaster. Intermediate economies typically have more developed economywide financial systems for the flow of funds, including small-scale private savings and transfers, and this diffuses the impact of disasters more widely. For example, in Zimbabwe following the 1991/92 drought, the transfer of remittances from urban to rural regions was facilitated by the well-articulated system for small savings. These transfers not only mitigated the impact of the drought in rural areas but also spread the effects more widely (Hicks 1993).

In the later stages of development, the relative scale of the economic impacts of disasters is likely to decline again, as is suggested by evidence on the reported costs of disaster damage (e.g., Alexander 1997) and

the effects of drought shocks on GDP (Benson and Clay 1998). In part, this relationship reflects the decline of the share in GDP of the particularly hazard-vulnerable agricultural sector, and its decreasing importance as a source of employment, a provider of inputs to other sectors, and an end-user. More developed economies are also typically more open and have fewer foreign exchange constraints, implying that any disaster-related increases in imports will not displace normal imports. Other factors that contribute to lower vulnerability include higher investment in risk reduction, improved environmental management, and lower levels of poverty. Moreover, a larger share of economic assets is likely to be held by the private sector and adequately insured against disaster, and a higher proportion of damage sustained by individual households will be covered by insurance. Thus, the scale and cost of relief and rehabilitation programs will be limited and less likely to necessitate a substantial increase in government domestic or external borrowing. Despite all this, a small segment of the affected population may be severely affected by loss of income, assets, and savings.

Within this broad framework, very small island economies represent a special case—a point that is illustrated in case studies and is underlined by recent attempts to develop national indices of vulnerability (see box 2.1). A cyclone (Hurricane David in Dominica) or a volcanic eruption (Montserrat) whose impact would be relatively localized in a larger country can be catastrophic to a small island country—it can disrupt the whole economy; destroy much of the transport, power, and communications networks, as well as productive capacity and social infrastructure; and precipitate an exodus of human capital. A loss that “would be merely a local transfer in a larger economy”—for example, the temporary or permanent displacement of markets for a country’s outputs—could be a devastating setback to a small island economy (Handmer and Thompson 1997: 15).

Prevailing Socioeconomic Conditions

A myriad of other factors, either coincidental or the consequence of deliberate public policy, can also act to dampen or amplify the economic impact of a hazard event. (For a fuller discussion, see Benson and Clay

2000.) Such factors are contingent, reflecting a range of dynamic influences. A probably incomplete list includes:

- Domestic macroeconomic policies such as stabilization or structural economic reform programs.
- Medium-term economic and social strategies such as poverty reduction (see box 2.2).
- Domestic sectoral policies such as those concerned with food marketing, foreign exchange management, or stockpiling of cereals—although there is no clear pattern relating to the implications of particular policies.¹⁷
- Deliberate changes in policy in response to a disaster—for instance, to control inflation, encourage reinvestment, or generate revenue to meet the costs of rehabilitation.
- The external policy environment, to the extent that it influences the pattern of productive activities and thus affects underlying vulnerability. In Dominica banana production has been encouraged by preferential trade arrangements. Malawi is experiencing deindustrialization as South Africa is reintegrated into the regional economy.
- Coincidental fluctuations in primary export and import prices (e.g., of cereals or oil), which may lessen or exacerbate impacts on the balance of payments and inflation.
- A country’s significance in specific export markets. The shift from agricultural to manufacturing exports, and thus to an apparently less hazard-vulnerable form of economic activity, may not in fact have reduced the potential sensitivity to disasters of Bangladesh’s export earnings.¹⁸
- The timing and nature of other shocks, especially conflict—for example, the independence struggle in Bangladesh and the war in Mozambique that destabilized Malawi’s transport links and brought an influx of refugees.
- The incidence of health hazards. The HIV/AIDS pandemic and the resurgence of malaria and tuberculosis are undermining coping strategies, eroding human capital, and placing potentially considerable strain on public finances in southern and eastern Africa.

The Macroeconomic Impact of Disasters

The wide range of views on the economic consequences of natural hazards justifies a careful reexamination of the theoretical arguments in order to set the context

Box 2.1 Measuring vulnerability

Several attempts have recently been made, essentially for purposes of international development policy, to assess countries' relative vulnerability to natural hazards. The results typically generate a numerical ranking of countries. Attaching a single quantitative number to a country's vulnerability is an appealing notion. Just as the poverty level provides an immediate indicator of the likely importance of poverty reduction efforts in a country and the extent to which poverty factors should be considered and addressed in broader policy, a summary indicator of vulnerability could highlight a possible need to address vulnerability to natural hazards and perhaps bring risk concerns into the heart of government thinking.

The recent flurry of interest in indices of vulnerability to natural hazards is part of a wider attempt to measure the extent of the vulnerability of individual countries, particularly small states, to external economic shocks. This interest is partly fueled by the fact that many small states have relatively high levels of per capita income, suggesting their economic strength rather than—as is often the case—economic fragility. The focus on their relative wealth, rather than on economic stability, has limited these countries' access to concessional aid resources, generating concern as to whether they may require differential treatment by the international development community. Vulnerability indices could become an important determinant of a country's graduation status within the United Nations and Bretton Woods systems (World Bank 2002).

The usefulness of vulnerability indices ultimately hinges on their success in capturing meaningful differences in sensitivity to shocks. The vulnerability indices that have been developed so far have been based on a (sometimes weighted) range of components designed to capture various aspects of vulnerability, including that relating to natural hazards. Vulnerability to natural hazards, in turn, has been measured on the basis of some form of historical record of impacts—for example, total damage from significant disaster events, defined as events causing damage that exceeds 1 percent of gross national product (GNP) over the period 1970–89 (Briguglio 1995); the percentage of the population affected by natural disasters over the period 1970–96 (Atkins, Mazzi, and Easter 2000); or the total number of natural disasters over the period 1970–96, expressed in relation to total land area (Atkins, Mazzi, and Easter 2000). The United Nations Development Programme (UNDP) is currently working on a more sophisticated form of vulnerability indicator which incorporates political, social, and economic factors that could influence current and future vulnerability. Even with that more refined measure, the scores and relative ranking of different countries will be approximate, at best.

Differences in definition, compounded by incomplete and inaccurate data, have resulted in significant differences in the ranking of countries—although all rankings highlight the apparent special vulnerability of small island economies to natural hazards. For example, Bangladesh ranked 15th as measured by total damage as a percentage of GNP, 2nd according to population affected, and 23rd according to total number of disasters relative to land mass. The corresponding rankings for Dominica were 2nd, 13th, and 7th, and for Malawi, 51st, 23rd, and 44th (a tie).

More fundamentally, any ranking is sensitive both to the period of analysis and to the type of hazard faced by a particular country. Different types of hazard imply different types of risk. A country might have a high score because of a single extreme geophysical event with very low probability of recurrence, or a very low score because it has not experienced such an event.

Moreover, each index has been based entirely on historical impact, however defined, and has ignored the dynamic nature of vulnerability, which demands a forward-looking perspective. The impact of past disasters is significant, and comparison of hazard events across countries and within countries helps build understanding of the factors contributing to vulnerability. Past impacts, however, cannot be directly equated with future vulnerability. The nature and scale of vulnerability, whether viewed in economic or other terms, are themselves highly dynamic and in constant flux, since human actions continually influence vulnerability, at both the household and macroeconomic levels. The insidious, progressive effect that the HIV/AIDS pandemic in southern Africa is having on vulnerability to natural hazards, which was fully exposed only when unfavorable weather triggered a humanitarian crisis in 2002, highlights these issues.

Source: Benson (2003b).

Box 2.2 Saying so does not make it so: poverty reduction strategies

During the 1990s, international commitments were made to what eventually became the United Nations Millennium Development Goals for poverty reduction. The commitment process was initiated in response to the disappointing outcomes of efforts to reduce poverty in earlier decades. As a consequence, since the late 1990s, preparation of a poverty reduction strategy paper (PRSP) or a similar policy document has become a major focus of government-donor dialogue on development strategies. To some extent, poverty reduction has superseded structural adjustment—which was the focal issue of development policy dialogue in the early 1990s, when the authors' initial studies were conducted (Benson and Clay 1998). Clear evidence of this change in priorities toward poverty reduction emerged in the course of the three country case studies.

At the time of the country investigations in mid-2000, the government of Dominica, a small lower-middle-income country, had not yet prepared a formal poverty strategy. Some aid officials saw the omission as an obstacle to support for disaster mitigation. In the aftermath of Hurricane Lenny in 1999, certain donors wanted to support only components of reconstruction that accorded with their poverty reduction priorities—for example, funding repairs to and hazard-proofing of parts of the vulnerable west coast road in the relatively poorer northern extremities of the island.

In Bangladesh the government published its draft strategy on poverty reduction and development while this study was in progress. Disaster reduction is not incorporated in any systematic way into the new strategy; as in previous medium-term planning exercises, it is treated as a separate sector of public action (Bangladesh 2002).

The draft Malawi PRSP is organized around a framework for sustainable improvement in the livelihoods of the rural poor, and the negative impacts of drought shocks on livelihoods are recognized (Malawi 2001). Before the food crisis in 2002, however, actions for mitigating drought and climatic shocks were not accorded any priority in the proposed strategy.

These cases suggest a potentially unsatisfactory feature of the PRSP process that merits further investigation. Linkages between disasters and poverty receive increasing recognition; indeed, exposure to risk and income shocks, including shocks emanating from natural hazards, is identified as one of the four basic dimensions of poverty in the PRSP handbook (Klugman 2002). Nevertheless, evidence from the three country studies suggests that disaster reduction is not being treated as a significant, integrated, cross-cutting priority within the new development strategies. Ways need to be found to ensure that disaster mitigation and preparedness are mainstreamed within the PRSP framework.

for a presentation of case study findings. This section reviews the available evidence on the economic impact of disasters, in both the short and the longer term, primarily as captured in aggregate measures of GDP performance. Disasters may also have implications for sustainable development more broadly defined, in terms of livelihoods, human development, and poverty reduction, but investigation of such effects was beyond the scope of the study.

Theoretical Perspectives

The study is based on the premise that natural hazards potentially have significant adverse macroeconomic consequences and so require serious consideration by policymakers and decisionmakers. A number of other studies have also recognized the economywide significance of natural hazards and the problems they pose for long-term development (see, for example, Jovel 1989; Anderson 1991; Gilbert and Kreimer 1999; UNDP 1999;

ECLAC and IADB 2000; UNISDR 2002). There has, however, been little wider appreciation outside the field of disaster management of the potentially serious implications of natural hazards.

Some economists, in fact, question the adverse effects of natural hazards and even argue the opposite—that disasters can be a positive shock:

The development costs of war are greater than the destruction associated with natural disasters, for two reasons. First, natural disasters such as floods, hurricanes, and earthquakes tend to destroy housing and transport infrastructure, but have less effect on productive capacity and leave human capital (other than those killed, of course) intact. Second, as organizational and social capital remains intact and natural disasters tend to be of relatively short duration, investment quickly recovers and may even have a positive multiplier effect on the economy as a whole. (Stewart and others 2001: 15–16)

This argument relies heavily on a multicountry empirical analysis (Albala-Bertrand 1993) of the impact of

single disaster events on overall levels of economic growth and other broad macroeconomic indicators. Albala-Bertrand examined the impact of 28 disasters in 26 countries occurring over the period 1960–79. He concluded that there are no such things as economic “national calamities” and that the overall rate of growth of GDP improves after a disaster.

A theoretical explanation for this apparently contradictory finding is provided by Aghion and Howitt’s (1998) endogenous Schumpeterian model of growth through a process of creative destruction. In this model, growth is generated by a random sequence of quality-improving innovations resulting from research activities (Benson 2003a). Replacement capital is likely to embody technical changes that raise factor productivity and thus competitiveness. A disaster would be the random event that results in the adoption of such improved innovations. Thus, each disaster would force an economy upward to a new, scaled-up version of itself.

In reality, the process is not that simple. Postdisaster investment resources, for instance, are not necessarily additional (see chapter 3), and some technological advances may occur at the expense of others that were already scheduled. Moreover, postdisaster reconstruction efforts are not necessarily well planned or carefully orchestrated, and so technological and other improvements may not occur. Financial capital may also move its place of business, or fresh FDI may select other sites, so that the disaster-affected area loses capital assets to less risky locations. And where factor mobility exists, there may be loss of human capital through labor migration.¹⁹

A careful reexamination of Albala-Bertrand’s data set suggests that his findings may not entirely contradict this study’s conclusions on the negative impact of hydro-meteorological disasters. Most of the countries that he found to have achieved higher GDP growth in the two years after a disaster, as compared with the two years before the event, had experienced earthquakes. Ten of the 12 countries with lower postdisaster growth had been affected by other types of hazard (Benson 1994). These contrasting results imply that the net positive effects reported were largely associated with geophysical hazards, the potential impacts of which are somewhat different from those of climate-related events. Large reconstruction programs may be required

in the aftermath of a geophysical disaster, potentially creating a construction boom that can last several years, while agriculture—which in many developing countries is still a major source of livelihoods—is seldom severely affected by geophysical events. Albala-Bertrand also treated disasters as isolated, one-off events rather than as recurring shocks with potentially cumulative economywide impacts. That is a reasonable assumption for a low-probability event such as an earthquake or tsunami, but in order to conclude that natural disasters are beneficial for long-term development, it would at least be necessary to undertake analysis over a much longer period and to include a careful examination of climatic hazards of relatively frequent occurrence, such as floods in Bangladesh or drought in southern Africa.

Short-Term Impacts

Disasters commonly cause a short-term decline in GDP. For example, Charvériat’s study (2000) of 35 disaster events in Latin America and the Caribbean between 1980 and 1996 found that real growth rates fell in the year of the disaster in 28 of the cases examined and typically rose sharply in the two succeeding years. This and other studies have, however, found wide variations in the level of interannual fluctuations in GDP, reflecting not simply the scale of direct losses but also other variables at work. In-depth analysis of individual country experiences is necessary in order to identify the factors underlying these variations and to understand the nature of their interplay with natural disasters.

In considering individual countries, it is useful to distinguish between three groups:

- Very small countries where hazard impacts may be economywide
- Larger countries where substantial areas are directly affected by individual events
- Larger countries that typically experience individual disasters in a geographically limited area.

Small island economies are particularly vulnerable to natural hazards. The impacts of hazard events typically show up clearly as interannual fluctuations in economic performance, as seen in Dominica, Fiji, and Montserrat. The sensitivity of Dominica’s sectoral

economic performance to hurricanes over the period 1978–98 was tested more formally in the case study, using regression analysis. The analysis confirmed the negative impact that major hurricanes have had on overall short-term economic performance, although it also indicated that the effects of hurricanes have become relatively less severe with the decline of agricultural sector product as a share of GDP. Fiji displays similar evidence of extreme sensitivity to natural disasters, as confirmed by regression analysis of sectoral economic performance from 1971 to 1994 (Benson 1997a).

Montserrat is the extreme case of a hazard-prone microeconomy. After the devastation of Hurricane Hugo in 1989, GDP returned to its predisaster level only in 1994. Then, after the volcanic eruption began in 1995, GDP fell by half over three years. Even these dramatic figures underestimate the true extent of economic downturn: since the onset of the volcanic crisis, the economy has been sustained only by substantial inflows of assistance, which have offset to some extent the massive decline in autonomous private sector economic activity (Clay and others 1999).

In geographically larger countries, the short-term effects of disasters are discernible when severe natural disasters affect extensive areas or the whole country. This was broadly the case in southern Africa in 1991/92. GDP contracted sharply in every country except Botswana and Namibia, whose economies are dominated by mineral exports. The recovery in 1993/94 failed to compensate for the departure from predrought trends before the next shock occurred in 1994/95. These regional findings are confirmed by country-level statistical analysis for Malawi and Zimbabwe.

In Bangladesh there is also a clear relationship between extreme volatility in the economy between 1965 and 1975 and catastrophic natural disasters. The disaster shocks were compounded by conflict and internal disorder during and after the War of Independence in 1971. The amplitude of disaster shocks considerably diminished after initial postconflict reconstruction. Reintegration of the economy was completed in the early 1980s, and subsequent structural transformation of the economy has further reduced vulnerability.

An earlier examination of the Philippines highlights potential difficulties in estimating the short-term effects of disasters in a geographically extensive economy.

The Philippines is one of the most hazard-prone countries in the world, experiencing all major types of natural hazard. Because of its large geographic size, however, individual hazard events (except for droughts) typically affect only a small part of the country, implying that their impact may not be reflected in fluctuations in national economic performance.²⁰ Measurement problems are compounded by the frequent occurrence of tropical cyclones and extreme floods in some parts of the country, which makes it difficult to establish a counterfactual (nondisaster) scenario. Indeed, government accounts of national economic performance refer only to major disasters. Yet annual losses as a consequence of tropical storms alone may be equivalent to as much as a 0.3 percent reduction in GDP growth (Benson 1997b).

Long-Term Impacts

Theories of development place considerable emphasis on the roles of capital and labor growth and productivity (see, for example, Solow 1956; Denison 1967). Capital assets and other resources can be severely damaged by natural disasters, and the productivity of undamaged capital and labor can be reduced by associated disruptions of infrastructure and markets. Except in the case of drought, significant direct capital losses can result. All major types of disaster (including drought) can disrupt longer-term investment plans for both physical and human capital, in several ways. Governments may divert resources away from planned investments to fund relief and rehabilitation. Public reconstruction efforts may also be funded through domestic or external borrowing, increasing future debt-servicing payments. Even if disaster-related external assistance is extended, it may not be entirely additional; instead, because of some combination of limited donor resources and constraints on local counterpart funding, it may in part replace development investment aid flows (see chapter 3). Other damage may be covered by insurance policies, but even this implies opportunity costs related to the payment of premiums (see chapter 5). Some destroyed assets may not be replaced at all. In the longer term, disasters and related risks can also contribute to economic instability and to an atmosphere of uncertainty, deterring potential investors.

Modeling the long-term impact of disasters. Research into the effects of natural disasters on longer-term economic growth and development has focused primarily on the implications of impacts for capital accumulation. For instance, a study by the International Institute for Applied Systems Analysis (IIASA) modeled the potential impact of disasters in three countries (using the World Bank's Revised Minimum Standard Model projection tool) and found that postdisaster financial resource gaps reduce future growth (box 2.3). Currently, projections of future economic performance and the identification of existing and prospective resources to meet growth objectives typically do not take into account the impact of potential disasters.

In a similar vein, Cochrane (1994) explored the important but rarely considered impact of disasters on a

country's indebtedness. A recursive Keynesian growth model was used, with disaster shocks introduced in the form of a reduction in private and public capital and an increase in government expenditure on emergency relief. It was assumed that the increased government deficit would be financed entirely through external borrowing. Cochrane concluded that disasters can lower a country's credit rating; increase interest rates on external borrowing, in turn dampening investment and reducing long-term growth; and increase debt stocks.

The empirical reality of ascertaining precisely how countries have in fact financed relief and rehabilitation is far from straightforward, however. As described in chapter 3, a considerable proportion of postdisaster public reconstruction efforts involves reallocated resources, but these resources are typically only partly

Box 2.3 Funding rehabilitation: the implications for long-term growth

The International Institute for Applied Systems Analysis (IIASA), in conjunction with the World Bank, has developed a planning tool for incorporating future probabilistic losses resulting from natural disasters into macroeconomic forecasting models and quantifying the implications—in particular, for growth objectives—of various options for financing rehabilitation. In essence, this tool is based on a simple model that focuses on the impact of disaster-related capital losses on rates of national economic growth.

To illustrate the use of the planning tool and the nature of the findings that it can generate, the IIASA applied it to three case studies, of Argentina, Honduras, and Nicaragua, under varying assumptions about sourcing of postdisaster funding. The results clearly demonstrate that the ability to finance losses following a catastrophe is crucial to recovery and affects how quickly a country can resume its growth path.

In the case of Argentina, it was assumed that all relief and reconstruction financing would be met out of private consumption and foreign savings and that the country would still achieve its growth projections by making sufficient financial resources available to replace damaged capital stock and fund needed future investment. The model was used to estimate the increased government expenditure and import requirements consequent on a disaster and the implied rise in external debt and decline in private consumption.

The Honduras study considered a situation in which private consumption and foreign savings (external borrowing) are not reliable sources of postdisaster reconstruction and relief funds (in the case of private consumption, because of the high incidence of poverty). The model forecast the impact of a disaster on the Honduran economy, assuming no access to foreign assistance to meet reconstruction needs. Under this scenario, investment resources were diverted into private and government disaster-related consumption, leading to chronic underinvestment. The model indicated that this would lead to stagnation in future expected economic performance.

Nicaragua, like Honduras, currently depends on external funds to sustain infrastructure investment, including postdisaster reconstruction. In this case, the impact of decreased economic growth as a consequence of natural disasters was translated into implications for poverty, using a household-level model to supplement the World Bank's Revised Minimum Standard Model (RMSM). The results indicated that the inability to finance probable losses would stall or defeat poverty reduction measures.

The conclusion from the analysis was that risks emanating from natural hazards should be incorporated into economic projections, for three reasons. First, there are high opportunity costs associated with the diversion of scarce financial resources into postdisaster relief and reconstruction efforts. Second, disasters can wreak havoc on the already complicated budgetary planning process. Third, disasters place high demands on international aid resources, diverting resources away from development uses (MacKellar, Freeman, and Ermolieva 1999; Freeman and others 2002).

reported in official accounts, making it difficult to determine total reallocations or the related opportunity costs. There are further complications in disentangling the roles played by disasters and other factors in determining levels of domestic and external borrowing or of any monetary expansion.

It is also typically difficult to establish exactly how much is ultimately spent, even by the public sector, on postdisaster response. Reconstruction projects are not necessarily labeled as such and may not correspond with the needs identified in postdisaster assessments, as the study of Bangladesh illustrates.

As for the private sector, it is difficult to get much of a handle on total private expenditure on reconstruction, let alone how it is financed. Aggregate consumption, saving, and lending data reveal very little, as demonstrated by case studies of Dominica, Fiji, and the Philippines. Data for some countries with large communities of overseas nationals, such as Bangladesh, do indicate considerable postdisaster increases in remittances, but how much of this is for consumption and how much for investment purposes cannot be determined without detailed investigation. Postdisaster private household investment would, anyway, entail considerable social capital.

These constraints make it extremely difficult to apply models such as those developed by the IIASA and Cochrane to draw out the implications of past rehabilitation funding decisions for long-term growth. Nevertheless, the models do indicate ways of planning financial responses more strategically in the future, through, for example, the incorporation of probable losses into the development planning process. These models could be of significant value in, among other things, determining the appropriate level of external assistance, as part of planning a more rational, coordinated response.

The IIASA model is currently restricted to RMSM-modeled countries. Many very small countries do not have RMSM models, implying that partial analysis, building on the types of statistical method used in this study, would be required. This approach should give reasonable approximate answers because small economies tend to be highly open and to have weak intersectoral linkages.

Empirical evidence. Despite the recent revival of interest in the significance of environmental and other geographic

factors for development, there has been little empirical analysis of the historical evidence on the impact of disasters on long-term growth.²¹ Benson (2003a) attempts to address this issue, examining comparative cross-sectional data on real GDP performance for 115 countries over a 34-year period, 1960–93. The results suggest that countries experiencing a higher incidence of disasters over the period of analysis tended to achieve lower rates of growth than countries experiencing fewer disasters.

There are fundamental problems in undertaking such an analysis. First, countries experiencing a lower incidence of disasters were typically among the more developed countries by the latter half of the 20th century. In other words, the subset of less developed countries includes a disproportionate number of more disaster-prone countries. So, the finding that slower growth and higher incidence of disasters are associated may simply reflect Quah's (1993) broader finding of a polarization toward a bimodal distribution, with countries already at the higher end of the income distribution likely to experience further increases in income. Second, the pace of growth and the level of development of an economy are obviously not determined by the incidence of disasters alone, as is clearly demonstrated by the vast body of evidence on other causes of development, underdevelopment, and economic growth.

Nevertheless, the basic finding, if tentative, of a negative association between disasters and development at a cross-country level is paralleled by qualitative evidence on differential development within individual countries. The poorer regions of a country are often more hazard-prone. Charvériat (2000), for instance, notes that the northeastern part of Brazil and coastal areas of Ecuador and Peru are typically poorer than less hazard-prone parts of the same countries. Kelly and Khan Chowdhury (2002) note a concentration of poverty in more hazard-prone districts in Bangladesh. In part, such patterns reflect differences in opportunities for growth and development, as determined by the relative risks faced by different communities.²² There is scope for further research on the differential influence that various forms of hazard exposure and related risks may have on regional development.

Qualitative evidence. The authors, in this and earlier studies, have adopted a less formal, eclectic approach

that combines various forms of partial statistical analysis with other qualitative evidence. An extended country-specific narrative is constructed that includes an assessment of the effects of a sequence of disasters. Although no attempt has been made to formally model or quantify the longer-term impacts of disasters in any of the three case study countries, there is strong qualitative evidence that disasters have affected the pace and nature of growth in these and in previously researched countries.

In Dominica disasters appear to have had a ratchet effect in determining shifts in the structure of the economy. Agricultural sector product and agriculture's share in GDP fell successively with each major natural disaster shock, in 1979–80, 1989, and 1995.²³

Natural disasters can hamper the pace of investment in basic infrastructure, with implications for long-term growth. As the government of Bangladesh recognized in a memorandum to the Bangladesh Development Forum, “inadequate infrastructure has been a constraint on investment in productive activities as well as on utilization of installed capacity” (Bangladesh 2000: 17). The memorandum notes that electric power interruptions, transport bottlenecks, limitations of port facilities, and so forth are well-known difficulties.²⁴ The fact that expenditure related to natural disasters has largely displaced planned capital investment and normal recurrent expenditure must be part of the problem.

Similarly, in the Philippines efforts to improve the country's transport systems have been only modestly successful, and increasing difficulties have been encountered in meeting the social infrastructural needs of the rising population. An important factor is that a large proportion of the available public resources earmarked for such purposes has had to be redirected in response to calamities (Benson 1997b).

Other case studies provide further glimpses of the longer-term impacts of disasters on various aspects of economic life. An example is the loss of human capital through emigration, as in Dominica after 1979 and Montserrat since 1995–98.²⁵ Furthermore, the poor draw on their financial and material savings to cope with disasters, thus incurring opportunity costs, as is well documented for droughts in Sub-Saharan Africa.²⁶ This behavior, combined with disaster-related losses of productive assets, can contribute to the progressive

impoverishment of poor households and communities—an issue that can be systematically explored only at a micro level.²⁷

Lessons Learned

Various lessons emerge from this study relating to methodological issues in exploring the potential impact of natural hazards. The evidence also provides some insights into opportunities for reducing the economic effects of disasters.

Complementary Approaches to Impact Assessment

A mixture of quantitative and qualitative analysis has been used to examine the macroeconomic impacts of natural hazards. The evidence assembled indicates that major disasters have both short-term and longer-term impacts for economic growth and development. This finding has broad policy implications. But such evidence cannot, by itself, be used directly as a basis for formulating disaster reduction strategies. Quantitative data are needed to facilitate risk analysis of the potential financial and economic returns to specific policy options and measurement of relative opportunity costs in the use of financial resources. At the level of the individual project (whether for preparedness or for hazard-proofing), cost-benefit or investment analysis is required.

Nevertheless, the case study approach sheds light on the factors that determine the nature of vulnerability and the outcomes of specific events. The impact of a particular event is determined by a complex and changing combination of factors. Thus, outcomes of similar events are, as the case studies demonstrate, likely to be significantly different even when separated by only a few years in time, and single-event analysis is likely to be an unsatisfactory basis for policy. Detailed, disaggregated, and careful assessments such as those undertaken in this study can generate considerable understanding of both the forms of vulnerability faced by an economy and the possibilities for mitigation and preparedness. They can also provide information that allows governments and civil society to consider how

they can incorporate risk reduction concerns into national economic strategies and policies and, ultimately, how to contribute to sustainable development.

The detailed case study approach in the current study sheds light on the forms that preemptive action might take by advancing understanding of the complex factors that determine underlying vulnerability so that it can be appropriately reduced. Cost-benefit analysis and investment analysis determine the economic efficiency of individual risk reduction actions. A formal broader economic planning tool, such as that developed by the IASA, provides a means of assessing remaining risk more broadly by quantifying its potential implications for economic growth and the requirements for reconstruction funding. Such findings could act as a wake-up call to governments and the international community to take further preventive action. Models of this kind can facilitate exploration of the implications of different public choices concerning reconstruction financing and financial planning for disasters. Thus, the various approaches are complementary.

But a methodological caveat is in order. The case study countries were selected purposively; they are all disaster-prone. The economywide and sectoral analyses undertaken show that in the short term, these economies are highly sensitive to natural disaster shocks, the impacts of which are visible in national income and trade flows and in physical measures of production such as crop yields. The more formal statistical analysis has quantified the effects of the most extreme events, where the footprint of a disaster is economywide or impacts are diffused through linkage and multiplier effects. For geographically larger countries, regional- or provincial-level, as well as national analysis, may be required, particularly where relatively localized natural disasters are a frequent occurrence. An earlier case study of the Philippines (Benson 1997b) highlighted the problems of isolating the impacts of disasters and differentiating them from annual fluctuations in key economic indicators in situations where the benefits of an entirely disaster-free year cannot be directly measured, even though nationwide disasters are rare. Thus, for large countries such as Brazil, Indonesia, and Nigeria, a more disaggregated regional analysis may be appropriate. Regional analysis, however, does not take into account redistributive impacts across provincial

boundaries and may provide an inflated measure of the national economic cost of a disaster.

Opportunities for Reducing Macroeconomic Consequences of Disasters

The evidence presented in this chapter suggests that natural disasters can and often do have negative impacts on both short-term and long-term growth. But it also demonstrates striking contrasts, not just in changes in levels of vulnerability but also in the changing forms of vulnerability. These developments belie somewhat simplistic notions of a general decline in vulnerability to natural hazards as an economy grows. Instead, a more sophisticated perspective needs to be adopted and applied in undertaking detailed risk assessments from a macroeconomic standpoint.

Using such assessments, risks emanating from natural hazards need to be incorporated into broad development policies and plans. In doing so, a distinction has to be made between potential short-term and longer-term hazard impacts. In addition, the possible trade-offs between the two and the interlinkages of impacts need to be recognized. Sometimes, direct short-term impacts are severe but recovery is rapid, as is illustrated by the case of banana production in Dominica. Or, the immediate impacts may be entirely indirect—for instance involving a reduction in availability of inputs to industry—but recovery may be slow.

Risk management strategies also need to recognize that disasters are not a single, homogeneous form of economic shock. The two broad categories of hazard—climatic and related hydrological hazards, and geophysical hazards—appear to be associated with different patterns of economic vulnerability and so entail different options for reducing risk. These differences partly relate to differences in the probability of occurrence. Climatic hazards occur more frequently, and it is economically worthwhile (and is recognized as such) to adapt productive activities—for instance, agricultural practices—so as to reduce risk. It is also worthwhile to take appropriate structural and related measures pertaining to the design and location of buildings and other infrastructure. By contrast, options for reducing vulnerability to geophysical events are largely restricted to physical structural and locational factors. Given rapid

urbanization in many countries and increasing investment in physical infrastructure, the potential importance of such measures cannot be overemphasized.

In addition, risk management strategies should take into account the challenges and opportunities presented by increasing trends toward globalization. Globalization has expanded the opportunities for risk diversification, and for nations as a whole, it is probably a positive trend from a natural hazards perspective, since it may open up opportunities for smaller enterprises and consumers, as well as larger corporations and governments. But whether globalization ultimately exacerbates or reduces the sensitivity of particular economies and of individual households is a complicated matter that depends on specific country circumstances, including public actions to reduce vulnerability (Benson and Clay 2002b).

Risk management necessarily involves the private sector as well as the public sector. The private sector should be encouraged and supported in enhancing its awareness and understanding of risks posed by natural hazards and in adopting appropriate risk management tools, both structural and nonstructural. As part of this process, it is important to ensure that sufficient investment is made in risk-mapping, monitoring, assessment, and dissemination and that this information is provided in an easily understood and usable form. Both the services industries, including financial institutions, and productive sectors should be included in such initiatives.

Postdisaster reconstruction efforts need to be well planned and carefully orchestrated and should seek to maximize the economic-structural, technological, and other improvements that can be made when rebuilding an economy. Currently, the emphasis often seems to be on restoring the status quo, which is politically and administratively the easiest approach and satisfies pressures for rapid recovery. Even where external

resources are involved, direct replacement of a particular road or power facility, or support for the recovery of existing agricultural and industrial activities, may not require detailed cost-benefit analysis or environmental impact assessments before a project is approved. Preplanning of changes that could be implemented after a disaster to reduce future vulnerability could be useful: the political will for change would already have been marshaled and preinvestment analysis completed, so that the changes could be made without jeopardizing the objective of rapid recovery. This point is discussed in greater detail in chapter 3.

Finally, lessons drawn from particular disasters need to be assessed, and action should be taken as appropriate. Disasters can induce policy changes and institutional innovations that are ultimately beneficial, not only in reducing vulnerability but also in supporting economic growth and development. Food policy reforms in Bangladesh were directed at preventing a recurrence of the 1974 flood-related famine (Clay 1985) and then containing the financial costs of subsequent floods (Ahmed, Chowdhury, and Haggblade 2000). The deregulation of agricultural investment after the floods in 1987 and 1988 encouraged the rapid expansion of disaster-reducing irrigation. The microfinance revolution was in part a response to the 1974 famine (Yunus 1998). These examples take the discussion into the realm of political economy and serve as a reminder that an economy is not a purely technical system that operates through mechanistic responses; there is also conscious learning, with potentially profound long-term consequences. An example of such adaptation is the application of climatic forecasting to reduce the impacts of climatic variability in southern Africa, as is described in chapter 4. Another area in which learning is taking place concerns financial mechanisms for managing risk, which are taken up in chapter 5.

Public Finance and Disasters

Little, if any, systematic examination has been conducted of the public finance consequences of natural disasters and related risk management, except in the narrow context of a single disaster event.²⁸ This chapter seeks to address the gap. It is based in the first instance on findings and issues raised by the Bangladesh case study.

Background

Natural disasters can have important implications for public expenditure. Disasters are likely to result in additional expenditure or the partial reallocation of already committed financial resources (or both), to meet the costs of repair and rehabilitation of public property and to provide support to the victims. These actions may lead to the postponement or abandonment of planned investments, reductions in the provision of public services, and deferment of wage and salary increases and of staff appointments. Implementation of ongoing projects may be delayed, increasing their ultimate cost. Such problems can be exacerbated by additional pressures on administrative capacity in the aftermath of a disaster.

Public revenue may also be affected. Disasters can cause government revenue to fall, since lower levels of economic activity, including possible net declines in imports and exports, imply reduced direct and indirect tax revenue. Although such losses may be partly offset by increased flows of official external assistance, they are unlikely to be entirely compensated for. Publicly owned enterprises may experience disaster-related losses, placing an additional burden on government resources.

In consequence, a government may face increasing budgetary pressures that it will be obliged to meet by

running down foreign exchange reserves, increasing levels of domestic or external borrowing, or expanding the money supply. These financing options, in turn, have potentially significant knock-on effects. The creation of base money is inflationary. Domestic borrowing exerts upward pressure on interest rates and can result in a credit squeeze. Foreign borrowing can lead to an appreciation of the exchange rate, reducing the price of imports and increasing that of exports, and it can place future strains on the economy via higher debt-servicing costs. Natural disasters can trigger an increase in interest rates charged on external debt by raising the risk premiums associated with a country's assets. The option of running down foreign exchange reserves is limited by the size of those reserves and also entails an appreciation in the exchange rate, with possible associated risks of capital flight and a balance of payments crisis (Fischer and Easterly 1990).

Disasters can also impose continuing pressures on public finance to the extent that governments undertake mitigation and preparedness measures. These are costs that governments in less hazard-prone countries do not have to bear.

On the positive side, postdisaster investment may result in high levels of economic activity. Rehabilitation and reconstruction also provide an opportunity for necessary but neglected repairs and for the upgrading of facilities. Needless to say, the specific circumstances in which a major disaster occurs, such as the Bangladesh floods of 1998, will influence the outcome.

The challenge is to respond to disasters and related risk in such a way that economic losses and disruption, including fiscal impacts, are minimized, rapid economic recovery is encouraged, poorer and more vulnerable sectors of society receive priority support in keeping with poverty reduction strategies, and the

attainment of longer-term development objectives is not significantly delayed. This is a tall order.

This chapter examines actual evidence on the public finance consequences of natural disasters. It is based, in the first instance, on findings and issues raised by the Bangladesh case study, but it also draws on evidence from Dominica and Malawi, as well as on previous work by the authors and others. The details of the Bangladesh, Dominica, and Malawi experiences are documented in the case studies and are summarized in the appendixes.

The Broad Fiscal Impact of Disasters

Major disasters can have significant budgetary impacts. Yet when broad fiscal aggregates, such as the central government's recurrent and capital expenditure, its revenue, and the budgetary deficit, are examined, disasters are found to have little discernible impact in many instances. Bangladesh is a case in point: a superficial review of overall budgetary aggregates in the 1980s and 1990s suggests that major disasters, including the most extreme floods in 1987, 1988, and 1998 and the devastating cyclone of 1991, had little impact on central government finances. Total revenue and expenditure increased gradually over the two decades, while the overall budget deficit remained fairly stable until the 1998 flood, when it rose markedly.²⁹ Indeed, an examination of Bangladesh's overall expenditure and revenue forecasts and performance suggests that the public financial impacts of even the 1998 flood were very limited.

In three other countries examined—Dominica, Fiji, and the Philippines—it is similarly difficult to discern much impact of natural disasters on government finances, apart from annual allocations of small tranches of budgetary resources for use in the event of a disaster. In the Philippines, for example, budgetary resources are annually allocated to a Calamity Fund, which totaled 0.4 to 0.7 percent of total annual government expenditure and 0.9 to 1.6 percent of discretionary spending over the period 1991 to 1994 (Benson 1997b). In Fiji budgetary resources to the tune of 2 million Fiji dollars (F\$), or US\$1.4 million at the 1994 rate of exchange, have been earmarked each year for emergency relief activities, with

a further allocation of F\$0.1 million set against the emergency transport of water (Benson 1997a). In Bangladesh the process is less formal, with some disaster-related expenditure apparently met in part by drawing on existing unallocated resources (block allocations) in the revenue budget.³⁰ In countries that experience localized disasters such as storms, landslides, and flooding every year, there is a strong case for such preassignment of funds to meet a substantial share of costs (see “Financing Hazard-Related Costs” in the “Lessons Learned” section, below).

The fiscal impact of more sudden disasters may be obscured by lagged effects. For example, a close examination of the 1988 flood in Bangladesh reveals that some effects of the disaster were delayed.³¹ The impacts of a disaster with lagged effects are not readily captured in a statistical analysis or modeled at a highly aggregated level.

The consistently contrary cases in which fiscal impacts of disasters are readily discernible are drought-affected Sub-Saharan African economies. Five of the six economies compared in Benson and Clay (1998) showed a sharp increase in government borrowing in response to drought. The sixth, Zimbabwe, was studied more closely. Over the period 1980/81 to 1993/94, fluctuations in both total central government and direct tax revenue generally mirrored overall trends in Zimbabwe's economic performance, including drought-related economic downturns. The 1982/83, 1986/87, 1991/92, and 1992/93 droughts all resulted in an increase in the public deficit (whether foreign grants were excluded or included). The droughts of the 1980s also led to higher borrowing and lower debt repayment than had been planned, although the extent of borrowing was apparently constrained by a deliberate government policy of containing the budget deficit.

Malawi experienced near chaos, fiscally, in the period of the two droughts in the early 1990s. In the context of violently fluctuating GDP—which fell and recovered twice, in swings of about 10 percent—public expenditure grew rapidly, rising by 30 percent in real terms between 1992/93 and 1994/95. Revenue, by contrast, declined by 9 percent in 1992/93 and again by 11 percent in 1993/94. The decreases reflected the effects of drought on exports and imports (other than emergency food), accentuated by fiscal laxity in an

election year. The deficit increased by 23 percent over three years. Confounding influences were also at work: the election and the incoming government's efforts to honor its commitments, especially to universal free primary education.

It is unwise to generalize from a small sample. Nevertheless, evidence for low-income African economies suggests that drought has distinct fiscal impacts. Part of the explanation may be that the adverse macroeconomic consequences of droughts can be particularly severe (see chapter 2). Other factors, noted in box 3.1, may also play a role.

Public resources in a very small economy can be overwhelmed by the sheer scale and duration of a disaster, as in the extreme case of the British overseas territory of Montserrat. In 1989 Hurricane Hugo wrecked the economy's infrastructure, necessitating massive external assistance for reconstruction until 1994. Then a volcanic eruption that began in 1995 forced 90 percent of the population to relocate; over 60 percent chose voluntary and officially assisted emigration. The volcanic crisis resulted in a massive budgetary deficit as revenue and increased expenditure contracted sharply, and the government lost its financial autonomy.³²

Disaggregated Reexamination of Public Finances

A fuller understanding of the fiscal effects of disasters requires a careful, more disaggregated examination of individual country experiences. Rather than focusing on budgetary aggregates, budgetary impacts and related government responses should be analyzed in the context of overall budgetary performance, recent government policies and budgetary targets, and the structure of government revenue and expenditure. Indeed, a more detailed examination of the budgetary impact of disasters begins to reveal a somewhat different picture, as has been noted in the case of Bangladesh following the 1988 flood.

One key issue is the reallocation of expenditure. Another is the role of funding sources. In some countries, external assistance finances a significant part of public expenditure, as is discussed in "External Aid," below.

Expenditure

Because of reallocations of budgetary resources, the impacts of disasters may be much greater than first apparent. Country case studies and anecdotal evidence

Box 3.1 Fiscal impacts of drought in Sub-Saharan Africa

The fiscal impacts of disasters are readily discernible in drought-affected Sub-Saharan African economies. The case studies, by identifying some specific factors underlying these impacts, help inform policies on the financing of disasters, both ex ante and ex post. These factors relate both to the nature of the impact of drought—the region's principal type of hazard—and to specific macroeconomic circumstances.

- The macroeconomic impacts of droughts can be particularly severe, directly causing a sharp fall in productive activity. These impacts are exacerbated in economies that are already weak, as are those of many Sub-Saharan African countries. Recovery may be relatively slow, particularly where strong intersectoral linkages exist between agriculture and other sectors. Unlike types of disaster that cause extensive physical damage, droughts do not trigger a potential postdisaster boost to the economy in the form of increased, largely nontradable, postdisaster construction activity.
- Because public resources are severely limited, less money is available for reallocation, and the limited capacity of government agencies may restrict ability to absorb costs. These factors effectively make relief and rehabilitation expenditure more visible by involving additional resources—for instance, in the form of external borrowing or aid.
- Relief and rehabilitation needs associated with droughts are typically very pressing and must be met immediately if further potential losses, including loss of human life, are to be avoided and if rapid recovery on the return of favorable rains is to be possible. This urgency puts severe short-term pressures on budgetary resources and creates a need for additional financing.
- Droughts have a direct impact on the principal source of livelihood for a significant share of the population in Sub-Saharan Africa. In combination with lower per capita incomes, they can force a large proportion of the population into dependency on public relief programs.

suggest that postdisaster reallocation of resources is common. The brunt of these reallocations, at least as they involve financial resources, appears to fall primarily on capital expenditure, which typically is largely discretionary.

In Bangladesh reallocations occur in most years because of consistently overoptimistic revenue projections (Rahman and others 2000) and underestimation of recurrent expenditure. Additional postdisaster-related pressures on resources then force further reallocation, as happened in 1998/99.

In Dominica the apparent insensitivity of budgetary aggregates to disaster shocks also partly reflects postdisaster reallocations to support relief and rehabilitation efforts. Indeed, the practice of reallocating expenditure in this way is apparently an annual occurrence, with unanticipated expenditure on landslide and storm damage crowding out routine maintenance.

In Fiji there has been significant redeployment of resources in the aftermath of major disasters. In early 1993, for instance, Fiji experienced a severe cyclone (Kina), necessitating a government rehabilitation program that was equivalent to almost a third of the annual capital budget and 5.3 percent of total allocated expenditure. Nevertheless, the government remained intent on containing expenditure and accordingly redeployed resources to meet the cyclone-related costs, holding a special meeting to determine reallocations. As a consequence, total annual expenditure was only 0.5 percent higher than budgeted. Recurrent operating expenditure, however, increased by 7.1 percent year-on-year, while capital expenditure fell by 3.4 percent, to around only 75 percent of the original allocation. Some investment projects were suspended, including a number of small rural projects and a rural road program.

Malawi's experience again confirms that fiscal effects are more extreme when disaggregated. The composition of expenditure, in broad sectoral terms and between recurrent and development expenditure categories, became extremely volatile in the early 1990s. There were substantial reallocations of expenditure to agriculture in drought-affected years.

The Zimbabwe government incurred almost 600 million Zimbabwe dollars (Z\$) in additional drought-related expenditure in 1991/92, equivalent to about 2 percent

of GDP and more than 6 percent of total expenditure. Yet real expenditure fell by 4.9 percent year-on-year, as part of broader government efforts to reduce the budget deficit under a structural adjustment agreement. The drought apparently forced a change of emphasis in the public sector investment program, with some planned projects brought forward and new, previously unplanned projects introduced.

With a few exceptions, such reallocations are typically poorly documented and cannot be easily quantified. In the Philippines, for example, circumstantial evidence suggests that postdisaster reallocations are significant, but they often occur within broad budget headings and so are not apparent in published expenditure reports.

There may also be substantial unrecorded reallocations within the recurrent budget. Freeman and others (2003) suggest that such reallocations are likely to be relatively limited because a large part of the recurrent budget (wages, debt servicing, and operational overhead) may be nondiscretionary. But in reality, considerable redeployment in kind (for example, of government staff, vehicles, and equipment and supplies of drugs and other items) may occur. According to the Bangladesh government (Bangladesh 1999a: 5), during the 1998 floods, "the entire civil administration was deployed in relief operations." Such reallocations can be even more difficult to track because funds are often spent under the same line item—salaries, maintenance of road-building equipment, and so on. In some cases, reallocation of recurrent resources is facilitated by the negotiation of temporary moratoriums on debt servicing.

In many countries, a substantial part of development expenditure is funded by external assistance but with a local counterpart funding commitment. If local funds are not available, aid disbursements are delayed, as happened in Bangladesh and Dominica, with consequences for non-disaster-related expenditure.

Disasters also have longer-term impacts that extend beyond the crisis year, again squeezing non-disaster-related expenditure. Some reconstruction projects may not begin for months or even years after an event. Measurement of the longer-term impacts of disasters on patterns of expenditure is again hindered by reporting practices. Disaster-related projects are often not reported as such, as was seen in Bangladesh after the 1998 floods.³³

Attributing expenditure to a particular disaster can be complicated because some infrastructure may have already been in a state of disrepair, as in Dominica immediately before Hurricane David in 1979.³⁴ In some instances, the upgrading of services in the course of reconstruction exacerbates measurement difficulties. Nevertheless, it remains important to ascertain how much disasters cost in order to inform strategies and policies on optimal risk management, including appropriate forms and levels of financial risk transfer.

Revenue

The impact of a disaster on government revenue depends in part on the structure (including the relative importance) of taxation and other forms of government revenue. In Bangladesh a substantial part of government revenue is generated from import earnings, and the revenue base has become more resilient to natural hazards since the early 1980s as a result of changes in the country's principal sources of foreign exchange (see chapter 2). In Dominica the insensitivity of local revenue to natural disasters in part reflects the absence of direct taxation on agricultural production, which is particularly sensitive to natural hazards, and the relative unimportance of export taxes, which since 1979/80 have accounted for less than 1 percent of local revenue. The yield on general consumption taxes will fall markedly only if widespread personal income losses occur—an exceptional outcome observed only in extreme cases such as the 1990s volcanic crisis in Montserrat.

Postdisaster changes in taxation can also affect levels of revenue. To address the economic consequences of natural disasters, a government may offer certain tax reductions as an incentive to economic recovery, or it may increase taxation to meet additional disaster-related expenditure. Some governments choose both courses of action, as happened in Bangladesh following the 1988 and 1998 floods.

The available evidence suggests that when fiscal changes are made, there is often some attempt to achieve greater equity and support those hardest hit. In Fiji an existing tax exemption on farming income was extended for another five years following two cyclones in 1985, partly in recognition of the particular difficulties faced by cane farmers (Benson 1997a). In the aftermath of the

1982/83 drought in Zimbabwe, a temporary 5 percent drought levy was imposed on all individuals except those in the lower tax brackets (Benson 1998). After the 1986/87 drought, Zimbabwe introduced a 2.5 percent surcharge on company taxes for the tax year April 1987 to March 1988 to help finance drought-related expenditure. Other efforts target particular industries, as in Fiji, where, following two hurricanes in 1985, tax payable on reinsurance premiums remitted overseas was waived to assist recovery in the insurance industry.

Decisions on postdisaster fiscal changes are often made rapidly, with little time for analysis. Yet such issues require careful retrospective analysis in order to inform future decisions. It is also important to explore in greater detail the impacts of disasters on different types of tax, with the aim of understanding how the overall sensitivity of the tax structure to disasters and other economic shocks can be reduced and what are the income distributional impacts of tax changes. More in-depth analysis of the effects of disasters on other sources of government income would also be useful.

Finally, it should be borne in mind that disasters may affect the timing of tax payments. Disasters can disrupt the smooth inflow of revenues through the year, perhaps creating increased bunching of inflows and necessitating greater short-term borrowing, as in Bangladesh in 1998.

Policy Context

The budgetary impact of disasters also needs to be understood in the context of prevailing government policies and priorities. Pursuit of various budgetary goals can play a role in obscuring the impact of disasters. As noted above, increased disaster-related expenditure may be offset by cutbacks elsewhere. The declining fiscal deficit in Bangladesh in the flood years 1987/88 and 1988/89, for instance, reflected deliberate efforts to reduce the fiscal deficit following the 1979 oil price shock and the collapse of international jute prices in the early 1980s. In fact, in the prevailing policy environment, which typically emphasizes careful budgetary management (perhaps partly because it may be an aid conditionality), natural disasters are often more likely to force reallocation of monies than substantial increases in expenditure.

Monetary objectives also influence budgetary outcomes. The Bangladesh government deliberately made only modest use of deficit financing in the aftermath of the 1988 flood, with the objective of keeping the expansion of domestic credit and broad money supply within the desired limit. In consequence, spending for the year on the Annual Development Program (effectively, capital and some recurrent expenditure) was almost 20 percent lower than budgeted, despite flood-related expenditure.³⁵ Such policies can delay rehabilitation and curtail other investments, contributing to lower long-term rates of growth (see chapter 2).³⁶

Disasters themselves can trigger changes in policy that affect budgetary outcomes. Temporary adjustments in fiscal or monetary policy are one response, but disasters may also prompt more fundamental changes that have longer-term budgetary implications. Following the 1987 and 1988 floods, for example, the government of Bangladesh embarked on deregulation of private agricultural investment. This shift in policy had a direct impact on production and, because of the government's active involvement in the food economy, on public finances in 1989/90 and beyond.³⁷

Reporting and Accounting Practices

Budgetary reporting practices can obscure the impact of a disaster. The Bangladesh government's method of reporting, which is unusual in several respects, makes it less likely that the public accounts will reveal the full extent of the impact of disasters on public finance. The quasi-fiscal deficit of the central bank is not yet recognized as part of the public deficit, even though the central Bangladesh Bank absorbs effective losses on subsidized credit programs that the financial sector is obliged by the government to offer and even though it counter-guarantees the government's external borrowing.³⁸ Analyzing the performance of the Bangladesh government's separate Food Account is difficult, as budgetary reporting does not cover stock changes.

More generally, it is not easy to obtain information about the impact of disasters on autonomous and semiautonomous government agencies. Information concerning public enterprise finances and transfers to and from such agencies may not be included in government financial statistics or budget estimates—as was the

case in Dominica. In exploring the impact of disasters on public sector enterprises, it is important to consider all such enterprises rather than make assumptions about likely impacts. For instance, the impact of the 1991/92 drought in Malawi and Zimbabwe was not confined to agricultural parastatals but affected utilities and transport parastatals as well.³⁹

External Aid

It is widely believed that the international community responds to disasters by increasing assistance, particularly in the form of emergency relief and food aid. This has given rise to concerns about moral hazard, in the sense that “provision of post-disaster assistance creates disincentives for recipient countries to ensure the physical protection of their assets through disaster prevention and mitigation measures” (Freeman and others 2002: 35). But is disaster-related assistance really additional?

The response by donors to a particular disaster needs to be seen in the context of their normal noncrisis activity. Aid typically provides support for development, including investment and (as case studies confirm) elements of recurrent spending associated with projects. In some policy contexts, bilateral donors and international financial institutions provide broader programmatic and budgetary support. When a subsequent disaster shock puts pressure on the country's public finances and creates foreign exchange difficulties, an appropriate crisis response is low-cost, rapidly disbursing, additional financial aid that is focused on meeting the direct costs of disaster response and counteracting the recessionary effects of the shock. The appropriate balance of aid instruments, including food aid and other relief supplies, depends on the precise nature of the shock and the circumstances of the affected country. Both governance and the sheer scale of the assistance required can influence donor decisions. In some cases, it is not feasible to provide all assistance in the form of financial aid to the government; direct emergency relief through international and nongovernmental organization (NGO) channels may be required (Benson and Clay 1998).

The case studies for Bangladesh, Dominica, and Malawi considered external assistance only in terms of

aggregate commitments and disbursements and the related fiscal and macroeconomic implications. The findings are consistent, despite very different country circumstances. In all three countries, external aid has been the main source of funding for development. In low-income Bangladesh and Malawi, external assistance also supports social safety nets directly through the provision of food aid and indirectly via poverty reduction activities of NGOs. In Malawi aid also finances small farmer inputs. Aside from emergency assistance in 1979/80 following Hurricane David, lower-middle-income Dominica has received development project aid and programmatic support in response to export earnings shortfalls and in the context of stabilization and adjustment policies.

The available data suggest that disasters have little impact on trends in aid flows in these countries. Many donors appear to respond to disaster crises by reallocating resources and bringing forward commitments under existing multiyear country programs and budget envelopes. Reflecting these practices, total aid commitments do typically increase in the year of, or immediately following, a major disaster. Reallocations can be an appropriate way of responding, in the sense that they involve a lesser administrative burden than the negotiation of fresh aid commitments. By the same token, however, development spending, which is largely aid supported, tends to fall as aid and counterpart local funds are shifted to emergency assistance. The reallocated resources are typically not made good subsequently; instead, aid commitments fall back after the crisis, with total aid receipts in line with longer-term trends.

After a disaster, a substantial gap often opens up between projected and actual aid disbursements, reflecting management constraints such as procedural difficulties, procurement delays, and lack of local counterpart finance. (These same problems can also delay disbursement of development aid.) But rapid disbursement of food aid commitments, in particular, may be vital; even relatively short delays can prejudice postdisaster agricultural recovery and cause food system-related financial pressures, as in Bangladesh in 1989 and Malawi in 1993.

Aid flows are also strongly influenced by other considerations, such as changing donor views on governance

and wider policy priorities. The requirement to demonstrate acceptable internal rates of return resulted in underinvestment in storm-proofing of port facilities in Dominica; the potential cost of storm damage had not been adequately factored into the calculations (see note 34). More recently in Dominica, some donors' preference for investing in poorer areas increased the difficulty of obtaining coordinated funding for protecting economically key sectors of the island's coastal road network.

Some of these policy decisions were unfortunately timed. At the time of the 1992 drought in southern Africa, bilateral development aid to Malawi had been frozen because of human rights abuses, and this exacerbated the financial effects of the drought. After a considerable surge in pre-Independence colonial aid to Dominica in 1978, the newly independent country was beset with governance problems and poor financial management. Most donors and international agencies had not established effective working relations with Dominica when its most extreme 20th century disaster, Hurricane David, struck in 1979. In 1974 the United States halted food aid to flood-affected, famine-stricken Bangladesh because of a breach of the U.S. trade embargo on Cuba.

These are not just old issues. Donor-related difficulties over governance and poor financial management delayed the commitment of emergency assistance to Malawi in the lead-up to the 2002 food crisis. The first famine deaths in Malawi since 1941 were reported in 2002 (Devereux 2002; IDC 2003). Low-income countries are at their most vulnerable, financially and economically, to a disaster shock when there are problems of governance and poor fiscal and monetary management. The international community needs to be especially alert to a potential disaster in such circumstances.

Is Reallocation an Appropriate Solution?

As described above, disasters can trigger considerable reallocation of budgetary resources. Such reallocations help limit overall levels of expenditure and, thus, any widening of fiscal deficits. On one level, such actions would appear beneficial, minimizing some of the potential adverse, longer-term impacts of disasters such as increases in public sector borrowing and monetary

expansion, and perhaps satisfying aid conditionalities regarding the size of budget deficits. To some extent, reallocations may also be a natural choice. Some planned expenditure cannot go ahead because of the damage and disruption created by a disaster, effectively releasing resources for reallocation.

Ideally, the reallocation of funds after a disaster should occur through a formal process, in the context of a careful strategic review, rather than on an ad hoc basis or via across-the-board restrictions on flows of funds to spending agencies. This, in turn, requires that procedures be in place preventing the transfer of funds. Donors, for their part, respond to disasters by reallocating funds as a rapid, practical expedient, working within an overall country aid program. This is rationalized as drawing on commitments to projects that are not performing well. But the point about the need for a formal and, in this case, joint review process holds here too.

A number of further conditions then need to be satisfied to ensure that reallocations are rational and cost-effective. These are discussed below, with illustrative evidence from Bangladesh.

1. *A clearly defined and applied policy framework.* Ideally, reallocations should be carefully planned to minimize disruption to and delays in the attainment of key policies and goals. A clear understanding of the implications of particular decisions for the achievement of longer-term goals and objectives is essential. That, in turn, requires well-functioning planning and control instruments linked to carefully defined, achievable objectives and outcomes, as well as a system for prioritizing individual projects (see point 2). In reality, however, planning processes are often weak, particularly where government capacity is limited, hindering rapid, appropriate decisionmaking in the immediate postdisaster context.⁴⁰

2. *A system of prioritization of individual investment projects.* The development budget, including most public capital investment, often bears the brunt of postdisaster reallocation of resources. Ideally, any reallocations should entail the movement of resources away from lower-priority projects. For such a process to be implemented rapidly and effectively, projects already need to have been ranked according to priority.

In Bangladesh certain “core” projects are indeed given priority under the Annual Development Plan (ADP).

This practice informally goes back at least to the mid-1970s, and a formal core investment program was introduced in 1983. In practice, the system does not appear to function particularly well. Following the 1987 and 1988 floods, available funds were basically spread more thinly across existing projects instead of allocations to individual projects being adjusted according to priority. After the 1998 floods, funding allocations to particular projects were adjusted according to priority, but they were determined not on a long-term strategic basis but depending on the projects’ stage of implementation (that is, whether they had been approved) and whether they received external aid.

Such problems may well be generic, a recurrent feature of budgeting practice. Writing about responses to shortfalls in budgetary resources more generally, Foster and Fozzard (2000: 18) comment on a tendency for across-the-board cuts to be made “on the grounds that this is ‘fairer’ to the various spending agencies and easier to apply.”⁴¹

There is some evidence suggesting that social sectors may come off particularly badly in postdisaster reallocations. For example, the available data on budgeted, revised, and actual allocations for the flood year 1998 in Bangladesh suggest that social sectors, particularly health, population, and family welfare, fared poorly. This pattern seems to run counter to the stated objectives and pro-poor policies of many governments.

3. *Up-to-date, reliable information on the current availability of resources.* Good accounting and monitoring systems are needed to provide timely information on the financial status of line agencies and the availability of resources, including external assistance, in the aftermath of a disaster. Immediate analysis is also required of the likely impact of disasters on future flows of public revenue, again including pledges and flows of external assistance, both on a monthly basis and for the remainder of the budget year. In reality, many countries may have problems satisfying this condition. In the three case study countries, information on actual revenue and expenditure becomes available only after considerable delay.

In fact, Foster and Fozzard (2000: 17) find that virtually all developing countries operate a cash accounting system in which transactions are registered only after payment has been made. This makes it difficult to obtain a clear picture of outstanding liabilities and payment

arrears at any given time, and thus of the resources available for reallocation after a disaster. Problems can be exacerbated where donors deal directly with line agencies in a country and the ministry of finance is not informed about postdisaster assistance.

4. *Up-to-date and reliable information on the demand for resources.* Information is also needed on the impact of disasters on planned spending and the new expenditure requirements they generate. Timely production of comprehensive and accurate damage assessments is essential, together with proper appraisals and reliable cost estimates of postdisaster rehabilitation and reconstruction projects.

Preliminary damage assessments are often produced relatively rapidly after a disaster. These assessments, however, are commonly problematic. In 1991 the Economic Commission for Latin America and the Caribbean (ECLAC) developed a formal methodology for assessing damage, and the ECLAC is working in conjunction with the ProVention Consortium to promote its wider use (ECLAC and IDNDR 1999).⁴² But many governments, particularly outside the ECLAC region, still do not apply comprehensive guidelines in estimating losses. This lack of guidance can result in nonscientific sampling procedures and incorrect valuation of damage. There are also often gaps and discrepancies in coverage. Damage assessments are typically undertaken by a range of government and other agencies, each with its own concerns, and so some impacts may go unreported. Moreover, as in Bangladesh following the 1998 floods, and in Dominica in 1999 after Hurricane Lenny, there is typically no considered reassessment of losses once a situation has stabilized, and no final loss figure is produced.

A comparison of the 1988 and 1998 floods in Bangladesh highlights the benefits of fuller assessment, as well as the critical need for standardized guidelines for reporting disaster damage. The coverage of impacts was still somewhat arbitrary in the 1998 assessment, but the consequences of the floods were more closely examined, providing a better understanding of the effects of the disaster and creating the opportunity for improved risk management in the future. The Bangladesh authorities also made more information available for external assessment, so that the management of the 1998 crisis was a more transparent process.

5. *Good information on the broader macroeconomic impact of disasters.* Government and other economic decisionmakers face considerable uncertainty in responding to a disaster and planning appropriate, cost-effective interventions. They have to consider not only the kind of direct assistance required but also the resources available to the government and, underlying this, issues such as the most appropriate fiscal and monetary policies. There are inevitably tradeoffs, and the relative benefits and costs of various options have to be considered. For example, should a government expand credit availability to support productive recovery, or tighten monetary growth to stem possible disaster-related inflationary pressures? The answer will depend on prevailing circumstances, which means that accurate, reliable, up-to-date information is needed on many aspects of economic performance (which themselves may be affected by the disaster), as well as on the direct costs of the disaster. In reality, it is difficult to obtain such information, and expectations of economic performance may be revised substantially in the months succeeding a disaster, as in Bangladesh in 1998–99 and Malawi in 2001–02.

To conclude, the conditions under which decisions on postdisaster reallocations of budgetary resources are made are likely to be far from ideal; indeed, disasters can result in budgetary chaos and confusion. Where disaster-related expenditure occurs regularly, resources should be specifically earmarked for postdisaster response as part of the annual budgetary process, and efforts should be made to ensure that appropriate mitigation and preparedness measures are properly funded and undertaken. Failure to do this constitutes poor budgetary planning and management. This discussion of reallocation processes and of the extent to which various preconditions are likely to be satisfied is also further evidence of the need for financial risk transfer instruments that can help meet the cost of larger rehabilitation programs, alleviating some of the pressure on budgetary resources following a disaster.

In fact, the time frame for budget preparation, execution, and finalizing of accounts is typically three years. Preparation starts perhaps a year or more before the budget year, but even this may not be enough. So, there may be insufficient time to analyze and adequately

address the impacts of a disaster, even in the budget for the succeeding year.⁴³

Risk Reduction Activities

In seeking to manage risk, a government needs to explore the precise nature and forms of vulnerability. On the basis of this analysis, it should develop an appropriate, integrated risk strategy that covers various aspects of vulnerability and draws on a range of responses (regulatory, fiscal, investment, and strategic policy). A system of monitoring is also required to explore the vulnerability implications of particular policies and expenditure decisions and modify them as appropriate.

Some elements of a strategy do not require substantial financial resources; others may. Even if the funds required are modest, budgeting is invariably very tight, with many demands competing for limited funds. Accordingly, the implementation of a risk strategy ideally requires a long-term budgetary framework to ensure that longer-term goals are not repeatedly subordinated to shorter-term, perhaps populist, spending decisions.⁴⁴ Fozzard and others (2001) observe that in reality, even countries with a tradition of five-year plans have not been successful in integrating these development plans with the annual budget. There is, however, at least increasing recognition of the need to capture the long-term implications of current spending decisions more generally, making for a more strategic approach that would benefit agendas that generate longer-term benefits, such as the promotion of risk reduction measures.⁴⁵

In the meantime, current evidence suggests that in many countries expenditure on structural mitigation may be lower than is economically justified. In Dominica public expenditure on disaster mitigation and preparedness was relatively low, at least until the 1990s.⁴⁶ An Organization of American States (OAS) study provides examples from a retrospective analysis of infrastructure damaged by disaster, illustrating how small incremental increases in initial investment costs would have avoided far higher postdisaster repair costs.⁴⁷

It is difficult to obtain more precise data on levels of expenditure for disaster mitigation and preparedness measures such as hazard-proofing of infrastructure, construction of physical defenses, scientific monitoring and

forecasting, creation of early-warning systems, preparation of emergency plans, and stockpiling of food, drugs, and relief supplies. Funding for such activities is often contained within overall budgetary allocations to individual departments. These departments are given only loose directives about their preparedness and mitigation responsibilities, and relevant measures and actions are not necessarily clearly labeled. Thus, it is nearly impossible to ascertain with any accuracy the total amounts spent on mitigation and preparedness. This lack of data has further policy implications because it is more difficult to present a possible case for maintaining or increasing expenditure if the current level of spending is not known.⁴⁸

The fact that governments and donors typically do not report expenditure on mitigation and preparedness suggests that such spending has low political priority. Measurement can be a problem, particularly where a risk reduction measure is included as a small component of a project rather than entailing dedicated projects that are clearly identifiable as mitigation or preparedness. Examples are cyclone-proofing or earthquake-proofing buildings as part of a school building project and drought-proofing a water supply. Other initiatives in areas such as poverty reduction, agricultural extension, and microfinance can also contribute to reducing vulnerability, and this further complicates any attempt at calculating spending. Aggregate expenditure on mitigation and preparedness, even on dedicated projects, is rarely, if ever, reported in annual public accounts.

The nature and level of recurrent expenditure also have implications for vulnerability. Many countries, including the three case study countries, have a dual budgeting system under which recurrent and investment expenditure plans are the responsibilities of different ministries, or of separate departments within the ministry of finance. Mitigation is sometimes perceived as involving major structural investment projects and so is of little concern to those preparing recurrent budgets. Yet levels of recurrent expenditure in particular areas, most obviously operations and maintenance (O&M), have substantial implications for vulnerability. Badly maintained infrastructure can increase vulnerability to natural hazards and postdisaster costs. In Bangladesh the high costs of rehabilitation following the 1987 and 1988 floods and the 1991 cyclone

partly reflected inadequate O&M and poor past investment planning. Inadequate O&M has been a major constraint on the effective functioning of flood control, drought, and irrigation infrastructure as well, despite huge capital investments.

Indeed, it is widely held that expenditure on O&M is too low in most developing countries.⁴⁹ Greater integration of recurrent and capital budgets, as embodied in the medium-term expenditure framework (MTEF; see note 45), would be beneficial in this regard, helping to tie mitigation objectives into the recurrent budget. If risk management concerns were more fully integrated into the project cycle, this could influence both the levels of expenditure on O&M and the design standards for construction of infrastructure. The road network in Dominica, which is vulnerable to coastal storm damage as well as to annual flooding and landslides, exemplifies these issues (see chapter 2).

Long-Term Policy Consequences of Disasters

To what extent do successive disasters thwart the attainment of long-term policy goals? Country case evidence suggests that disasters have had some effect but that it may be difficult to demonstrate clearly. In Bangladesh poverty reduction is widely acknowledged as the country's central development challenge (see, for example, Bangladesh 2002; World Bank 2002). Successive governments have attached high priority and devoted considerable resources to poverty reduction, focusing on economic growth and human resource development as the main ways of achieving this goal. Disasters, however, have played a role in thwarting the attainment of targets and have hindered efforts to develop the country's infrastructure. As demonstrated above, disaster-related expenditure displaces planned investment and normal recurrent expenditure. In Dominica, too, disaster spending has displaced planned investment by creating more urgent needs, although it is difficult to measure the precise impact on the overall level of capital expenditure.⁵⁰ Efforts to improve the efficiency of the Philippines' transport systems are reported to have been only moderately successful because a large part of the available resources has been redirected in response to calamities, with knock-on implications for the pace of improvement of rural transport linkages.⁵¹

Other disaster legacies include increased indebtedness, which has potential long-term development implications, primarily relating to the opportunity cost of future debt-servicing and repayment costs.⁵² Disasters can exacerbate external debt pressures to the extent that they destroy infrastructure and other assets funded with outstanding external loans.⁵³

The financial effects of disasters can have long-term implications for broader economic policy. In Dominica these severe budgetary effects have been a factor in the adoption of major reforms. In the aftermath of Hurricane David, Dominica undertook certain reforms under a program supported by the International Monetary Fund (IMF). A subsequent structural adjustment program (SAP) in 1986/87 sought to address the problem of slow recovery from the 1979–80 disasters and the effects of later storm damage on exports. There was further pressure for adjustment following the 1995 storms.

But on some occasions disasters have been used as an excuse for fiscal problems partly attributable to other causes, thus deflecting pressures for policy change. In Zimbabwe the 1991/92 drought was in part blamed for difficulties which in fact were the result of the government's SAP that had been adopted in the previous year. Such tactics are potentially dangerous, perhaps buying a government and other interested parties time but implying that efforts to address other underlying causes of budgetary difficulties might be postponed. More positively, the existence of Zimbabwe's SAP ensured that an effective macroeconomic monitoring system was already in place, providing early indications of the additional economic difficulties that emerged as a consequence of the drought (Benson 1998).⁵⁴

Lessons Learned

The primary lessons to be drawn from the analysis of the interaction between public finance and disasters concern budgetary analysis and reporting, options for financing hazard-related costs, and governance.

Analyzing and Reporting Budgetary Impacts of Disasters

This chapter has shown that a disaggregated approach to exploring the public finance impacts of disasters, and

better documentation of expenditure on all aspects of risk management and postdisaster response, would aid public decisionmaking.

A superficial review of broad fiscal aggregates is likely to be hugely deceptive, in that it suggests that even severe disasters have very limited budgetary consequences. The initial attempt in this study to explore more closely the budgetary effects of disasters and related decisionmaking implies a somewhat different picture. Disasters were found to have significant narrowly fiscal impacts in the short and longer terms and broader implications for development. They caused widespread—if largely nontransparent—immediate and interannual reallocations of funds by governments and aid donors. Disaster responses can and do crowd out other expenditure.

In all the countries studied so far by the authors, it was impossible to ascertain actual levels of expenditure on either postdisaster responses or mitigation and preparedness. Expenditure is made from a number of budget lines held by various departments and levels of government and is often not explicitly identifiable as disaster related. These limitations of fiscal reporting lead to several specific recommendations.

1. Expenditure on disasters and other related risk reduction activities should be measured more explicitly. Spending on mitigation and preparedness needs to be properly reported. Risk management measures, however, take many forms and cut across virtually all sectors of government. It is not proposed that dedicated funds should be established for such purposes but, rather, that relevant activities and related expenditure be tagged so that total expenditure in this area can be estimated. Spending levels could then be assessed in relation to government risk reduction policies and goals.

2. Improved information on the fiscal impact of disasters is required. This will help ensure the adoption of appropriate mitigation measures in the design of new projects and the implementation of dedicated structural projects, where necessary. More broadly, it will facilitate the integration of risk management concerns into medium- and long-term economic and financial planning.

Careful and detailed review of the fiscal implications of individual disasters would also help identify appropriate postdisaster policy responses. The reasons underlying any failure to reach planned targets would be more transparent—which is ever more pertinent,

given stagnant aid resources and increasingly stringent donor conditionality. Such reviews could provide a useful input into policy on taxation and other forms of revenue generation in a postdisaster situation.

3. As part of efforts to improve information, attempts to finalize disaster loss figures would be helpful. It would also be useful to tag postdisaster relief and reconstruction funding. Currently, postdisaster assessments produced in the turmoil and disruption immediately following an event are rarely revised, and actual relief and rehabilitation activities may not directly correspond with those identified as required immediately after a disaster.

4. Finally, for longer-term consideration, the sensitivity of revenue generation to disasters and the effects that different forms of revenue raising, such as indirect taxes or school fees, have on affected groups in a post-disaster situation are also issues for fiscal policy.

Financing Hazard-Related Costs

Policies on the future funding of postdisaster relief and reconstruction would benefit from better information on the impact and cost of disasters. Many countries lack any explicit policy on financing postdisaster response, beyond making some relatively minor annual budgetary allocations for use in the event of a disaster. Instead, they implicitly rely on postdisaster reallocations to meet a large share of relief and rehabilitation costs, without exploring the long-term developmental implications of the various funding options (reallocation, borrowing, insurance, and so on). In many developing countries, it is assumed that additional external assistance will be forthcoming in the aftermath of a disaster, although the reality is somewhat less straightforward (see “External Aid,” above). Such approaches to the financing of disaster relief and rehabilitation constitute poor planning. Moreover, in many countries, because of the escalating cost of disasters, they may not be sustainable in the long term without causing significant economic damage. Better information on the costs and impacts of disasters is required in order to persuade policymakers to change existing practices. Emerging realization of these facts has at least triggered increased interest in alternative ways of financing disaster costs, as described in chapter 5.

In countries experiencing localized disasters, such as storms, landslides, and flooding, almost every year, there is a strong case for the annual preassignment of funds to meet a substantial share of relief and rehabilitation costs, as well as for mitigatory measures. Annual budgetary allocations help strengthen financial planning and fiscal discipline. But such allocations, by themselves, may not be the most cost-effective strategy. When disasters do not occur, the contingency provisions may well be dissipated in wasteful, last-minute, unplanned supplementary allocations to various expenditure heads. By making budgetary allocations for use in the event of disaster, governments are also raising the general level of budget expenditure or squeezing planned allocations to programs.⁵⁵ Moreover, contingency funds of this nature are unlikely to be adequate in the event of a major disaster, particularly where the same budget line is required for other purposes.⁵⁶

Longer-term disaster contingency reserves that are rolled over from year to year raise different problems. These reserves can be held either domestically or abroad, ideally in highly liquid accounts allowing immediate access to funds. Such accounts, however, offer only a 5 to 6 percent rate of return, compared with the 16 percent rate of return frequently attributed to investment in development projects, an alternative use of resources (Freeman and others 2003). In theory, annual contributions to contingency reserves should be equal to annual expected losses, depending on the risk the fund is designed to cover. But, Freeman and others argue, the time required to accumulate a sufficient fund would be so long that the fund would not effectively protect against large events occurring in the first years of accumulation. In addition, there may be political difficulties in keeping up adequate commitments and protecting accumulated funds if there is a long run of disaster-free years. Instead, hazard-prone countries need to undertake analysis to determine optimal bundles of financing options. They should consider all possible instruments and the funding needs raised by more extreme events and by more frequently occurring lesser events (see box 2.3 and chapter 5). They should also try to determine appropriate forms of mitigation and preparedness and adequate levels of funding for them.

Postdisaster reconstruction should be better planned, incorporating mitigation needs, as well as being consistent with development objectives. An option for governments experiencing frequent, large-scale disasters would be to preplan possible reconstruction and rehabilitation programs on the basis of a series of disaster scenarios and, within those, to identify critical projects that should receive priority in the allocation of funds after a disaster. These exercises should also seek to identify key areas of capital and recurrent expenditure that must be protected in a crisis. Possible policy options, such as specific fiscal changes and monetary measures, could be explored through scenarios to develop guidelines for responding to disasters. The guidelines could be presented in the form of computer simulations.

For improved financial management of disasters, it is also necessary to look at how the frequency of hazards and the magnitude of their consequences may change over time. The main factors likely to affect occurrence are global climatic change and more localized environmental changes. In Bangladesh the costs of urban flood protection, including drainage and continuous protection against erosion, are inevitably rising, but the rethinking of the rural disaster reduction strategy points to the possibility of less costly, more localized solutions in the future. The effects of climatic change, and how these effects will interact with the dynamics of land and water use, also need to be taken into account. In Dominica the decline of agricultural exports makes protection of communications infrastructure, which is essential to the services sector, increasingly important. In Malawi evidence of increased sensitivity to climatic variability resulting from a number of factors, including the wider HIV/AIDS pandemic, will require a rethinking of financing for information systems.

Governance

Donors and civil society organizations draw attention to the critical role of good governance, which includes a transparent and accountable fiscal regime. The countries studied were certainly most vulnerable to natural disasters during periods of conflict and weak governance characterized by extreme uncertainty and insecurity, as in Bangladesh from 1969 to 1975 and Dominica in 1978–80. Governments were ineffective in managing

relief, and public finances were chaotic and plagued by corruption. Dominica's case is relatively straightforward; the country returned to more disciplined fiscal management during the 1980s. In Malawi the government's failure, since the early 1990s and despite democratization, to manage the fiscal and monetary aspects of shocks has contributed to increased sensitivity to disasters. But such a simple, generalized explanation of failure is too facile, and it gives those working to ensure good governance a means of escaping responsibility.

There are other influences on vulnerability, and there are things that can be done within a country and internationally to reduce vulnerability, even if serious

problems of governance persist. In Bangladesh the Ministry of Finance slowly, and not without reverses, established a more stable budgetary envelope and, with the central Bangladesh Bank, achieved more disciplined monetary management in the 1980s and 1990s. The government allowed, and sometimes actively encouraged, the growth of microfinance institutions, with much support from international donors. Such developments eventually contributed to reduced sensitivity to disasters. Nevertheless, political instability continues, and micro-decisionmaking within the government remains severely compromised by short-term rent-seeking behavior (Sobhan 1998).

Information on Natural Hazards and Disaster Reduction

Information on natural hazards plays a key role in the management of disaster risk. This chapter employs the conceptual framework of international public goods to explain sources of weakness in hazard information systems. It considers provisionally, on case study evidence, whether funding of hazard information for developing countries, as an international and national public good, is adequate.

Information and Public Action

The availability of good-quality, trustworthy data is a necessary condition for effective management of natural disaster risk. Evidence from the case study countries provides clear examples of how strengthening of information systems and the application of information in risk management have reduced the economic and human suffering inflicted by extreme events.

The cyclone warning system in Bangladesh is widely recognized as a successful instance of disaster reduction. The meteorological forecasts are able to provide earlier and more precise advice on imminent storms. This information has been translated into warnings, with increasing effectiveness (notably in 1997), allowing precautionary evacuations of at-risk people to shelters and of livestock to protective mounds.

In Dominica reassessment of the coastal protection levels required to minimize damage and economic disruption from wave action during severe hurricanes is reflected in the more limited impacts of recent storms. In 1999 Hurricane Lenny, a Category 4 storm, caused limited damage to infrastructure that had been reinforced or constructed to higher specifications in the 1990s—for example, the sea defenses in the capital, Roseau. By contrast, costly damage, causing extended

disruption, was suffered by port facilities, coastal roads, and other infrastructure that still had little protection against wave action in a severe storm. The risks were understood, but funding constraints had curtailed protective measures.

The case studies also provide evidence that weaknesses in the systems that generate and disseminate information on natural hazards and their likely effects have been a factor in the potential for extreme natural events to become social and economic disasters. The floods in southwest Bangladesh in 2000 and, notably, the 2002 food crisis in Malawi and in the wider southern African area are recent examples.

An organizing framework is required to make sense of these experiences with good and bad practice. This chapter therefore considers the usefulness of the international public goods concept in explaining sources of weakness in hazard information systems. Research into global climatic processes and forecasting of the likely weather on regional and smaller scales are classic examples of public goods. The case studies shed light on the applicability of the public-good framework but also highlight situations in which it breaks down, as when there is rivalry among users of information (for example, between countries that share a river system).

Hazard Information as a Public Good

The generation and dissemination of scientific information on natural hazards would appear to be a classic example of a public good.⁵⁷ If a good's benefits are both nonrival and nonexcludable, the good is a pure public good.

A good's benefits are *nonrival* when one agent's consumption or use of the good does not detract in the slightest from the consumption opportunities of other

users of the same unit of good. *Nonexcludability* requires that no one can be excluded from the use or consumption of a good once it has been provided. Theoretically, “where benefits are non-rival, it is inefficient to exclude anyone who derives a positive benefit, because consumption to more users creates benefits that cost society nothing” (Kanbur, Sandler, and Morrison 1999: 61). But the provision of a good is inherently problematic: institutions can restrict access, and there is an incentive to free-ride, which cannot be prevented. In practice, goods may not exhibit either nonrivalry or nonexcludability in a pure form. Nevertheless, information on environmental hazards and environmental change (i.e., changes in hazard risk) is generally regarded as being a public good.

Meteorological information on tropical storms is close to the theoretical paradigm case of a public good. Such information typically includes climatic risk assessments, which may be the annualized probability of a storm above a specified wind speed or the probable levels and intensities of wave action associated with specific wind speeds. Forecasts are the other typical products—real-time information on the likely spatial range, duration, and intensity of a storm when it is threatened or actually happening. Both types of information have made important contributions to reduction of disaster risk in Bangladesh and Dominica, as shown in the case studies.

A public good may be international, regional, or national, depending on the potential spread of benefits. Some hazard information is country-specific (e.g., assessment of landslide hazard risk in Dominica). An example of a regional public good (RPG) is a tropical storm warning in the Caribbean. The El Niño–Southern Oscillation (ENSO) is a phenomenon with global consequences, and information on it is being explicitly generated and disseminated as an international public good (IPG). Even where programs are country-centered, benefits may spill over to others; for example, seismic monitoring in India registers events that occur in Bangladesh.

Practically, the World Bank (2001) has found it useful in considering IPGs to distinguish between two categories of activities:

- Core activities that aim to produce public goods
- Complementary activities that prepare countries to consume the IPGs that core activities make available while at the same time creating valuable national public goods (NPGs).

Public choice analysis suggests that different IPGs are likely to require different funding arrangements. These arrangements will depend on the extent to which IPGs are pure public goods and on the practicalities of exclusion and country financial capacity (Sandler 2002). Grant funding may be required for the generation of core IPGs, and complementary activities that are largely country-specific are appropriately funded by governments, to the extent that NPGs are involved. NPGs may justify and more easily allow the use of traditional country-based aid instruments, including loan finance (Ferroni and Mody 2002). The level of aid funding for IPGs is difficult to estimate precisely, but it is currently at least 10 percent of official development assistance (ODA), and the share is generally agreed to be increasing.⁵⁸

Nonexcludability is a common source of problems with coordination and financing because of the incentive to free-ride (Ferroni and Mody 2002). All countries benefit from an IPG (in the case of an RPG, all countries in the region benefit), and all should contribute to the costs of provision. But there are problems of valuation, and also differences in ability to pay, as reflected in the experiences of the case study countries.

Climatic Forecasting in Southern Africa

Global climatic processes, especially the forcing mechanisms that underlie variability and climatic change, are the subject of intense investigation. The El Niño–Southern Oscillation phenomenon is widely regarded as a key indicator of global processes, providing a basis for long-lead forecasting (Stockdale and others 1998; Zebiak 1999). This research is widely regarded as generating an international public good. International coordination takes place through the World Meteorological Organization (WMO), and the findings and predictions of a substantial number of forecasting models are regularly and openly reported—for example, by the International Research Institute for Climate Prediction (IRI) at Columbia University, New York.

In southern Africa, the close association between El Niño events and the regional droughts in 1982/83, 1991/92, and 1994/95 provided the impetus for the development of regional long-lead or seasonal forecasting (see figure 2.4). By 1997/98, a formal process

for consensus-based long-lead forecasting had emerged, managed through the Southern African Regional Climate Outlook Forum (SARCOF) and involving national meteorological agencies from all the Southern African Development Community (SADC) countries (Thomson, Jenden, and Clay 1998). The process was funded, to begin with, as part of a wider global initiative to strengthen regional climatic forecasting. SARCOF forecasts rely heavily on forecasts from global models that also strongly reflect the behavior of ENSO. Additional detail takes account of regional topography. During the 1997/98 El Niño, conditions in the closer southern Indian Ocean were locally influential, resulting in higher-than-anticipated rainfall in some countries, especially Malawi and much of Mozambique. Much less well understood oceanic-atmospheric interactions in the Indian and South Atlantic Oceans are now recognized as important influences on rainfall patterns and have become the focus of internationally supported research (Spencer, Slingo, and Davey forthcoming).

The precision of SARCOF forecasts is still very limited; broad probability bands are assigned to zones that encompass parts or the whole of several countries. The forecasts are difficult to downscale and are imprecise as to the risks of erratic rainfall patterns that are critical to crop performance.⁵⁹ But the greater attention now paid to forecasting and weather monitoring throughout the season ensures that scientific data on a 10-daily basis are more rapidly available to inform assessment and decisions. Global climatic developments are also closely watched, and assessments are quickly disseminated through the Internet. A real problem is that decisionmakers would like very clear predictions (“This climatic event will lead to this pattern of weather in the coming months”), particularly when food security depends on good crop-growing conditions. The reality is that because of the complexity of weather patterns and impacts, forecasts often have to reflect a lack of certainty. For example, in 2002, as a food crisis affected six southern African countries, forecasters indicated the high probability of a moderate El Niño event and then confirmed its occurrence. However, there was great uncertainty about what this might mean for the 2002/03 wet season and whether it would continue. In effect, the models are saying that decisions about an already difficult food security situation have

to be taken in circumstances of more than usual uncertainty about rainfall.

The international effort to understand and predict global climatic processes is a pure public good. The generation of this public good has been extended through international support to regional forecasting as an RPG in southern Africa and elsewhere in Sub-Saharan Africa. Because of the wider consequences of food security crises in the region, the international community finds itself with a contingent responsibility to respond, and regional forecasting in Sub-Saharan Africa therefore continues to be a core IPG activity. The effectiveness of these efforts, however, depends on decisionmakers’ capacity to use this information at the country level and below.

Country-specific forecasts can alert international and national agencies and civil society to the need for precautionary measures to safeguard food security and water supplies, and they can reduce the cost of potentially financially destabilizing crisis measures. The study of Malawi has confirmed the value of forecasts at a country level and the need for complementary activities, but it has also highlighted problems (as discussed above) that at present limit the value of forecasts. Currently, only some commercial farmers are able to respond to more specific seasonal forecasts. Smallholders lack the technical options and resources to modify significantly their choice of crop, seed variety, or traditional planting practices. These differences in capacity to exploit information have implications for income distribution and poverty. Pressures for cost recovery at a national level could result in a focus on product development and dissemination as “club goods” for those with the incentive and ability to pay. The use being made of climatic forecasting is promising, but institutional strengthening, technical capacity building, more systematic application of current scientific knowledge, and investment in data and equipment are needed.

The World Bank, using IDA credits, has invested in the development of climatic forecasting in Malawi, following closely the distinction between core and complementary activities (Clay and others 2003).⁶⁰ This was done within the wider context of supporting the strengthening of the national meteorological agency. The limitation of this approach is that forecasting has a high proportion of recurrent fixed costs, posing a problem of sustainability. In Malawi these costs are well beyond

the level of expenditure funded by the central government. Meanwhile, the possibilities for cost recovery in providing relatively generalized information are severely limited. In such a situation, a cost-benefit calculation is required to indicate whether this IPG and complementary activities at the country level should be continuing priorities for international support.

Although it is difficult to assign a robust value to climatic forecasting for southern Africa, qualitatively its potential usefulness is clear. Efforts to strengthen climatic forecasting and the associated dissemination activities have:

- Provided a process for scientific consensus
- Integrated and strengthened meteorological systems in the region
- Established systems for closer monitoring and reporting of weather throughout the year
- Identified priorities for further research to improve forecasting ability
- Created systems for assessing climatic risk that can feed into decisionmaking processes.

The strengthening of forecasting systems is yielding improved real-time data on rainfall and on weather more generally that can inform decisionmaking after a crisis has begun. So far, however, benefits in the shape of demonstrable improvements in decisionmaking have yet to be reaped.

The financial costs attributable to the whole forecasting effort for southern Africa are around US\$5 million, spread across services and research institutions within and outside the region. There is a large fixed-cost element in sustaining climatological monitoring capacity, and forecasting at the national level is a joint product whose costs are difficult to isolate. These costs, however, are modest compared with the economic costs imposed by climatic variability in the region, which are estimated to be equivalent to at least US\$1 billion a year. Even a small reduction in losses through improvements in public decisions on food system management and in private risk management would justify both past and continued investment in better forecasting.⁶¹

Although long-lead forecasting is still in its infancy, climatic research is making rapid progress. Regional climatic forecasting needs to be sustained as a learning process. Scientists need to understand and then attempt to respond to more specific information requirements,

and public and private users need time and, probably, assistance to understand how climatic information can improve risk management.

Tropical Storms

The case studies of Bangladesh and Dominica offer examples of the uses of forecasting and risk assessment in dealing with risks from hurricanes, cyclones, and other tropical storms.

Bangladesh

Cyclone protection became an intermittent priority for official donors and international NGOs in response to specific extreme events. After the 1970 cyclone in Bangladesh, in which at least 350,000 lives were lost, the Bangladesh Red Crescent managed programs for cyclone shelter construction, with increasing success. Although 140,000 people lost their lives in the May 1991 cyclone, 340,000 were evacuated and were housed in purpose-built shelters and public buildings. In May 1997 a similar cyclone claimed fewer than 200 lives, and 1 million people were evacuated to shelters (IFRC 2002). Since 1991, cyclone shelters have been designed for multipurpose use, mainly as schools (with budgetary implications for O&M). Even so, underprovision of shelters persists. For that reason, and because the buildings are in multiple use, the principle of nonrivalry is compromised. Mitigation investments and humanitarian aid, unless provided at levels that saturate demand (so that they become a free good) are private goods, subject to rivalry and excludability, and this situation raises intense problems of competitive access. Institutional arrangements are required to ensure that the poorest are not excluded (Pantelic and others 2000).⁶²

A critical factor in the success of cyclone protection is the considerable progress that has been made in coastal cyclone warning since the devastating storm of May 1991. Meteorological observation of storms by remote sensing has become, in effect, an internationally funded public good. The complementary cost of using this information is relatively modest, and an institutional vehicle has been found to undertake the task.⁶³ Cyclone

protection has been facilitated by the gradual emergence of large NGOs that provide further institutional support to affected communities, including the poorest, in crisis situations.

Dominica

Tropical storm warnings in the Caribbean region have been progressively strengthened. The region benefits from its proximity to the United States, the lead nation in official support for forecasting as a public good. In addition, commercial media and Internet-based communication have come to provide real-time information on storm risks. But, as the unpredicted course of the destructive Hurricane Lenny demonstrated in 1999, even the most advanced prediction models may be found wanting.

The recurring damage to Dominica's key infrastructure highlights deficiencies in risk assessment that are only slowly being remedied. Following independence in many Caribbean states, wider regional arrangements for scientific research on strengthening disaster management are emerging under the auspices of the OAS, supported with international and bilateral (U.S.) financial and human resources. These projects have contributed to enhancing scientific hazard assessment and monitoring. For example, concerns about sea-level rise in the Caribbean Sea and the absence of reliable benchmarks have highlighted the past lack of sea-level and wave monitoring within the region. Dominica itself has no capacity to undertake such monitoring independently. Consequently, only qualitative assessments of the coastal sea conditions associated with the impact of individual storms, including Hurricane Lenny in 1999, are available. To provide benchmarks for determining the effects of climate change, the OAS has launched a regional program for sea-level monitoring, supported by the Global Environment Facility (GEF).⁶⁴

Failures in the Provision of Information as a Public Good

Examples from Bangladesh, Dominica, and southern Africa highlight how rivalry and exclusiveness undermine the public-good character of forecasting and information provision.

Transnational River Systems

Riverine flood warning in Bangladesh is still primitive and provides very limited advance warning. Bangladesh effectively received only a 24-hour warning, in the form of "rivers at danger level" advice, from its upper riparian neighbor, India, at the time of the 2000 floods in southwestern Bangladesh. On Bangladesh's part, river modeling, which is crucial for risk assessment, began to be seriously undertaken only in 1989, under the Flood Action Plan. Even this work has been restricted by the attempt to model only for Bangladesh, which contains the larger part, but not all, of the Brahmaputra-Gangetic delta system.⁶⁵

This weakness partly reflects very restricted regional cooperation in meteorology and the monitoring of hydrological systems. The long-running dispute over the use of the Farakka Barrage upstream in India to control the flow of the Ganges River illustrates the problems that arise when the assumption of nonrivalry in consumption of information does not hold.

The floods in Mozambique in 1999–2000 highlighted similar problems with hazard warnings between upper and lower riparian countries. There are indeed externalities in water use and control, but the generation and regional dissemination of knowledge on hydro-meteorological systems can help address the problem of significant externalities and provide a basis for cooperation.

Geophysical Hazards

The Bangladesh and Dominica case studies reveal the difficulties in ensuring that an adequate system of monitoring is established and sustained for geophysical hazards. The problem appears to stem from the typically low probabilities of severe or catastrophic events. The issues have to do with awareness of hazard risk and understanding of the appropriate risk management response to hazard assessment.

Bangladesh. All of Bangladesh lies within a high earthquake risk region. Minor tremors are common, and one of the most extreme earthquake events ever recorded—a quake in 1897 that registered 8.8 on the Richter scale (RS)—had its epicenter in the nearby Shillong Plateau in the Indian state of Meghalaya. The 1950 Assam earthquake brought huge sediment loads

into the Brahmaputra River, raising the river bed for a number of years (which probably contributed to the serious floods in the mid-1950s) and creating large areas of new alluvial land in the Meghna estuary.

Assessment of earthquake hazard in Bangladesh has been relatively neglected. This again reflects an institutional failure at a regional level to provide scientific information on a serious natural hazard as a public good.⁶⁶ The historical record implies an average of more than one extreme (RS 7.0+) event every 50 years. But the fragmentation of seismic monitoring systems in 1947 and again in 1971, as political boundaries changed, left Bangladesh with little monitoring capacity—a single seismographic station—and so unable to triangulate the epicenter of tremors. The danger was highlighted in February 2001, when a tremor of RS 4.2 was identified by Indian sources as being centered in northeast Bangladesh.

Because of the low awareness of seismic hazard and of weaknesses in enforcing building regulations, little regard has been given to earthquake-proofing during the rapid urban expansion that has been going on since the late 1980s. Earthquake-proofing has been undertaken, however, in major internationally funded construction projects such as the Jamuna Bridge and the Ashuganj fertilizer factory.

Reinterpretations of the causes of the 1897 Meghalaya earthquake show the challenges in undertaking relatively accurate risk assessment in the region, which may have large buried faults. On the positive side, the recent Gujarat earthquake in western India, which was extensively reported and shown on television in Bangladesh, appears to have transformed attitudes within the government and civil society about earthquake hazard. This has implications for public expenditure on seismic monitoring and risk assessment as public goods.

Incorporating earthquake resistance into design will increase investment costs for public and private construction of key infrastructure and commercial property. (The insurance option for managing risks is discussed in chapter 5.) Decisions on the tradeoffs between costs and variability would be better informed if improved risk assessment were publicly available.

Dominica. Institutional issues have to be addressed in ensuring adequate support for monitoring volcanic

hazards in Dominica. Scientific hazard monitoring and information dissemination have been organized in the Caribbean area at a regional level in ways that reflect colonial history. For seismic-volcanic monitoring, Dominica contributes to and relies on the Seismic Research Unit (SRU), based in Trinidad.⁶⁷ There is a convention of extreme caution in making potentially sensitive information available, at least in those former European colonies that have not had a tradition of open government. The centralized authority in colonial times had a general responsibility—a contingent liability, in insurance terms—in the event of a disaster, and nonexclusion of potential beneficiaries is still seriously qualified by administrative reluctance to make information available.

Dominica is seismically extremely active. The SRU successfully monitored volcanic alerts in the 1970s and 1980s and initiated risk assessment and risk-mapping activities. When, however, a new volcanic alert began in September 1998, the monitoring arrangements were found not to have been properly maintained and also to be inadequate, given that an alert has occurred almost every decade. The monitoring network had to be refurbished as well as enhanced, with additional emergency external support, to provide the appropriate level of seismic monitoring. This suggests that the SRU network was insufficiently funded to enable it to conduct enhanced crisis monitoring.

The way the 1998–99 alert was handled raises the difficult but important issue of how scientific information should be disseminated to the wider public to ensure that both public and private sector institutions make rational decisions about natural hazard risk. Despite previous alerts, a volcanic emergency plan had to be specially prepared. Emergency exercises were carried out, but little precise information was made publicly available on the nature and extent of the risks. There was considerable uncertainty in the private sector and among civil society organizations about the precise nature and level of risk, how the crisis might evolve, and the appropriate responses. The result was a confused range of reactions. For example, some insurance companies temporarily stopped taking on new business in the southern part of the island, a few declined to renew existing annual policies, and others continued to provide coverage. But positively, and presumably as

a result of the experience gained in this crisis and the example of the continuing volcanic eruption in Montserrat, the SRU has begun to make its risk assessments widely and freely available, both on the Internet and through public meetings.

The gap between formal science and the perspectives of most of those making public and private decisions is highlighted by the problem of giving an objective assessment of the risks of a volcanic eruption in ways that can be easily understood (box 4.1). If the experts draw attention to a nonzero risk but an eruption does not occur, or is “unfulfilled,” the general public may misinterpret the warning as a false alarm. Similar

issues arise with respect to all categories of hazard risk because decisionmakers want clear predictions.

Findings and Conclusions

There are several recurring issues relating to the generation and use of information on natural hazards as a public good.

1. The public-good framework is helpful in clarifying issues for further consideration. The distinction between core and complementary activities is especially useful in distinguishing between the generation and the

Box 4.1 Evidence-based volcanology: application of Bayes' rule to the situation in Dominica in 1998

Bayes' rule provides a formula for updating estimations of the relative odds of scenario A and an alternative scenario B, given new evidence about either or both scenarios.

The formula for the new (or posterior) odds is:

$$\frac{\text{Pr (scenario A | evidence)}}{\text{Pr (scenario B | evidence)}} = \frac{\text{Pr (scenario A)}}{\text{Pr (scenario B)}} \cdot \frac{\text{Pr (evidence | scenario A)}}{\text{Pr (evidence | scenario B)}}$$

where Pr (evidence | scenario) is the conditional probability of seeing the evidence given the scenario occurs, and the ratio of the two conditional probabilities in the above expression is referred to as the likelihood ratio of the evidence.

Pr (scenario A) / Pr (scenario B) expresses our prior odds (or belief) and is sometimes referred to as the base rate. (As exemplified in some notorious law cases, ignoring the base rate can lead to fallacious conclusions about the correct weight to attribute to evidence.)

In the case of Dominica, where a local earthquake swarm started in 1998:

- Scenario A might be the hypothesis that there will be an eruption within a short interval (e.g., the next six months).
- Scenario B would be the hypothesis that no eruptive activity will occur in the next six months.

The prior odds ratio,

$$\text{Pr (eruption)} / \text{Pr (no_eruption)}$$

might be estimated from the information that the last eruption in Dominica was about 685 years ago (SRU 2000) and that there have been three eruptions on the island in the past 1,200 years. From the latter information, the current likelihood of an eruption in any six-month period might be estimated as about 1 in 800, on average. (This estimate could be reduced if we had reason to believe that the chance of observing an interval of 685 years or longer is unusual in the distribution of eruption intervals for Dominica.) So, for present purposes, the prior odds of an eruption (in any six months) might be estimated at 1/800, or, in betting terms, about 799 to 1 against.

If a seismic crisis has already begun, we should now use Bayes' rule to estimate

$$\text{new_odds} = \text{prior_odds} * \text{likelihood_ratio}$$

where the second factor is a ratio of likelihoods that can be derived from additional information about volcano-seismic crises and eruptions in Dominica. There have been eight seismic crises in Dominica in the past 50 years (before the present episode) and at least 12 in the past 200 years, none of which resulted in an eruption. So, extrapolating over the past 685 years, there might have been between 40 and 110 such noneruption seismic crises, and perhaps more. If 75 is used as an average estimate, the equivalent “false alarm” probability is about 0.05 in any one six-month period.

(continued)

Box 4.1 Evidence-based volcanology: application of Bayes' rule to the situation in Dominica in 1998 (continued)

Almost all strong eruptions are preceded by some form of seismic activity, which would be detectable by modern instruments, suitably deployed. Assuming that there is no more than a 2 percent chance of *not* detecting precursory seismic activity before the next eruption in Dominica,

$$\Pr(\text{seismic_crisis} \mid \text{eruption}) = 0.98$$

then the likelihood ratio, calculated as

$$\frac{\Pr(\text{seismic_crisis} \mid \text{eruption})}{\Pr(\text{seismic_crisis} \mid \text{no_eruption})}$$

is approximately $0.98/0.05 = 19.6$, and

$$\text{new_odds}(\text{eruption}) = 1/800 * 19.6 \doteq 1/41$$

or, in betting terminology, 40 to 1 against an eruption in the next six months. Even at the much lower noneruption crisis rate implied by the known 12 episodes in 200 years, the new odds would still be about 24 to 1 against an ensuing eruption.

So, even though a notable volcano-seismic crisis has started in Dominica, it is still extremely unlikely, *solely on the basis of the evidence that an earthquake swarm has begun, as considered here*, that there will be an eruption in the next six months. The numbers can be reworked for other forecast periods, and other evidence—such as the duration, intensity, or seismic characteristics of the events involved, or separate independent indicators such as changes in geothermal conditions—might cause us to modify the probability of this particular episode being a unfulfilled alarm.

These low odds for an eruption can be contrasted with a view that is commonly expressed under such circumstances. As noted above, almost all sudden-onset volcanic eruptions we know about have some form of detectable precursory seismic activity, and, making allowance for incomplete knowledge, we might guess that this happens in at least 98 out of 100 eruptions of volcanoes of the type found in Dominica. Thus, the equivalent odds of there being no detectable seismic activity before an eruption are less than 1/50 ($\Pr \sim 2$ percent)—a “statistic” of such low probability that it leads many people to believe, mistakenly, that an eruption must be almost inevitable once an earthquake swarm develops under a volcano. (In evidential matters, this is an example of what is known as the transposed conditional, or the prosecutor's fallacy.)

Source: Derived from Aspinall and others (2002).

dissemination of information or knowledge. Dissemination is often not a pure public good because forecasts or hazard assessments can be provided to restricted groups.

2. Information is most likely to be generated where the hazard is recognized as a global issue. Developed countries are taking the lead in generation of information and promotion of its use, as an international public good. This is most obvious for climatic variability and extreme weather events such as tropical cyclones.

3. Geophysical hazards are a more uncertain area. The funding of basic research, a core activity, seems not to be in question—again, because of the risks posed in developed countries. Hazard risks, however, are region- or even country-specific, and so the provision and dissemination of information is more often a national

public good that is relevant to land use regulation and building standards. Furthermore, unless a disaster has occurred recently, the status of hazard monitoring and the use of information in risk management are likely to be the accidental consequences of history.

4. Public funding of hazard monitoring and dissemination is worthwhile, although precise cost-benefit calculations are difficult. The case studies suggest that there are considerable potential benefits but that they are not smoothly distributed. Costs are relatively modest but are largely recurrent. The combination of patterns of benefits and costs makes for difficulties in sustaining national funding in countries with severe budgetary constraints.

5. The use of information is apparently unsatisfactory in many cases. This has partly to do with the probabilistic

nature of the information generated by scientific research and monitoring (see box 4.1), and it raises a series of questions:

- What forms of information are appropriate to make available to various stakeholder groups?
- How can scientific information be disseminated in an easily understandable form?
- How should scientific information be used, and what are the implications of its use, bearing in mind that it will be probabilistic and thus difficult to take into account?
- What role should scientists play in informing the general public and other stakeholders directly about natural hazard risk and uncertainty?

6. In relation to crisis-affected Malawi and to southern Africa more generally, there is a need to avoid creating excessive expectations. Put simply, “At this time, weather forecasts can prompt governments and international agencies to move to a higher level of preparedness, but cannot effect significant changes in production.”⁶⁸

7. There are encouraging examples of improved practice. The concerns about global climatic change have contributed to ensuring interest in climatic processes and funding of research on them. Progress in using information to reduce the impacts of tropical storms is impressive. There is evidence, too, of institutional learning about the need to ensure wider dissemination of information, such as seismic risk assessments in the Caribbean.

Financing the Cost of Future Disasters

Historically, there has been heavy reliance on aid to meet disaster-related relief and reconstruction costs in the developing world. But today, global aid flows are stagnant, while the annual cost of disasters is increasing. Global climate change could imply a further rise in the incidence and cost of natural disasters. Questions are therefore beginning to be asked about alternative ways of meeting disaster-related costs. This chapter reviews some ideas and options that are being explored, and in some cases applied, relating to risk transfer tools and their potential relevance and scope for application to developing countries.

Risk Transfer Tools

Risk transfer mechanisms shift financial risk from one party to another. The two basic tools for catastrophic risk are insurance and instruments for spreading risk directly to the capital market. An insurance policy provides cash payouts in the aftermath of a disaster in return for the payment of monthly *ex ante* premiums; insurance companies, in turn, redistribute their risk to global reinsurers. Over the past five years, novel instruments, entailing some form of hedging transaction in the capital market, have been developed in response to dramatic increases in the cost of insurance and reinsurance, with an entrepreneurial push from New York investment bankers. *Weather derivatives* involve automatic and immediate payouts (typically available within 72 hours) on the occurrence of a predetermined trigger event, irrespective of the scale or nature of damage. *Catastrophe bonds* provide attractive payments to investors, but if the specified catastrophe occurs, the principal or interest (or both) on the bond is reduced or even canceled. Performance of these new mechanisms is largely uncorrelated with that of other capital market

instruments, thus offering investors a way of diversifying capital market risk.

The potential advantages of risk transfer mechanisms include:

- A reduction in postdisaster pressure on fiscal and external balances
- Increased government control over the financing of disasters, possibly including the immediate and timely availability of funds⁶⁹
- Greater capacity for a government to set its own priorities in the management of relief and rehabilitation
- Increased transparency in the delivery of relief and reconstruction funding
- Promotion of mitigation, by making provision of mechanisms conditional on particular structural measures being in place or by offering discounts where they are.

An increase in public insurance, in whatever form, may also stimulate more extensive and fuller private coverage.

In developed countries, there are well-established markets for insurance against a wide range of hazards, including the major natural hazards of floods, droughts, cyclones, earthquakes, and volcanic eruptions. Newer hedging instruments are also gaining some popularity. Weather derivatives have been written on indices of earthquake intensities, temperature levels, cumulative precipitation over a specified period, and wind speed. Some catastrophe bonds have been issued in the United States and Japan.

In some developing countries, some basic form of insurance is often necessary to secure formal sector loans. In Dominica, for example, such policies are required for obtaining mortgages and must cover all natural hazards, including windstorms and volcanic risk. In many other developing countries, catastrophe

insurance has to be purchased separately and is often not specifically required in order to secure loans. The availability of business interruption insurance and agricultural insurance is also typically severely restricted. Fire and hail insurance for commercial farmers and agribusiness is generally available from the markets, but securing multiperil crop insurance is often difficult except where it is provided under government schemes. Overall, it is estimated that less than 1 percent of the losses from natural disasters is insured in the world's "poorest" countries (Freeman and others 2002: 2).

In the developed world, most insurance is taken out by the private sector. Governments the world over typically retain all risks associated with their investments, including those relating to natural hazards. Whereas governments in richer nations have the resources to absorb risks by adjusting internal funds, their counterparts in many developing countries frequently do not. Instead, these governments often take the view that if a disaster occurs, international assistance will be forthcoming and that financial risk transfer mechanisms are not required. In reality, this may not always be the case, nor does this approach guarantee the best response in terms of speed or of a government's ability to determine the allocation of reconstruction funds. Moreover, aid resources are finite, and natural disasters are placing increasing demands on them. The evidence summarized in chapter 3 suggests that there is little additionality in aid over the medium term, and so disaster assistance largely diverts funds from development.

As a consequence of these factors, there has been a recent growth of interest in exploring ways to support developing countries in gaining greater access to international risk transfer markets. This chapter briefly explores the potential obstacles to greater coverage. It then reviews some solutions that have been pursued to overcome these obstacles and explores the use of risk transfer mechanisms in loss reduction. The discussion draws, in particular, on evidence from the three country studies.

Potential Obstacles

The main obstacles to coverage of disaster risk in developing countries are affordability, demand, determination of parametric insurance triggers that do not

require direct verification of loss, and the structure of the insurance industry. Each is taken up in turn in this section.

Affordability

The current and future affordability of any risk transfer scheme and the related issue of price instability are immediate and obvious potential constraints on greater insurance coverage, particularly in developing countries where opportunity costs are higher. (Because of the lower capital stocks in these countries, insurance premiums compete with the potentially higher returns to investments as a use for resources.)

Catastrophe insurance premiums can be several times higher than the actuarially determined expected losses (Froot 1999). This reflects the high variance associated with expected loss. An insurer needs to have sufficient capital to support the risk underwritten and to be able to meet claims should the most extreme event covered occur.

Because of their high transaction costs, capital market instruments are even more expensive than insurance—perhaps twice as expensive, according to some estimates (Swiss Reinsurance Company 1999). Consequently, these instruments have been primarily purchased by reinsurers to add to their higher-level capacity, increasing their ability to provide coverage against very high losses resulting from extreme events.

The cost of insurance is negotiated annually (unlike the case of most capital market instruments), and so rates fluctuate widely, often reflecting the annual global scale of bills incurred by the industry rather than more localized factors. In 1992, for example, premiums rose three- or fourfold when Hurricane Andrew generated record claims. Volatility in rates is particularly high in some regions, such as the Caribbean, where some 80 to 85 percent of gross property insurance premiums are transferred to reinsurers. Any fluctuations in reinsurance costs, whether caused by local, regional, or global factors, are passed directly on to insurees in the region. Country-specific risk factors seem to come into play only when local risks are perceived to be particularly high—often, after disasters occur in quick succession.

Demand

Uptake of available risk transfer mechanisms offered in a particular market depends on demand—that is, willingness and ability to pay—and demand depends in part on the cost (price) of the instruments. The extent of risk aversion, which is often partly determined by subjective factors, also influences demand. In addition, income levels play a role in determining demand for private insurance, and budgetary constraints affect demand for public insurance.⁷⁰

In developing countries, willingness to pay may be influenced by expected flows of external assistance in response to future disaster events. Some observers see a problem of moral hazard in this regard because the international community accepts a contingent liability in a postdisaster situation. As noted by Freeman and others (2002: 35), “Insurance is only an effective tool to reduce risk if the party concerned is willing to pay for the insurance. In the case of catastrophes and developing countries, this party would be the affected poor countries that currently rely on post-disaster assistance.” Postdisaster assistance is often highly concessional, while catastrophe insurance is expensive. Freeman and others estimate, for instance, that for Honduras, insurance for flood and storm risk for all events occurring less frequently than once in 10 years would cost US\$100 million annually. They conclude that the only reason the government of a poor country might seek to take out insurance would be an anticipated reduction in the availability of timely postdisaster external assistance.

Private sector demand for insurance in developing countries is also apparently low, at least as measured by the volume of insurance actually written. Businesses, as well as private homeowners, may require insurance in order to access financial loans, but the extent to which some form of catastrophe coverage has to be included varies among countries, in part depending on awareness and understanding of levels of hazard risk. Low levels of coverage in part reflect lower per capita incomes and perhaps cultural attitudes as well (World Bank 2002). In addition, willingness to pay in the private sector may to some extent reflect expectations about likely government postdisaster assistance. Government grants may be available to reconstruct homes and businesses, whether in a direct form or indirectly (for instance, through tax breaks, loan deferrals, and write-offs), reducing the

perceived need for private businesses and homeowners to secure their own coverage.

The rapid expansion of microcredit programs has given rise to an important new category of at-risk institutions, with large portfolios of potentially highly vulnerable clients. Considerable refinancing requirements for microcredit were borne by the Bangladesh Bank as lender of last resort after the 1998 floods. That disaster, which threatened to destabilize the country’s highest-profile initiative in poverty reduction, has generated considerable interest in incorporating insurance into microcredit. Some large microcredit providers, such as BRAC and the Grameen Bank, could emerge as significant insurance providers. But, as Brown and Churchill (1999) state, “[F]or mass, covariant risks that occur frequently in the same region, such as floods in Bangladesh, the cost of (reinsurance) coverage will likely be prohibitively high.” These insurance portfolios will require continued acceptance of contingent liability by the Bangladesh Bank and aid donors. Another possibility might be some form of risk-pooling arrangement with microcredit institutions in other parts of the world, effectively spreading risks geographically.

Determination of Parametric Insurance Triggers

Derivatives, or parametric insurance, are intuitively appealing. Payouts can be fast and need not be dependent on the completion of lengthy damage assessment procedures. These instruments do require a careful assessment of the nature of the hazard faced, however, including sufficient high-quality historical data to enable computation of probabilities and thus the rate of premium charged. To be economically sensible, the trigger event must be highly correlated with economic losses, and this requires some understanding of the relationship between types of risk and socioeconomic vulnerability—for example, how a particular hazard would affect the production of specific crops (box 5.1).

Commercial, large-scale agriculture is a well-established insurance user, as confirmed by the three country case studies. The challenge is to find simple instruments with low transaction costs for smallholders that require minimal direct verification. The World Bank has undertaken initial investigations of the scope for providing support to governments to develop such instruments. It has

Box 5.1 Insuring banana growers against disaster: the WINCROP scheme

Windward Islands Crop Insurance (1988) Ltd. (WINCROP) insures growers of export bananas against damage by “windblows” and tropical storms. The scheme, which covers the entire export crop in Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines, is owned by the banana marketing organizations in the four countries. In 1999 there were over 12,900 active growers producing 131,000 metric tons, for an average of about 10 tons per grower.

The WINCROP scheme only provides coverage against a small proportion (20 percent) of losses, but since own labor and delivery often form a large part of the cost of production, payouts are sufficient to enable growers to rehabilitate their plantations quickly. Collection of premiums is simple, and payment is assured, since all growers for export are obliged to market through the organizations, which deduct at source. Verification of losses is also easy, as the scheme only covers one crop against one hazard, with known probability of incidence, intensity, and impact on the crop. Losses are assessed by a 5 percent physical survey of affected growers to obtain the proportion of damaged plants. The benefit is based on 75 percent of average deliveries over the preceding three years and a value per plant of about 25 percent of delivery price. The verification system is not strictly the same as those involving parametric insurance, but it is similar.

The scheme does entail problems of covariant risk because the geographic spread of risks is insufficient. For instance, in 1999, although claims were made against 16 loss events, almost 90 percent of the claims were settled against a single event, Hurricane Lenny, which caused damage to several islands. Furthermore, reserves are not adequate to cover the part of the liability that has not been underwritten. Premium income is, on average, too low because of covariant risk. The premiums reflect the low incomes of the producers and the political difficulty of setting adequate rates. There is partial reinsurance, but it is constrained by costs and, again, by premium income.

WINCROP has been unable to extend coverage to other crops or to other businesses on behalf of banana growers. There are legislative restrictions, and the rates quoted by reinsurers have been discouraging. The scheme’s monocrop focus could ultimately threaten its viability, as declining banana exports and a squeeze on grower profitability create pressures to keep premiums below a level adequate for covering payouts and the operational costs of the scheme, and as the ratio of overhead rises because of falling exports.

also explored the potential for provision of some form of parametric weather insurance to individual farmers and associated traders.

In Bangladesh, however, there are great practical difficulties in defining a trigger event. Flooding in Bangladesh is hugely complex; it cannot be measured simply by the amount of rainfall at particular weather stations or by river flow or depth. Drought insurance, too, poses complex problems. The rapid expansion of irrigation may invalidate the attempt to infer losses from historical data. Bangladesh exhibits considerable agro-hydrological complexity, and even within relatively small areas there are likely to be large numbers of both losers and gainers from interacting weather and hydrological conditions. Furthermore, enormous problems having to do with landholding titles, sharecropping, and extreme fragmentation hamper verification and determination of entitlements to compensation. Some of these problems, in particular relating to the determination of trigger events, exist in many other countries as well.

In Malawi it would be practically too difficult to establish a trigger event for payouts to smallholders. The sensitivity of smallholder agriculture to climatic variability is extreme and may be increasing, and there is considerable variability in rainfall patterns within the country. Maize, the staple crop, is sensitive to low rainfall but also to erratic or excessive rainfall. These relationships require further agro-meteorological research. Liberalization of grain markets has been poorly carried out, and market imperfections pose risks to food security. At present, smallholder food production, much of it for own consumption, is being partially sustained by programs of free targeted inputs. Efforts are also going into strengthening social safety nets. With the ability to pay low, and cost recovery prospects minimal, it would be difficult to distinguish parametric insurance from postdisaster relief. Even the data on agricultural production have been discredited. These are, for the moment, unpromising conditions in which to look for a simple alternative risk-spreading mechanism.

Overall, these experiences suggest that the most promising circumstances are when the hazard is readily measured (i.e., is of a known intensity), insurance is specific to a crop or a livelihood activity, and cost recovery is simple, transparent, and assured. Good governance is a factor that will determine the transparency and credibility of any public scheme with widespread coverage.

Structure of the Insurance Industry

Successful insurance requires both that risk is spread and that insurers are sufficiently capitalized to bear potential claims. The country case studies revealed potential structural constraints, which may well be common to other developing countries as well.

In Dominica and in the wider Caribbean area, there are concerns about the efficiency and underlying strength of the insurance industry, relating to the proliferation of property and casualty insurance players in the region. There is apparently strong competition for property insurance, motivated by the desire to capture reinsurance commission revenues. The widespread competition for direct fees, however, discourages primary domestic insurers from accumulating reserves and, together with tax disincentives on the sector, results in a high-dividend-paying industry, high dependence on foreign reinsurance, and continued fractionalization.

The sharp rise in reinsurance premiums in recent years has led to higher commissions, attracting even more insurers and agents into the Caribbean market. A World Bank report (1998b: 20) states that “the proliferation of small insurers is cause for concern regarding efficiency . . . but even more regarding safety. Are these small companies sufficiently capitalized for the 15% of the risk they retain? Are they sufficiently careful in choosing reinsurers that can be relied upon to pay up their 85% share? Regulation in this sector needs to be substantially strengthened . . .” The report suggests, among other things, that tougher standards, including an ability to cover maximum probable losses consistent with international industry practice, are needed if domestic companies are to improve their safety, particularly given the stochastic nature of catastrophic events. To this end, the Eastern Caribbean Central Bank (ECCB) has reviewed the regulatory framework of the insurance

industry in the Organisation of Eastern Caribbean States (OECS) and has drafted new insurance legislation aimed at providing disincentives to small players and encouraging amalgamation across countries.

Creative Solutions

The preceding list of potential obstacles to increased uptake of risk transfer mechanisms in developing countries, on both the demand and supply sides, contains few surprises. Many of the problems are well recognized, and various ways of overcoming them have been tried. Some of these involve initiatives on the part of particular private sector interests to obtain coverage at more favorable prices. In other cases, governments and international organizations, in particular the World Bank, have sought to promote increased utilization of risk transfer mechanisms and so provide alternative sources of disaster financing (as has been discussed above in relation to weather derivatives).

In the private sector, one of the more common responses to the high cost of insurance premiums has been to establish disaster reserves. In some countries, governments deliberately encourage this development through tax breaks. Some governments also make annual budgetary allocations to some form of calamity fund, which could at least limit budgetary reallocations in the event of a disaster. For countries experiencing localized hazards every year, such practices are highly prudent, helping to strengthen broader financial planning and fiscal discipline.⁷¹

Logically, a related measure is to try to purchase insurance for losses only in excess of a particular level, or for a specific layer of coverage (that is, for losses exceeding \$ x but not for losses over \$ y , where x is less than y). In years of more severe disaster, substantially larger resources may be required, beyond the scope of calamity funds, but by covering restricted levels of loss themselves, businesses or governments can secure some reduction in premiums. Some larger and special-risk categories in the Caribbean, such as power utilities, have been unable to obtain full, affordable insurance in recent years. Some of them have therefore voluntarily devised high self-insurance deductibles, seeking insurance only against higher levels of loss (World Bank 2000).

Risk-spreading within a group is another solution, and one that has been tried or at least explored in various guises. For example, members of the Caribbean Hotel Association have created a risk management firm for their own exclusive use. It is based on a probable maximum loss (PML) profile of members' properties which indicated that risks were sufficiently diversified to allow a regional insurance company to survive a 1.3 percent probability of a major storm. In Dominica, however, the historical record suggests a substantially higher incidence—at least a 4 percent a year probability of a direct hit by a Category 4 hurricane.

Also in the Caribbean area, as described in box 5.1, banana growers' organizations in four countries have pooled risk from storms through the Windward Islands Crop Insurance (WINCROP) scheme, which is extremely important in providing a risk-spreading mechanism for the growers. The success of group or club solutions such as WINCROP suggests a model for micro-credit organizations: the scheme is transparent to members, and the group addresses the problem of moral hazard by obliging all to participate and by exerting peer pressure. But WINCROP is a highly context-specific mechanism that is confined solely to wind damage to bananas, and extension of coverage to a wider range of risks has proved difficult.

There has been debate about the creation of a more general regional risk management tool for the Caribbean area, possibly involving some form of contingent funding. In a recent initiative, the World Bank developed a proposal for the East Caribbean that favors an inter-country insurance-pooling arrangement. The arrangement would aim to utilize reinsurance and risk-financing resources more effectively by reaping economies of scale and improving capacity to accumulate and retain capital reserves. In the earlier years of the pool, its full capitalization would require guarantee financing, a contingent line of credit for quick disbursement from a multilateral institution, or, alternatively, a long-term bond issue in the capital markets.

Other efforts to help promote insurance have involved support to governments to establish some form of mandatory insurance, as in Turkey after the Marmara earthquake.⁷² Several countries are also reported to have expressed an interest in establishing some form of mandatory catastrophe insurance that would involve pools

supplemented by various insurance and capital market instruments.

Promoting Mitigation

Risk transfer mechanisms can be used to help promote risk reduction—that is, to modify the behavior of those insured. As noted in IADB (2001: 11), “insurance is an important part of risk management strategy, and should be promoted not for its own sake, but because it can be a powerful tool to promote risk awareness and enforce risk mitigation measures.”

The issuance of catastrophe insurance policies can be made conditional on the implementation of specific loss reduction measures and on adherence to building and land use zoning codes. Catastrophe coverage may be required before a business or home loan can be obtained, to ensure that the loan can be paid off in the event of damage to or destruction of the business or property. Weather derivatives also indirectly encourage actions to minimize losses. If the trigger event occurs, those covered will receive payouts regardless of levels of loss, and thus it is in their interest to minimize losses.

In reality, the record on the use of insurance in promoting risk reduction is rather disappointing. In Bangladesh, for example, premium reductions are currently not formally offered for measures to reduce risk, although reductions can be negotiated case by case.

In Dominica catastrophe coverage (covering all natural hazards) is mandatory for securing a mortgage. A differential premium structure also exists to some extent, with at least some companies offering discounts for hazard-proofing. More widespread discriminatory pricing practices, in Dominica and the Caribbean area at large, are discouraged by low retention of risk combined with the reinsurance industry's blanket-pricing policy. Large geographic areas are placed in the same PML category, “without regard for the topographical features and structure resistance distinctions propounded by regional and international experts” (World Bank 2000: 57–58). Meanwhile, individual insurance companies are reported as fearing that significant premium discounts for their better-protected risks cannot be balanced by

surcharging poorer risks (OAS 1996). That being so, insurance companies (with one notable exception) typically follow the reinsurance lead—in effect, doing little to promote hazard mitigation in the region.⁷³ More widespread discriminatory premium pricing would require comprehensive hazard-mapping, as well as inspections, to determine the vulnerability of individual properties. Fiji is an apparent exceptional case among developing countries because of its relatively high rate of cyclone insurance coverage in urban areas.⁷⁴

Conclusions

To date, insurance and capital market instruments have played a relatively small role in the transfer of risk in developing countries. Risk transfer mechanisms seem to work best at middle-range risk frequencies (World Bank 2002). High-frequency hazards require annual allocations of funds to meet their anticipated consequences, as well as mitigation and preparedness efforts. At the other extreme, there is probably little demand for insurance against geophysical events that are likely to occur centuries apart. There is certainly merit, however, in exploring the potential scope for the increased use of risk transfer mechanisms for well-defined hazards in the middle-risk range, such as extreme tropical storms, especially in view of the significant pressures that such disasters can place on government, donor, and private resources. Indeed, interest in financial risk transfer mechanisms is growing as appreciation of the potential benefits increases.

A larger challenge that is just beginning to be addressed is how to make insurance and related instruments available to the poor. Insurance is being explored as a means of protecting local-level saving and microcredit schemes, such as those run by NGOs in Bangladesh. Perhaps the starting point for microcredit insurance is coverage against idiosyncratic shocks such as ill health and the death of the borrower. The covariant risk associated with natural hazards makes refinancing of losses difficult to avoid, and continued acceptance of contingent liability by public bodies and aid organizations will be required. This is especially so where a microcredit scheme is already expanding with the support of concessional or grant funds from aid sources. There is also

considerable scope for greater use of risk transfer tools in promoting mitigation.

Some practical obstacles have to be overcome before insurance coverage can be increased substantially. In a number of developing countries, there is a need to reform the structure and the legal and regulatory framework of the insurance industry, including removal of barriers to entry. The cost of insurance has to be both affordable and stable. At the same time, insurers must remain sufficiently capitalized to bear any losses, which will require detailed scientific information on current and future risks. This is certainly a challenge, given the uncertainty about the precise implications of climatic change for the incidence and severity of hazards and the evidence on increasing vulnerability, as in Malawi. And making insurance available to the poor is not simply a matter of affordability; there are administrative and legal problems, too, involving, for example, land titles.

The case of Montserrat, although extreme, serves as a reminder that international insurers can withdraw at short notice should the perceived risks become too great. The insurance sector is a for-profit business, not a provider of a public good. In addition, globalization is changing risks but not necessarily reducing them.⁷⁵

In view of all the obstacles, creative solutions need to be sought and tested. Application of some combination of tools for different layers of loss coverage is a possible way forward. The bundling of various types of hazard under one contract could also reduce premium rates to the extent that better-understood risks such as cyclones are bundled with less well understood ones (e.g., earthquakes). In some situations, as in rural Malawi, more conventional administrative, publicly funded, subsidized livelihood programs and safety nets are still the appropriate way to tackle growing vulnerability and provide basic food and health security.

The success of insurance and risk transfer options assumes a favorable financial environment in which transparency is the norm and there is confidence that contracts will be honored and that continuing arrangements will not be prejudiced by short-term political considerations and rent-seeking behavior. Institutional stability is required so that insurance and other schemes can be expanded and tested in practice. These preconditions raise more general issues of governance.

Developing country governments need to acknowledge explicitly that a decision not to make risk management a priority issue is a policy stance on the handling of risk in society and the economy (Freeman and others 2002). At first glance, it might appear that in the event of a disaster, additional external assistance will be forthcoming. As this study has shown, however, ultimately

disaster-related external assistance may not be additional but instead may displace funding for development. Moreover, the costs of disasters are rising, while aid resources are, at best, stagnant. Governments need to be persuaded to take a medium-term perspective on appropriate risk management, including financial planning for future catastrophes.

Findings of the Study and Implications for Policy and Research

The broad objective of this study has been to increase understanding of the wider economic and financial impacts of natural disasters through the detailed analysis of three countries. Factors that determine the vulnerability of hazard-prone economies have been described, opportunities for improving the management of risk have been noted, and obstacles that inhibit the adoption of such measures have been identified. This final chapter reviews the findings of the study and their policy implications and highlights areas that merit further investigation.

Findings

The findings from the study are broken down into the macroeconomic consequences of natural disasters, their budgetary impacts, the contribution of hazard information generation and dissemination in reducing the effects of disasters, and options for the financial transfer of risk.

Broad Macroeconomic Consequences of Disasters

1. Major natural disasters can and do have severe negative short-run impacts. Disasters, especially when they occur frequently, also appear to have negative longer-term consequences for economic growth, development, and poverty reduction, although these effects are more difficult to isolate and quantify.

2. The two broad categories of hazard—hydro-meteorological and geological—are associated with distinct patterns and forms of economic vulnerability, in part reflecting differences in their frequency of occurrence. The recurrent nature of hydro-meteorological hazards

encourages adaptation in economic and social activity. Historical climatological and hydrological records allow formal assignment of risk to inform investment and production decisions that are then likely to favor less hazardous locations and risk-spreading and to encourage disaster mitigation. Geophysical hazards, by contrast, are mostly low-probability, seemingly random events, and their risks are often almost wholly discounted. Yet these risks need to be recognized in highly exposed countries and regions because their potential costs are rising exponentially with economic development.

3. Within the timescale of this study (20–35 years), environmental change has not had a discernible impact on hazard risk, as measured by the frequency and intensity of extreme events likely to have severe economic consequences. In particular, the widely anticipated effects of global climatic change are not yet apparent in the hazard data.

4. The vulnerability of a country to natural hazards is determined by a complex, dynamic set of influences relating to factors such as economic structure, stage of development, and prevailing economic and policy conditions. Where vulnerability has been reduced, this improvement can be linked to appropriate investments in disaster mitigation and favorable developments in the structure of the economy, in production technologies, and in the wider economic and domestic policy environment. Similarly, negative trends, notably the increasing sensitivity of southern Africa to climatic variability (encompassing not just drought but also erratic rainfall, extremely high rainfall, and related floods), reflect a complex mix of factors.

5. Catastrophic events can induce conscious responses, relating to technical progress, policy changes, and institutional innovations, that may ultimately increase an economy's resilience.

Budgetary Impacts

In view of the lack of existing research data on the fiscal consequences of disasters, these impacts, including effects on public expenditure and revenue, were carefully examined.

1. Natural disasters can create significant budgetary pressures, with potential narrow fiscal impacts in the short term and wider long-term implications for development.

2. The behavior of broad fiscal aggregates such as total recurrent and capital expenditure, revenue, and the budgetary deficit can be misleading because it may suggest that disasters have little discernible impact. (Drought, however, does have severe impacts on the macroeconomic performance of economies largely dominated by agriculture, as is seen in low-income Sub-Saharan Africa.) The apparent general insensitivity to hazards reflects the successful efforts of many countries to remain within already established budgetary envelopes. Disasters often result in widespread, if largely nontransparent, immediate and interannual reallocations of resources.

3. Reallocation is the primary fiscal response to a disaster. The study found that:

- The brunt of financial reallocations appears to fall primarily on capital expenditure and social sectors.
- There may be considerable in-kind reallocation of human and physical resources within recurrent expenditure.
- With a few exceptions, reallocations are typically poorly documented and cannot be easily quantified.
- The conditions under which decisions on post-disaster reallocations of budgetary resources are made are usually far from ideal.

4. In all eight countries studied by the authors (see chapter 1), it has been impossible to ascertain actual levels of expenditure on mitigation and preparedness or on postdisaster response.

5. The available data on external assistance suggest that disasters have little impact on trends in total aid flows. Many donors appear to respond to disaster crises by reallocating resources and advancing commitments within existing multiyear country programs and budget envelopes.

The Contribution of Information to Disaster Reduction

1. The international public good framework is helpful for exploring the issues surrounding the generation of knowledge and the dissemination of information about hazard risks.

2. Knowledge is most likely to be generated, and monitoring to be sustained, where the hazard is recognized as a global issue, as is the case for climatic variability and extreme weather events such as tropical cyclones. The adequacy of information on geophysical hazards is less assured because the risks are regional or even country-specific. This is especially so where no disasters have occurred recently.

3. There are encouraging examples of improvements in the use of hazard information. Concerns about global climatic change have helped ensure interest in climatic processes and funding of research on them. Progress in reducing the impacts of tropical storms is impressive. There has been institutional learning about the need to ensure wider dissemination of information.

4. Nevertheless, the use of scientific information in public and private sector risk assessment is unsatisfactory in many cases. This has partly to do with the probabilistic nature of the information generated by scientific research and monitoring. For example, there is a danger of creating excessive expectations about the precision and potential uses of climatic forecasting, specifically in relation to crisis-affected southern Africa. At this time, weather forecasts can prompt governments to move to a higher level of preparedness but cannot effect significant changes in agricultural production.

Risk Transfer

1. Insurance and capital market instruments have played a very small role to date in the ex ante transfer of catastrophic risk in developing countries, despite increasing interest in these mechanisms.

2. There are potentially significant obstacles to greater coverage in a number of developing countries, in part relating to affordability, attitudes toward risk, and the current structure of the insurance industry.

3. The record on the use of insurance in promoting disaster mitigation appears rather disappointing in many developing countries, with a few notable exceptions.

Policy Implications

The findings from the study have implications for national development and macroeconomic policies, public finance, the generation and use of information, and the financing of disaster costs. A precondition for improvement in all these areas is good governance.

National Development Policy and the Macroeconomy

Natural hazards warrant more serious consideration in the formulation of national economic policies and strategies. Risk assessments should be made from a broad macroeconomic standpoint, exploring areas of both sensitivity and resilience. Assessments should seek to understand the underlying factors determining vulnerability, including the potentially complex and dynamic interlinkages between various influences and the scope for risk reduction. Vulnerability has to be assessed according to the particular type of hazard.

1. Regular assessment of hazard risk is required to ensure that risk management strategies are appropriate. From a macroeconomic perspective, vulnerability can shift quickly, particularly in countries experiencing rapid growth and socioeconomic change, including urbanization.

2. For geographically large countries, where nationwide disasters are rare, regional analysis is potentially more appropriate than country-level analysis for understanding vulnerability and designing relevant policies.

3. Management of natural hazard risk should be integrated into the broad development process, as part of the determination of priorities, policies, and strategies. This requires an assessment of vulnerability from a macroeconomic perspective that distinguishes between potential short- and longer-term impacts and takes into account knock-on or multiplier effects. Special efforts need to be made to minimize any adverse impacts of disasters on priority policy areas, such as poverty reduction (see box 2.2).

4. Risk management necessarily involves the private sector and civil society, as well as the public sector. The private sector should be encouraged and supported in enhancing its understanding of natural hazard risks and adopting appropriate risk management tools. Both structural and nonstructural measures may be required.

As part of this process, there should be adequate investment in risk-mapping, monitoring, assessment, and dissemination, and information should be provided in an easily understood and usable form (see “Knowledge and Information as Public Goods,” below). Services sectors, including financial institutions, as well as productive sectors, should be included in initiatives to promote adequate risk management.

5. Postdisaster reconstruction needs to be better planned and carefully orchestrated to exploit potential organizational, technological, and other improvements that could be made in rebuilding an economy while keeping priority development objectives on track. Governments should consider preplanning possible reconstruction and rehabilitation programs on the basis of disaster scenarios and, within that, identifying critical projects that should receive priority in postdisaster funding. There is a case for exploring economic policy options through disaster scenarios that include the likely effects of fiscal changes and monetary measures in order to develop guidelines for policymakers in responding to disasters (see “Public Finance,” below).

6. National or economywide disaster impacts, including total financial losses, should be reassessed as a matter of course 12 to 18 months after an event. This task might be undertaken as part of an end-of-project report for a recovery loan or in a paper for consideration at an annual consortium or roundtable meeting.

7. Lessons learned from particular disasters need to be understood and, where necessary, acted on. Disasters can induce policy changes and institutional innovations that are ultimately beneficial, not only in reducing vulnerability but also in supporting economic growth and development.

Public Finance

Expansion of the government budget may be appropriate as a disaster response where aggregate demand is likely to be depressed by the impacts of the disaster. This is most obviously so for a drought shock. But the domestic and international sources of funding for additional public expenditure have to be carefully and explicitly considered to avoid crowding out private sector demand, and financially destabilizing and inflationary pressures need to be guarded against. Where a disaster

causes great damage, which might quickly stimulate a reconstruction boom, but disruption of economic activity is limited, a more cautious approach, largely reliant on temporary reallocations, is indicated.

1. A disaggregated approach should be taken in reviewing the public finance implications of disasters.

2. Postdisaster reallocations, disaster relief expenditure, and rehabilitation spending need to be closely monitored and reported. In particular, the consequences for income distribution of such decisions need to be carefully assessed and the implications for pro-poor policies analyzed.

3. Postdisaster reallocation of budgetary resources should be made through a formal process, in the context of a careful strategic review. Four elements are required to ensure that the process is rational and cost-effective: a clearly defined and applied policy framework; an already established system of prioritization for investment projects; up-to-date and reliable information on the current demand for and availability of resources; and a considered assessment of the broader macroeconomic impact of the event.

4. Better documentation of expenditure on all aspects of ex ante risk management is needed, together with data on the postdisaster response and the results of macroeconomic vulnerability assessments. This information will help inform governments and the international community about appropriate spending levels on mitigation and preparedness and areas that might be underfunded (or overfunded). Relevant activities and related expenditure should be tagged.

5. Risk management concerns need to be integrated with the annual budgetary process and appropriately reflected in the allocation of financial resources.

6. Where disaster-related expenditure occurs regularly, the use of predesignated calamity funds should be explored.

7. Greater use of financial risk transfer instruments is required to help meet the cost of larger rehabilitation programs, alleviating some of the pressure on budgetary resources.

8. Because of a combination of limited administrative capacity, the effects of the HIV/AIDS pandemic, and exceptionally severe budgetary constraints, Sub-Saharan African governments may require special support in planning for and dealing with the consequences of

disasters. Low-income countries in general are at their most vulnerable, financially and economically, to disaster shocks when there are problems of governance and poor fiscal and monetary management. The international community needs to be especially alert to potential disaster in such circumstances.

Knowledge and Information as Public Goods

As in all areas of public action, the availability of good-quality, trustworthy data is a necessary condition for effective management of natural disaster risk. The generation of knowledge about hazards and the sustaining of global and regional information systems bearing on risks must be international priorities. The international community should also concern itself with the adequacy of funding and the quality of complementary programs for risk monitoring and dissemination of information in both low-income and extremely hazard-vulnerable middle-income countries. Special attention should be given to the risk exposure of poor people and communities. On the country level, risk information, as a national public good, should be identified as a thematic issue in periodic public expenditure reviews.

1. Natural hazard risks require regular (perhaps five times a year) reappraisal because of the interacting influences of socioeconomic and environmental change on vulnerability.

2. Much more can be done to make better use of scientific information on natural hazards in setting public policy at the country, regional, and international levels. This is illustrated by examples of climatic forecasting, volcanic hazard monitoring, and riverine flood warning.

3. Some recommendations can be made for increasing the usefulness of climatic forecasting:

- Forecasting should be focused on climatic variability more broadly, not just drought. This requires more research, downscaled to zonal levels, and intraseasonal timescales.
- More specific information should be derived from real-time monitoring on the weather situation as it evolves. This would be of value to those user groups that can quickly modify their actions, such as commercial farmers and managers of food security stocks and water resources.

- Greater agronomic-meteorological collaboration would help national and international institutions make more effective use of forecast information in their food security and agricultural support decisions.
 - More rapid reporting of intraseasonal variability would help enable faster responses to an evolving situation.
4. Volcanic hazard assessment has a strongly regional and national focus and so lacks an international institutional framework comparable to that for meteorological issues. International assessment of the adequacy of regional and national monitoring systems is required, along with, perhaps, supervision.
 5. Flood hazard warnings for major regional river systems pose special problems. Such information is not an international public good because of the potential tradeoff between the interests of stakeholders in different parts of the river system. Some recent disasters have highlighted weaknesses in monitoring and hazard warning, especially failure to include both upper and lower riparian levels. International efforts to ensure development of the knowledge base on hazards in major river systems need to be sustained. Special efforts are required to strengthen regional cooperation, as well as cooperation at the national level between central and provincial authorities.
 6. Hazards that are likely to be entirely within a country, especially geophysical hazards, landslides, and flash flooding, require separate attention because national hazard information systems in developing countries are likely to be underfunded.
 7. Governments in geophysical high-risk zones should be encouraged to develop hazard plans that include ex ante risk reduction measures, preparedness, and post-disaster reconstruction scenarios.

Financing Future Disaster Costs

Governments need an appropriate risk management strategy that includes ex ante financial planning for future disasters over an 8–10-year time horizon, beyond the normal medium-term planning period of 3 to 5 years. Disaster-related external assistance for immediate relief or reconstruction cannot be assumed to be additional, and the strategy should seek to extend the

basis of funding. In some situations, more conventional administrative, publicly funded, and subsidized programs to protect livelihoods and provide safety nets are still the appropriate way to tackle extreme and possibly growing vulnerability. This protection is likely to be part of the provision of basic food and health security by government and civil society organizations, with, as appropriate, international support. Some specific suggestions can be made for achieving a wider funding basis for meeting disaster costs.

1. The increased use of risk transfer mechanisms for well-defined hazards, particularly in the middle-risk range, should be promoted. Efforts to design initiatives and instruments that would support greater uptake should be continued.

2. The application of a combination of mechanisms for different layers of loss coverage is likely to be constructive. Options for risk sharing should be considered as one of the potential mechanisms.

3. Strategies for insurance should be used to promote risk reduction more effectively. For example, the issuance of insurance policies for buildings and equipment or for business interruption should be made conditional on the implementation of specific loss reduction measures and on adherence to building and land use zoning codes. Premium discounts could be offered for better-protected risks. Insurance providers and governments (the latter through legislation and promulgation of land-zoning and building codes) have complementary roles to play.

4. Fresh initiatives to make insurance and related instruments available to poor households and communities are needed and should be actively encouraged and appropriately supported by governments and international institutions. It should be recognized that the central bank or donors may have to accept some form of contingency liability. Options for risk-pooling arrangements with other microcredit institutions, perhaps across borders, should be explored.

Good Governance

Many of the policy recommendations in this chapter fit within the broader framework of initiatives to promote good governance. There is clear evidence that weaknesses in governance have contributed to heightened

vulnerability to disasters. Four aspects of good governance are highlighted that would contribute to disaster reduction:

- Efficient and accountable public sector institutions, including strong public expenditure management systems—for example, better reporting of relevant expenditure and postdisaster reallocations, and enhanced capacity to respond effectively and efficiently to disasters while also protecting priority areas of government spending
- “Good” policymaking, which includes taking natural hazard risks into account in policy and strategy formulation and seeking to reduce vulnerability at both microeconomic and macroeconomic levels
- Predictability of policies through long-term commitment to mitigation and preparedness, including investment in and maintenance of structural mitigation measures, sustained expenditure on scientific monitoring and forecasting, and continued commitment to an optimal bundle of mechanisms for transfer of financial risk
- Elimination of corruption (or, more realistically, curtailment of rent-seeking behavior) via, for example, the introduction and enforcement of appropriate land use and building codes.

Directions for Future Research

It was recognized at the outset that this study would be investigating a complex and multifaceted subject and would probably highlight many areas worthy of further, separate examination outside its own scope. The study has, indeed, identified several such areas, as outlined next.

Macroeconomics of Disasters

Three methodological approaches are commonly used to investigate the macroeconomic impacts of natural disasters: narrative case studies, quantitative modeling, and cross-sectional statistical analysis. Given their strengths and limitations, these approaches should be regarded as complementary rather than alternative ways of exploring the complex consequences of natural disasters.

An extremely worthwhile project would be to try to integrate these different approaches into an exemplary investigation for a highly disaster-prone country that would explore the longer-term economic and poverty implications of hazard vulnerability. For such an investigation to be feasible within a realistic budget and time frame, relatively good time-series data on hazards, income distribution, poverty, and the economy would have to be already available. The study would need to be able to draw on substantial intellectual investments in exploring longer-term development and poverty processes at both the microeconomic and macroeconomic levels. If the relative strengths of different computable models for exploring future disaster scenarios are to be compared, these models would also need to be available for use.

The implications of disasters for poverty include not only direct impacts on affected people and communities but also effects transmitted through the impacts of disasters on the wider economy. Further research is needed that combines both micro-socioeconomic and macroeconomic analyses. More specifically, investigations should include:

- Analysis of the regional or provincial impacts of natural hazards in geographically larger countries and how these impacts are felt in the national economy
- Analysis of the medium- to longer-term impacts of geophysical events, extending up to several decades beyond particular events, to explore to what extent and in what ways such shocks may have positive effects and to support efforts to ensure that any potential benefits are maximized
- Examination of the implications of deregulation and globalization for levels and forms of vulnerability, the sectors and socioeconomic groups that require particular support, and potential opportunities that could be exploited for economic gain.

Public Finance

The budgetary impacts of natural disasters are complex and multifaceted, and this study has only begun to scratch the surface. A number of areas are worthy of further investigation. In many cases the findings would help support broader initiatives to promote and sustain good governance and to manage natural disasters

more effectively. The suggested subjects for further research are:

- Real-time studies of a government's response to a disaster, documenting how key decisions are made and how the crisis is handled through the recovery phase and drawing lessons for future occasions. This proposal is similar to the "learning support office" concept developed for humanitarian operations by ALNAP (2002).
- Detailed analysis of the budgetary impacts of disasters in Sub-Saharan Africa to explore why the fiscal impacts of such disasters are more readily discernible there than in other countries, in order to support improved fiscal management of climatic variability.
- Detailed investigation of the impact of disasters on autonomous and semiautonomous agencies. Improved knowledge and understanding of such impacts, which are not apparent in central government budgetary reports, are important for the establishment of financially sustainable public risk management policies.
- Analysis of risk management at provincial and local government levels to explore the balance between the cost of responsibilities and the availability of funds, as well as the implications for regional disparities in the standards and level of provision of services and infrastructure.
- Examination of the relationship between disasters and aid flows, exploring the extent to which post-disaster response entails additional aid resources, the distribution of resources between relief and rehabilitation needs, and the effectiveness and efficiency of financial instruments such as the IMF's compensatory financing facility and the European Commission's (EC's) post-Stabex, Cotonou, supplementary grants, as compared with conventional project-type relief and rehabilitation assistance.

Information and Disaster Reduction

The benefits and costs of knowledge generation for each of the main types of natural hazard deserve fuller investigation. The object is to determine priority information areas for support as international public goods

that advance global poverty reduction goals and developing country priorities. The recommended studies include:

- Review of the adequacy of support for research on and monitoring of natural hazards as a requisite part of every country poverty reduction strategy or plan.
- Review of the patchy performance of recent efforts to strengthen national information systems, especially through external technical cooperation. This review could provide a better basis for international assistance.
- More systematic research into the relationship between climatic variability and economic performance, especially the performance of the rural economy in low-income countries. The research should cover relationships, in southern Africa and probably Sub-Saharan Africa, between crop performance and weather conditions—not only drought, but also erratic rainfall and very high rainfall. Climatic change is expected to bring increased rainfall to some areas, and the consequences are not necessarily unambiguously beneficial. Such investigations are therefore needed to better inform assessments of the consequences of global climatic change on both regional and country levels.

Financing Future Disaster Costs

Insurance and capital market instruments have played a relatively small role to date in the transfer of risk in developing countries. There is merit in continuing to explore the possibilities for their greater use, particularly in view of the significant pressures that such disasters can place on government, donor, and private resources and, ultimately, on sustainable development. Topics for research include:

- The potential scope for increased use of risk transfer mechanisms for well-defined hazards in the middle-risk range, such as extreme tropical storms
- Ways of making insurance and related instruments available to the poor, with attention to the role of microfinance institutions.

Dominica: Natural Disasters and Economic Development in a Small Island State

The study of Dominica focuses on hazard events since Independence in 1978. During this period, the country has experienced major hurricanes, tropical storms, and a landslide. A volcano alert has been in place since 1998.

The Commonwealth of Dominica is a small, lower-middle-income Caribbean island state with an estimated population of 76,000, 30 percent of whom were estimated in 1996 to be living at or below the poverty line. There is a long-established pattern of net out-migration. The island is of volcanic origin and is the most mountainous of the eastern Caribbean islands, with dense vegetation, very high rainfall, and many narrow, deeply incised river valleys and steep ridges. Slopes of 30 degrees or more are found in at least 60 percent of the island. Reflecting this topography, most of the population and infrastructure is concentrated on the coast and is vulnerable to strong winds and high seas. Dominica is a member of various regional organizations created to promote cooperation in trade and economic development. Preferential trading arrangements for bananas with the United Kingdom and the European Union have been a significant factor in the island's development.

Natural Hazards and Disasters since Independence in 1978

Dominica lies well within the Atlantic hurricane belt, and the most common and historically most significant of the natural hazards facing it are tropical storms and hurricanes. Since 1978, the island has suffered the damaging effects of seven hurricanes—three of them Category 4 storms with sustained wind speeds in excess of 210 kilometers per hour—and three tropical storms. The most extreme disaster event since 1978 has been Hurricane David, in 1979. Landslides are common and, like the

Layou River Valley landslide in March–November 1997, can have substantial socioeconomic impacts, as well as the potential for loss of life. Although there has been only one volcanic event in Dominica's recorded history, the island is now in a period of increased seismic activity. The risk of volcanic activity is relatively high, particularly in the south, where 20 percent of the population lives, and there is a related risk of earthquake. Droughts, storm surges, floods, bush fires, and tsunamis have been regarded as lesser hazards, but any of these could assume major proportions if physical conditions or social activity altered levels of vulnerability.

There is much uncertainty about natural hazard risks, which need to be regularly reappraised. For example, Hurricane Lenny caused extensive unexpected damage in 1999 when the storm tracked west to east, 150 miles from the island. No hazard warnings were issued because the “normal” approach is from the east, and at the distance involved, a hurricane would not “normally” affect Dominica.

Environmental Impacts of Natural Hazards and Global Climate Change

The scope of this study does not extend to natural hazards as part of continuing geophysical processes. The analysis does, however, explore some aspects of the environmental impact of natural hazards and the possible effects of environmental and global climate change on vulnerability, because of the economic and financial implications.

Dominica's increasingly important ecotourism sector is closely tied to its image as the “Nature Isle of the Caribbean,” with a wealth of flora and fauna, rich marine biodiversity, an expanse of forest area, and surface evidence of its volcanic origins. This environmental

resource wealth is vulnerable to natural hazards. Hurricane David damaged an estimated 5 million trees, and studies indicate that species populations have taken 20 years to recover from its impact. Hurricanes and tropical storms can also accelerate erosion, damaging beaches and reefs. Human activity—for example, forestry management practices or the excavation of deltaic sites for building materials—may increase the vulnerability of environmental assets to natural hazards. There are also concerns that a rise in global air and sea temperatures in the Caribbean Basin could substantially damage the marine environment and give rise to more frequent and more powerful hurricanes. Environmental change in the short term may be so small as to be barely perceptible, but over a period of several decades, the cumulative effects could be considerable.

Enhanced environmental monitoring is needed to obtain robust baseline data and to measure the precise ecological impacts of natural hazards and climatic change on resources such as forests and fauna and thus provide the impetus for measures to reduce vulnerability. In the meantime, according to expert advice, there are measures that need to be taken—for example, in relation to forestry management—to reduce the vulnerability of important environmental assets to future hurricanes and storms.

Macroeconomy

Dominica has a small, very open economy that is still heavily reliant on a single export crop, bananas, which represented a third of total merchandise export earnings in 1997. Although the agricultural sector's share of GDP fell from 37 percent in 1977–78 to 20 percent in 1997–98, it remains the main productive sector and is the principal source of livelihoods. Despite limited growth in other private sector activity since the mid-1970s, the private sector remains small. Between 1977 and 1998, manufacturing output rose from 3.9 to 8.2 percent of GDP, and there has been promising growth in the offshore financial services industry. Along with tourism, which by the late 1990s accounted for an estimated 35 percent of external earnings, manufacturing and financial services have helped meet the substantial deficit in the visible external trade account.

Economic Performance and Natural Hazards

Analysis of annual fluctuations in Dominica's agricultural, nonagricultural, and total GDP alongside the incidence of major disasters demonstrates the important impact of natural hazards on the island's economic performance since 1978 (see figure 2.1). This influence is confirmed by the results of a more formal regression analysis. The combined impact of Hurricanes David, Frederick, and Allen in 1979 and 1980 was particularly devastating because of the already weak economy, the scale of physical damage and disruption, and the resulting budgetary pressure. Real GDP plummeted by 17 percent in 1979, while agricultural sector output alone fell by 32 percent in that year and by another 2.1 percent in 1980. Hurricane David was a significant factor in forcing the country into a structural adjustment program (SAP) that was aimed at achieving a sustainable rate of economic growth, lower unemployment, better living standards, and strengthened fiscal and balance of payments positions. Relatively high rates of growth between 1986 and 1988, averaging 7 percent per year, reflected the success of the SAP, as well as rapid increases in banana prices and in volumes of exports and high levels of aid flows. But Hurricane Hugo in September 1989 destroyed about 70 percent of banana production, and an unfavorable shift in the exchange rate reduced the value of banana exports. Overall, GDP fell year-on-year by 1.1 percent in 1989, with agricultural GDP alone dropping by 14.6 percent. (Nonagricultural GDP rose by 4.4 percent.) The visible trade deficit increased to the equivalent of 38.5 percent of GDP. During the 1990s, GDP growth averaged 2.4 percent a year, the weaker performance reflecting difficulties in the banana industry and adverse weather conditions. The continued growth of GDP was attributable to compensatory expansion of the manufacturing and service sectors and to the reduced share of agriculture in GDP.

Economic Development Strategies

Among the world's countries, Dominica is one of the most vulnerable to both natural hazards and other external shocks. It is vitally important that risk reduction become an integral part of policies for achieving social and economic stability. This is true, as well, for other

similar small island developing states. Achieving risk reduction remains one of Dominica's biggest challenges.

Since before Independence, Dominica's government has emphasized economic diversification away from banana production within the agricultural sector and into nonagricultural sectors, with the aim of creating a more resilient economic structure. There has also been explicit recognition, notably following Hurricane David, of the vulnerability of the one-crop economy to natural hazards. In practice, however, there is little evidence that this vulnerability has been addressed. Hurricane David, in fact, furthered the shift into banana production: the government did not actively promote diversification through such measures as incentives, and bananas offered a quick, low-cost way to restore agricultural production and export income. Banana production continued to be profitable through the 1980s, and during this period the government did not explore potential opportunities for developing the services sector and diversifying within the manufacturing sector.

The declining profitability of bananas in the 1990s forced a reexamination of the composition of the agricultural sector. Yet there is still no clear-cut growth strategy, and the risks from natural hazards are still not being effectively taken into account in the formulation of economic strategies and policies. The same is true for the Caribbean region in general. This shortcoming needs to be addressed; the evidence from Dominica indicates real scope for reducing the structural vulnerability of the economy provided that the opportunities are grasped. The reduced importance of the agricultural sector in the economy has helped lessen the impact of recent storms, and the burgeoning international financial services sector could play a significant role in reducing vulnerability to hazards. More information and analysis on the economic and financial impacts of natural hazards would be helpful in integrating risk reduction concerns into medium- and long-term economic and financial planning and would thereby contribute to sustainable growth.

Sectoral Impacts

The macroeconomic analysis shows that not all sectors and subsectors of the Dominica economy have been equally vulnerable to natural hazards. The study explored in more detail the effects on the principal productive

and commercial sectors of the economy. Critical factors in reducing economic impacts at the sectoral level include action to build disaster mitigation features into facilities and to spread risk through insurance. The protection of key infrastructure is vital.

Agriculture, Livestock, and Fisheries

Around half the population of Dominica is still directly dependent on agriculture. Damage to agricultural production and markets therefore affects the welfare of the majority of the population immediately and deeply. The dominant crop, bananas, is especially sensitive to damage from winds of 40 miles per hour or more, and even the fringe impacts of less severe storms can cause serious damage. Nevertheless, a number of factors have combined to reinforce the concentration on banana production, to the exclusion of other crops that could significantly reduce the overall sensitivity of Dominica's agricultural sector to natural hazards. Banana production levels can be restored quickly, with replanting, within 6 to 9 months following a complete loss of the crop; a compulsory insurance scheme for banana producers has returned farmers only about 20 percent of the value of lost production; and there has been an assured export market. The livestock sector is small and reasonably resilient, although meat imports increase temporarily following storm damage. The fishing sector, by contrast, is highly vulnerable and is slow to recover. Although fishing is declining, it is important in a diverse economy and provides the main livelihood of many poor families.

Manufacturing, Tourism, Construction, and International Financial Services

Although the manufacturing sector grew by an average 7.1 percent a year between 1977 and 1999, in 2000 the government still regarded it as being in an embryonic state, heavily concentrated as it was on coconut-based soap and detergent production. (Soap and dental products overtook bananas in 1996 as the largest merchandise export in value terms.) Natural disasters are not seen as a major constraint on growth in the sector, although some individual products may be sensitive to weather conditions. There is some evidence of effective

risk management measures (e.g., higher construction standards for the Dominica Coconut Products Ltd. jetty, to withstand storms). A major failure in risk management is inadequate business insurance coverage.

Expansion of tourism has been a central thrust of Dominica's development strategy for the past 20 years. Assessing natural hazard impacts and drawing lessons for the future for this sector are therefore particularly important. Hurricane David had a devastating impact on tourism, halting its growth for five to six years. Infrastructure investment following the hurricane, including measures to protect cruise ship facilities, was helpful in supporting rapid growth from the late 1980s on and in reducing vulnerability. But underinsurance is still a problem, especially with the occurrence of an extreme event such as Hurricane David, and it is of particular concern in a sector composed entirely of locally owned sole proprietorships and partnerships. Uncertainty about hazard risks—for example, of a volcanic eruption or an earthquake affecting the strongly tourism-focused businesses in the south—may make for difficulties in securing insurance coverage and investment funding. The massive increase in the growth of the cruise ship business suggests that tourism may now be more sensitive to the impact of natural hazards on the wider Caribbean tourism market.

Construction is the one industry in which disaster brings increased activity, but there is no evidence of a general postdisaster construction-led boom. This may reflect Dominica's reliance on imported building materials.

Since the mid-1990s, the government has sought to make Dominica an offshore financial center, and the financial services sector has grown rapidly. Although reduction of vulnerability was not a factor in the government's decision to promote this sector, financial services are likely to be largely unaffected even by major disaster events. Continued expansion of the sector should therefore bring about a further reduction in broad economic vulnerability.

Infrastructure and Buildings

Between 1950 and 1978, Dominica was transformed from an underdeveloped plantation-cum-subsistence colony into an independent, middle-income economy. Key to this achievement was rapid infrastructure

development. Given the severe financial constraints, construction costs were kept as low as possible. The investment took place following more than 20 years without any major hurricane impacts. Under these circumstances, adequate hazard-proofing was not provided, and when Hurricane David struck, the consequences were devastating.

Following Hurricane David, there was wider interest in reducing vulnerability by incorporating more effective mitigation measures into design and construction. Since then, substantial, but uneven, progress has been made in reducing vulnerability in all areas of infrastructure and building. Although some investments have been exemplary, financial constraints and an emphasis on restoring facilities to normal use as quickly as possible after a disaster have meant that initial construction, repair, and restoration work has often not incorporated fully effective hazard-proofing features. The long-term effect has been higher overall costs and increased pressure on limited resources. The rehabilitation cost of major storms since 1979 is estimated at EC\$380 million (US\$140 million), at 1999 prices, equivalent to EC\$18 million per year, with around EC\$10 million per year for key infrastructure.

The history of the deepwater port at Woodbridge Bay, which was built between 1974 and 1978, highlights the value-for-money case for designing new infrastructure and buildings to withstand hurricane damage. An internal rate of return of 13 percent was achieved by substantially scaling down the original design, even though there was evidence of a high risk of storm conditions potentially far more damaging than were provided for in the sea defenses incorporated within the port design. Rehabilitation costs following the damage caused by Hurricane David were equivalent to 41 percent of the original costs. Had the original structure been built to withstand a Category 4 hurricane, the initial investment costs would have been only 11 percent higher. Because of continued financial pressure, hazard risk again seems to have been underestimated in the expansion of the port. The case raises awkward questions in relation to economic analysis.

Most of Dominica's road system runs along the narrow coastal strip, very near the shore, rendering it potentially highly vulnerable to storm damage. Other key infrastructure networks—telecommunications, electric

power, and water distribution—run alongside the road and are similarly vulnerable. The record of investment in constructing sea defenses to protect this infrastructure and in building roads to more robust standards is patchy. In places, there have been some exemplary investments that incorporate higher storm-resistance specifications, but elsewhere the road system remains highly vulnerable. The apparent slow progress in providing sea defenses partly reflects the scale of investment financing required and partly a lack of donor coherence. Piecemeal projects focus on particular coastal sections—perhaps reflecting different donor priorities such as overall economic development or targeting of poorer geographic areas—and involve different design and construction processes. All three key public utility systems were devastated by Hurricane David and were partially disrupted by coastal damage from Hurricane Lenny in 1999. The vulnerability of this infrastructure to natural hazards now varies, reflecting the degree of mitigation investment that has taken place and the associated practical and funding issues.

External Accounts

The links between disaster shocks and export earnings are clear and direct; the links with imports are more inferential. Dominica has typically had a real trade deficit equivalent to 12–13 percent of GDP. In some years, the deficit has been much higher, reflecting variability in export levels and postdisaster surges in imports—notably, of building materials, equipment, and food. The declining trend in banana export earnings since about 1989 has reduced the sensitivity of the trade account to disaster shocks. Despite the loss of banana earnings in 1995–96, total export earnings increased because of the growth in earnings from soap and detergent products and from relatively resilient nonfactor services such as offshore banking and tourism. The shift shows how the nature of an economy's sensitivity to natural disaster shocks can change rapidly. Governments and international organizations need to take account of this and regularly reappraise their disaster response policies. For example, arrangements for buffering the effects of natural disaster shocks have focused on compensating for loss of primary commodity export earnings. Easily

accessible mechanisms for countering shocks in other sectors may now be equally important.

Disaster-related increases in capital inflows following hurricane years have typically overcompensated for downward pressures on the trade account and have contributed to reconstruction investment.

Investment and Domestic Consumption

It is difficult to discern evidence of the effect of natural disasters on total investment or consumption in Dominica except in the aftermath of Hurricane David in 1979. Then, the scale of both losses and reconstruction funds created an opportunity to replace and update much of the island's infrastructure and commercial and productive capital, following years of inadequate maintenance and limited investment. Gross domestic investment increased by almost 25 percent year-on-year in 1979 and by over 65 percent in 1980, but it fell by over 25 percent the following year. The falloff in private investment from 1981 on was marked, suggesting that once repairs had been completed, the hurricane may have deterred new investment. Subsequent hurricanes have not led to any comparable infusion of reconstruction capital.

Nevertheless, the World Bank attributes the relatively high level of consumption volatility in the Caribbean region as a whole to the fact that, in the face of high vulnerability to a range of external shocks, countries are not spreading their risks optimally, despite having relatively well-developed financial systems. The Bank concludes that financial and insurance markets need to be developed further, through, among other means, closer harmonization within the region's financial and insurance markets, strengthening of securities markets, pension reform, and the more efficient transfer of risks to the international market.

Financial Aspects

The study examined how natural disasters affect financial systems and how private and public financial institutions cope with the associated pressures.

Banking and Credit Institutions

Banking and credit systems can help spread risk in disaster-prone countries. Natural disasters place pressure on banking and credit institutions as money is withdrawn, loan repayments are deferred or defaulted on, and increased credit is sought to finance uninsured rehabilitation costs and disruptions in income flows. In extreme cases, the outcome may be the collapse of part of the banking sector. Dominica has no national central bank; rather, the Eastern Caribbean Central Bank (ECCB) conducts monetary policy for the Organisation of Eastern Caribbean States (OECS), supervises and regulates commercial banks in the member states, and is lender of last resort (although it has never been called on in this capacity). Dominica itself has five commercial banks, one national bank, a rapidly growing network of credit unions, and several nonprofit bodies involved in loans and credit.

The available data suggest that natural disasters have had relatively little overall effect on Dominica's banking and credit sector. Nevertheless, the sector's limited and fragmented ability to spread and transfer risk, not only in Dominica but also in the Caribbean region in general, is a serious concern, and measures are being explored to address the problem. Within the OECS, some services are being initiated that will facilitate risk-sharing as banks in the regions shift increasingly into syndicate lending. There has also been some discussion about the establishment of a jointly owned lending subsidiary that could diversify across territories and fund loans that are too large for individual banks. In Dominica banks and credit institutions are seeking to reduce risk exposure by limiting agricultural lending, but this may make postdisaster recovery more difficult.

Inflation

The rate of inflation has remained low over the past 20 years and, with one exception, natural disasters have had only a limited effect on it. The exception was Hurricane David, following which the food index alone was reported to have increased by over 45 percent between 1978 and 1979. Dominica's reliance on imports for most construction materials may have helped constrain post-disaster price hikes. Legislation allows prices to be fixed

for some essential products, but it is not clear whether this law has been applied.

Insurance and Other Risk Transfer Mechanisms

Dominica's insurance industry is relatively well developed in comparison with that in many other developing countries. There is, however, a major problem of underinsurance, partly reflecting the high and volatile cost of insurance in the Caribbean region. About 80 to 85 percent of gross property insurance premiums in the region are transferred to reinsurers; any fluctuations in reinsurance costs, whether local, regional, or global in origin, are passed on directly to those paying the premiums. Premium rates typically increased three- to fourfold between the 1970s and 2000, although they fluctuated considerably year by year. Data on underinsurance specific to Dominica are not available, but it is estimated that 25 to 40 percent of dwelling stock in the Caribbean region is uninsured, and much of the insured dwelling stock may be underinsured. Use of business interruption policies is also very low, perhaps as little as 5 percent. Insurance of public property is almost certainly limited by budgetary constraints.

The proliferation of insurance players in the Caribbean, some of them very small, has led to concerns about the efficiency and, more important, the safety of the insurance industry. New insurance legislation to be enacted by OECS members aims to address some of the main concerns, through disincentives to small insurance players, incentives to encourage amalgamation of insurance operators, and regulations on minimum levels of share capital required for registration. The World Bank has also recommended that companies and households in the region establish reserve funds to finance uninsured disaster losses. In addition, for a number of years now, regional and international organizations have been discussing the creation of some form of regional risk management tool, such as an intercountry insurance-pooling arrangement.

To date, there has been limited use of insurance as a mechanism for promoting mitigation through differentiated premiums to reflect lower risks on strengthened land and buildings. More widespread discriminatory premium pricing would be valuable, but it would require

comprehensive hazard mapping and inspection of individual properties.

Public Finance

Since Independence in 1978, one of the Dominican government's objectives has been to strengthen and stabilize public finances by exercising tighter control on spending and by increasing revenue. Balancing the budget has nevertheless been difficult; the high costs of providing an infrastructure and public services network to a small and dispersed population, together with the costs implied by Dominica's extreme vulnerability to natural hazards, place huge burdens on the country's limited resources, and it has been difficult to balance the budget. The government's ability to increase the money supply to reduce public debts is strictly limited by the ECCB, which is responsible for monetary policy across the OECS. Aid and other foreign funding have contributed significantly to both capital and recurrent expenditure; taxes, for example, accounted for only around 60 percent of total revenue between 1978/79 and 1997/98.

Aggregate budgetary figures suggest that disasters have had little impact on public finances except following the most extreme events, such as Hurricane David. Until the 1990s, expenditure on mitigation and preparedness also appears to have been low. In reality (although this is largely unrecorded), the costs of meeting more urgent needs in the aftermath of disasters have tended to displace planned investment, and the extent of the necessary reallocations has been exacerbated by the absence of any calamity reserve fund. Over time, cumulative reallocations and disaster-related damage to and destruction of public infrastructure and other facilities have had an adverse effect on the pace and nature of physical and economic development, making it more difficult to attract and sustain new productive investment. Against this background, it is essential that the budgetary impacts of disasters be measured more explicitly and that risk reduction concerns be built into medium- and long-term economic and financial planning. In this way, a more rational response to risk and disasters will be possible, including more soundly based reallocation decisions and better targeting of external assistance.

External Assistance

External assistance accounts for a large proportion of the Dominican government's public capital spending and for some current expenditure. Although there has been considerable short-term variability in total aid flows, no discernible trends are visible for the period since Independence. Disaster-related aid is often received some time after the event, and to some extent, aid provided in the aftermath of a disaster is diverted from non-disaster-related projects. Apart from Hurricane David, which was severe enough to attract widespread international publicity, aid levels have not altered significantly in response to public expenditure pressures following natural disasters.

Social Issues and Poverty

At the household level, poverty is the single most important factor determining vulnerability to natural hazards. This vulnerability reflects housing quality (location, building materials used, and failure to provide adequate support for low-cost housing in the aftermath of disasters); the primary sources of household income for poor people; limited financial resources; and lack of access to risk-spreading mechanisms. Despite the importance of issues of social vulnerability and the impacts of natural hazards at the household and community levels, there has been little research to date on this subject in Dominica. These issues need to be better understood so that a risk management strategy can be developed that addresses the special vulnerability of poor households and recognizes that poverty can be caused or exacerbated by natural disasters.

Several highly vulnerable economic sectors are particularly important to the livelihoods and incomes of poor households. A large number of extremely small, marginal producers are involved in the banana industry, which has given many poor households a means of reestablishing their incomes following disasters. The compulsory insurance scheme, however, disproportionately benefits the larger producers. Huckstering—trade between Dominica and nearby islands—is an important part of the informal labor market and is typically undertaken by women, often from poor rural

households. It is highly vulnerable to natural hazards, but no insurance coverage is available for huckster consignments. Fishing, which is pursued by some of the country's poorest households, is another extremely vulnerable sector, but the evidence shows that little has been done to recompense or rehabilitate households affected by disasters. On the positive side, there is increasing recognition of the importance of tackling vulnerability to natural hazards as part of a poverty reduction agenda for the region, and the government has determined that further investigation into the nature of poverty in Dominica is needed.

Disaster Management

Considerable progress has been made over the past 20 years in Dominica's state of preparedness for natural disasters. The 1996 National Disaster Plan is a substantial and detailed document that focuses on disaster preparedness and immediate postdisaster responses. Lead responsibility for the plan and for disaster preparedness lies with the Ministry of Communications, Works, and Housing. Individual government departments are responsible for undertaking postdisaster impact assessment, and donors interested in supporting particular aspects of relief approach the relevant ministry.

The National Disaster Plan, however, largely overlooks long-term mitigation and prevention issues and measures for addressing economic impacts and promoting economic recovery. Overall, there does seem to be a good awareness of disaster issues, but the generalized concern and commitment have not been translated into a coherent overall strategy for disaster reduction. Such a strategy would need to include or use information that has not been available so far: comprehensive and robust assessments of potential physical damage and of macroeconomic and social impacts; mitigation and preparedness plans; implementation plans to support affected groups; and a comprehensive rehabilitation plan. It would require consultation with local stakeholders and NGOs and cooperation with regional bodies and funding agencies.

Experience in Dominica and in the wider region suggests that a high-level interdepartmental task force, well supplied with resources and given the responsibility for

disaster management, would be more effective both in a crisis and in planning for future disasters than the existing department-based arrangements.

Environmental assessment of hazards poses particular problems for small developing countries. Concerns about the growing exposure to risks highlight the need for increased assessment and monitoring and for provision of clear and accessible information about hazard risk. Dominica has no capacity to undertake this effort independently. The necessary regional approach is now emerging in work being done under the auspices of the OAS, with international funding and expertise.

A particular cause for concern in Dominica's disaster mitigation and management arrangements is that the opportunities for promoting highly cost-effective hazard-proofing by setting appropriate design and construction standards have not been grasped. Regional civil engineering experts have estimated that spending 1 percent of a structure's value on hazard-proofing measures can reduce the probable maximum loss from hurricanes by, on average, one-third. Currently, however, Dominica has no formal building code. The island's infrastructure remains vulnerable to tropical storms; land use planning is weak; and there is evidence that as recently as 1996 new housing was built without adequate anchoring of roofs to walls.

Conclusions and Policy Implications

A number of key conclusions emerged from the country study:

- Considerable uncertainty and unpredictability are attached to natural hazards. Hurricanes may not follow established patterns, causing unforeseen damage, and a series of disasters may strike after a long period of calm. Regular reappraisal of risks is needed.
- The economy's vulnerability is constantly changing, reflecting changes both in the levels of development and capital investment in the island and in the structure and composition of economic activity. Measures can be taken to reduce the structural vulnerability of the economy. Greater integration of hazard risks into medium- and long-term economic and financial analysis and planning could substantially

reduce the economy's vulnerability to natural hazards and contribute to sustainable growth.

- In the immediate aftermath of a disaster, the public and private sectors face choices between pursuing rapid recovery and seeking reductions in longer-term vulnerability. Similar choices arise in determining the quality and standard of development investments. In Dominica, with its limited public and private resources, and in the absence of the necessary political impetus or financial incentives for investment in mitigation and changes in land use, the emphasis has been on quick recovery and least-cost investment. But the opportunities for reducing vulnerability must be seized. Improved information on the budgetary impact of disasters is needed to facilitate the cost-effective allocation of resources and to emphasize the importance of integrating hazard concerns into medium- and long-term planning.
- The unsatisfactory levels and forms of hazard risk information available in Dominica hinder effective risk-averting decisionmaking. Urgent action is needed to ensure sufficient investment in monitoring, assessment, mapping, and dissemination activities. There

is also a need for clear and accessible public information. Achievement of these information objectives for a small island economy like Dominica will require regional and international cooperation.

- There are wider implications for other small island states. The vulnerability of a small, open economy can alter rapidly, reflecting the significance of external factors. In considering appropriate disaster mitigation measures, it is important to recognize the physical characteristics underlying the island's economy and society. Fostering less vulnerable areas of economic activity and strengthening key infrastructure will help ensure long-term sustainable growth and minimize disaster impacts. Much more needs to be done in the Caribbean region as a whole to spread and reduce hazard risks through insurance and other financial risk transfer mechanisms. Donor agencies can also secure better returns to investments in disaster mitigation by undertaking more joint programs and having certain agencies take the lead on particular projects, rather than working in parallel, and by supporting regional solutions and reducing micromanagement of some projects.

Bangladesh: Disasters and Public Finance

This appendix, which summarizes a study on natural disasters and public finance in Bangladesh, focuses mainly on the period since 1980. During that time, five major disaster events triggered national and international emergency responses. The study uses available data to examine movements around trends and to compare economic performance (forecast and actual) before and after disasters, and it places these findings in the economic and social policy context of Bangladesh. It breaks new ground in that, although the immediate emergency and short-term budgetary implications of individual natural disasters have been much studied, this is the first investigation of the recurrent longer-term aspects of disaster risk, which are particularly relevant for disaster-prone countries.

Natural Disasters and Hazard Risk in Bangladesh

Bangladesh is one of the most disaster-prone countries in the world. Most of its large, densely settled population of 130 million people is at significant risk from more than one form of natural hazard. In terms of area and number of people directly affected, impact on economic activity, and damage or destruction of assets, the types of disaster that have been most important since Independence in 1971 are exceptionally widespread riverine flooding, severe tropical cyclones and associated coastal storm surges, river bank erosion, and drought. Official estimates are that 139,000 people were killed during the 1991 cyclone and that 31 million were directly affected by the 1998 floods. Rapid-onset flash flooding, tornadoes, and landslides are frequent causes of more localized, but intense, human suffering and loss. Severe earthquakes have been rare but are a potentially catastrophic hazard. Around 50

percent of Bangladesh's population is classified as poor and about 34 percent as living in extreme poverty. These people typically live and work in the areas most at risk from natural disasters. At the household level, poverty is still the single most important factor determining vulnerability to hazards.

It is difficult to make robust, quantitative assessments of the probable levels of risk associated with the main natural hazards in Bangladesh. Some reasons are:

- The exceptional complexity of the natural environment in the country
- The obvious limitations of historical data
- Environmental changes, some recorded and others so far only identified as possible consequences of global climatic change
- Human activity in Bangladesh and the immediate region, which is possibly altering the likelihood of specific events as well as, more obviously, the associated effects.

Current understanding of the risks of extreme, catastrophic events, and the problems of assessment, varies widely according to the particular hazard.

River Flooding

Four extreme flooding events have occurred over the past 30 years, in 1974, 1987, 1988, and 1998. Very high floods in 1976 and 1984, although less severe than the extreme events in height, maximum flow, and proportion of the country's area inundated, caused widespread suffering and loss and elicited an international emergency response. The implied annual risk of an extreme flood is a high 10 to 20 percent. Historical data on heights and flows for the major rivers are of doubtful quality and are available only for one station on the Ganges (in operation since 1934) and for one

station on the more unstable and recently more threatening Brahmaputra River (since 1956). The 1950 Assam earthquake upset the flow of the Brahmaputra, and the course of the Jamuna section of the river continues to move westward. Massive upper-riparian interventions have been made in neighboring countries since 1950—so far, mostly for the Gangetic system—and the potential impacts were highlighted by the floods of 2000, the worst in 80 years in southwestern Bangladesh.

Cyclones and Storm Surges

A record of more than 100 years exists for storm tracks and approximate intensities of storms in the Bay of Bengal. At least 14 very severe storms affected Bangladesh during that time, implying an annual risk of over 10 percent. Clusters of storms, such as the six major storms that affected Bangladesh between 1960 and 1970, can occur within the otherwise random series. So far, there is no evidence of changes in the frequency or intensity of storms in the Bay of Bengal. If, however, mean sea level were to rise, that would increase the expected severity of impact of a cyclone and the associated storm surge. Human intervention, including deforestation in the Sundarbans and the network of often poorly maintained embankments, may alter the incidence of impacts.

Earthquakes

Bangladesh lies within a high-risk region. Minor tremors are common, and one of the most extreme events, an 1897 earthquake that measured 8.8 on the Richter scale, had its epicenter in the nearby Shillong Plateau of the Indian state of Meghalaya. Because of the inadequacies of the available data, local assessments provide only highly tentative risk-zoning within the country, and only in map form.

Drought

The estimation of risks and their likely impacts on the basis of historical data is likely to yield seriously inaccurate results. There have been seven reported droughts in Bangladesh since 1971, an implied frequency of one almost every fourth year. Such repeated reports of drought suggest widespread problems of lower-than-average

rainfall, causing moisture stress and limiting crop growth. Drought as a disaster category, however, should be restricted to extreme, uncommon events. Furthermore, agriculture may now be less sensitive to rainfall variability within a wider range than previously because of the rapid spread of irrigation and the emergence in the late 1990s of irrigated boro (dry-season) rice as the main crop. However, the consequences of draw-down of the water table in an exceptionally dry year might imply both a different seasonal pattern and overall intensity of impacts on agriculture, other water-intensive activities, and human water supply. Finally, there are the potential impacts of climatic change, which could lower the risk of extremely low annual rainfall patterns that have historically caused agricultural drought.

River Bank Erosion

Erosion of river banks is a continuous, rather than intermittent, problem that can be predicted with some accuracy. The high level of risk makes insurance of assets or production impracticable. The most effective mitigation measure is strict land use zoning, but this is currently unenforceable. Consequently, both NGOs and, more recently, the government, through the National Water Management Plan of 2001, have moved toward supporting microscale protection and nonstructural measures.

Flash Flooding

Flash flooding is an annual phenomenon, and there is considerable scope for predicting the areas of likely incidence and the timing of floods. This would involve combining geographic information system (GIS) data, local ground confirmation, and real-time information on rainfall and river levels and would require international cooperation to communicate and assess information at least daily.

Tornadoes and Line Squalls

Tornadoes and line squalls are a common, localized phenomenon, traditionally associated with the Bengali New Year in April. The risks are potentially computable in

terms of risk-zoning and expected frequency, making insurance of assets a possibility.

Impact of Major Disaster Shocks on Bangladesh's Economic Development

Since Independence, Bangladesh's economy has achieved impressive rates of growth. In the late 1970s, it recovered rapidly from the devastating effects of natural disasters, war, and famine that marked the years 1970–75. The average real annual growth rate of GDP was 4.2 percent in the decade 1980–90 and increased to 5 percent in the decade 1990–2000. Average annual growth of per capita GDP rose from an average of 1.7 percent in the 1980s to 3.3 percent in the 1990s, reflecting both higher GDP growth and declining population growth. At the same time, there has been a change in the structural composition of the economy: agriculture's share of GDP has declined, while the industrial and service sectors have expanded, resulting in a sharp shift in the composition of the country's exports. A gradual process of structural adjustment and trade liberalization, along with more disciplined monetary management, resulted in maintenance of a single-digit inflation rate in the 1990s and an annual current account deficit of less than 2.5 percent of GDP. The reforms have also helped increase private sector development and foreign direct investment. Fiscal policy has not been so successful: a World Bank report points to large fiscal deficits, a low tax-to-GDP ratio, and relatively poor-quality spending.

Several features of Bangladesh's economy are particularly relevant for the public finance impacts of disasters:

- Because of the high level of public sector involvement in the economy, the government ultimately bears a substantial share of any disaster-related losses.
- High reliance on imports for industrial development and production and the large proportion of government revenue generated from import earnings mean that the performance of imports and exports and the availability of foreign exchange are important determinants of the amount of resources available to the government. The export base remains narrow and therefore vulnerable to external shocks. The shift from agricultural to manufacturing exports

may not have reduced the vulnerability of export earnings to natural disasters. For example, as the world's primary jute producer, Bangladesh was a price-setter, even in times of disaster. By contrast, as a ready-made garment manufacturer, it faces severe competition. Disruption of production results in loss of export revenue and overseas markets. The level of foreign exchange reserves has periodically emerged as a critical issue, in part because of its vulnerability to natural hazards and other shocks.

- External assistance has helped fund a major share of public investment (and, by implication, of total investment) and meet the country's large trade gap, and it has contributed significantly to postdisaster relief and rehabilitation.
- The ratio of debt to GDP has been growing (from 6 percent in 1973 to 47 percent in 1998) because fiscal debts have been financed through borrowing. Any further growth in domestic borrowing—for example, as a result of disaster-related budgetary difficulties—would lead to pressure for cuts in discretionary areas of recurrent spending and then, potentially, to cuts in programs for postdisaster rehabilitation.

Natural Disasters and Macroeconomic Performance

Some highlights emerge from a simple assessment of the sensitivity of Bangladesh's economic performance to major disaster, as measured in terms of fluctuations in agricultural, nonagricultural, and total GDP:

- In the period 1965–75, there was extreme volatility in the economy, clearly linked to catastrophic natural disasters as one destabilizing influence.
- Major disasters, with the notable exception of the 1998 floods, have led to a downturn in the agricultural sector's annual growth rate.
- The impact of disasters on the nonagricultural sector appears much less significant, although the longer-term impacts are not reflected in interannual fluctuations. If resources are diverted from productive investment to disaster management, the pace and nature of development will be adversely affected.
- The sensitivity to disasters of both the agricultural and the nonagricultural components of GDP appears to be declining over time, suggesting greater resilience.

Of course, the economic impacts do not reflect the severity of disasters in terms of loss of life and human tragedy.

Impacts of Disasters on Public Finance: Budgetary Process and Performance

Public finances are highly centralized in Bangladesh; in the mid-1990s, the central government accounted for about 97 percent of total revenues and 93 percent of public spending. The following analysis is restricted to central government operations.

The movements of broad budgetary aggregates—revenue expenditure, development spending, central government revenue, and the budget deficit—in the period since 1981 suggest that disasters have had little impact on central government finances. Revenue expenditure, development spending, and central government revenue have risen gradually over the period. The overall budget deficit remained fairly stable until the 1998 flood, when it rose markedly. Closer analysis of expenditure and sources of finance, however, gives a rather different picture.

The budgetary process. Responsibility within the central government for public finance planning, allocation, and monitoring is shared by a number of government departments. Procedures in place for tracking and controlling total annual public expenditure (equivalent to US\$3 billion) have not provided the clear lines of responsibility and delegation necessary to respond effectively to disaster shocks. For example, the distinction between revenue expenditure and capital spending is somewhat artificial; revenue projections and expenditure forecasts have typically been overoptimistic; and under the existing financial reporting systems, public accounts tend to underestimate the full effect of disasters on public finance. Changes now under way to improve monitoring of spending should facilitate more cost-effective reallocation of resources, provided that there is also a clear system for prioritizing projects.

Development spending. The Annual Development Plan (ADP) is the basic instrument for public capital investment planning and implementation, covering expenditure

allocations against specific central government projects, as well as the investment projects of public enterprises funded with government and foreign aid contributions. ADP spending has increased over time, and foreign aid accounts for a declining but significant share of its expenditure (on average, 45 percent between 1980/81 and 1998/99). Over the same period, actual expenditure averaged 89 percent of the ADP budget, with little apparent linkage between the incidence of disasters and the ratio between actual and budgeted spending. The tendency to underspend reflects factors such as project delay (due in turn to counterpart funding constraints), staff shortages, complex bureaucratic and procurement procedures, delays in land acquisition, conflicting conditionalities set by donors, and poor monitoring. Delays lead to cost increases and greater exposure to natural hazards, since unfinished projects are more vulnerable to damage.

Over time, the composition of the ADP has changed. Investment in roads, water, and sanitation has assumed increased importance. When cutbacks have been necessary, agriculture, rural development, water resources, and infrastructure have generally been spared as far as possible, with the social and industrial sectors taking the largest cuts. The fact that disasters have not forced a significant increase in spending on the ADP suggests that they have instead led to reallocation of resources or to delays in ongoing projects. If that is happening, it is important that reallocations be made in a way that minimizes their long-term developmental impact. This will require:

- A clearly stated and applied policy framework linked to defined and achievable objectives
- A sound method for prioritizing projects
- Reliable information on resource availability, and full and accurate damage assessments
- Proper evaluation of postdisaster rehabilitation and reconstruction projects.

The basic medium-term strategic planning tool for capital spending in Bangladesh has been the five-year plan. A three-year rolling plan was introduced in 1991/92. ADP projects are examined for their compatibility with the strategic plans and for their cost, technical quality, and economic viability. But the composition of the ADP may also reflect political pressures, the availability of external assistance, and donor priorities. Heavy

dependence on aid has, not surprisingly, led to less government control of a development vision.

Effective reallocation of resources depends on a clear ranking of projects according to level of priority. In theory, “core” projects have been given priority under the ADP. A formal core program of projects was introduced in 1983, but the practice was already informally in place in the mid-1970s. In that early period, priority was accorded to quick-yielding projects and to those in advanced stages of completion. Among sectors, agriculture (in particular, labor-intensive, small-scale drainage schemes) and resource exploration projects were favored. Draining and dredging of small rivers and canals took precedence over work to control major rivers, and small-scale irrigation projects were preferred over large-scale ones. In reality, rather than lower-priority projects being targeted for spending reductions, across-the-board cuts were generally used to restrain expenditure.

No specific guidelines for prioritization were provided in the formal core projects system introduced in 1983. The criteria for selection included stage of completion, production and employment potential, level of donor support, and links with other projects. In the late 1980s, the World Bank found that these priorities were being reflected in the composition of the ADP but were not being applied effectively in determining preferential access to funds. Following the 1987 and 1988 floods, available funds were again spread more thinly across existing projects rather than being allocated to priority projects. With the introduction of three-year rolling plans, core projects are now designated for priority funding, and other projects are assigned rankings. Despite this, the World Bank’s assessment is that more consistent use of objective criteria based on an economic rationale is needed to set expenditure priorities between and within sectors. Only by strengthening this area of public and financial planning can the government be confident that the development projects actually undertaken represent the best value for the public good and for longer-term growth and income. Donors who play a large part in project design have a responsibility for helping to secure improvements in this area.

Revenue budget. Since 1987/88, the revenue budget has typically accounted for more than half of total central

government spending. Gradual budget increases have reflected rising nondiscretionary expenditure on pay and debt servicing, which together make up almost half of total revenue spending. Despite budget growth, some nondiscretionary spending areas covered have been consistently underfunded. Commentators have highlighted, in particular, low levels of expenditure on operations and maintenance (O&M). Discretionary expenditure is by definition more vulnerable to cutbacks, including cuts in the wake of natural disasters.

Surprisingly, growth in the revenue budget has not been substantially higher in disaster years. Disaster-related expenditure seems to have been met within the existing budget envelope by drawing on unallocated resources (e.g., to meet needs for agricultural subsidies) and through diversion from other uses—for example, through redeployment of government staff. The real and underlying implications of disasters for revenue spending can therefore be understood only with the help of more detailed knowledge of decisions taken at the time of a disaster.

Government revenue. Bangladesh’s revenue structure is very weak. Total revenue averaged only 6.9 percent of GDP in the 1980s and 9.3 percent in the 1990s. External grants and loans have supplemented revenue, increasing the total available by an average 40 percent in the 1990s. Tax revenue has accounted for the largest part of total revenue, and there is an overwhelming dependence on indirect taxes, particularly import duties. Between 1992/93 and 1997/98, income tax accounted for only 15 percent of tax revenue.

The available evidence suggests that natural disasters have had little impact on aggregate tax performance. Examination at a finer level of detail shows, however, that adjustments have been made. In response to the 1987 and 1988 flooding, the government increased some taxes to meet the additional costs of disaster aid while at the same time reducing the tax burden on other parts of the economy to stimulate growth and aid recovery. Since the late 1980s, various measures, such as the introduction and subsequent extension of a value-added tax, have been taken to enlarge the tax base and reduce exemptions. It is widely agreed that the government still needs to increase its tax revenue, perhaps to 13–14 percent of GDP. But higher reliance on taxes to fund public

expenditure implies greater tax losses as a result of disasters if there is no change in tax composition. This would have consequences for alternative financing requirements and place further pressures on expenditure. Longer-term tax reforms in Bangladesh, therefore, need to aim at reducing the overall vulnerability of tax revenue to disasters, as well as increasing revenue.

Funding the government deficit. Since Independence, Bangladesh has run large, but gradually declining, public expenditure deficits. In recent years, the costs of funding the deficit have been rising, with increasing reliance on higher-cost domestic debt instruments rather than foreign assistance. Time-series statistics show no discernible relationship between disaster shocks, on the one hand, and patterns of expenditure and funding sources, on the other, although there is some evidence of lags in the impact of shocks on public finance.

Major Flood Disasters and Public Finance Performance: The Floods of 1987, 1988, and 1998

It is worth highlighting some of the public finance impacts of the most extreme recent floods, in 1987, 1988, and 1998, and some aspects of the government's response.

A comparison between forecast and actual annual revenue and expenditure suggests that the flood crises had limited effects on public finances. The government sought to limit the budgetary impact of the floods. Domestic revenue was augmented by the introduction of specific measures to increase tax revenue (although there were also targeted fiscal measures to assist recovery), and action was taken to contain revenue spending. Actual figures for revenue, expenditure, and the budget deficit were relatively close to budget.

The main adverse public finance impacts of the flood crises are seen in ADP expenditure, which was substantially lower than budgeted, in part reflecting the government's usual practice of relying on the ADP to bear cutbacks in total expenditure. In the case of the floods of 1987 and 1988, the limited availability of local currency resources also constrained the scope of the ADP and may have led to underutilization of donor funding. In all the flood years, the introduction of flood-related reconstruction and protection projects placed

additional pressure on the resources available for planned projects. The substantial pledges of foreign aid were critical to the recovery programs, but notwithstanding the generosity of donors, there was a lag between the commitments and the availability of funds in the ADP budget. The system for reallocating resources from lower- to higher-priority projects was applied more effectively following the 1998 floods than in the aftermath of the 1987 and 1988 floods. Expenditure on rural development and institutions and on transport increased as a result of the reallocations, reflecting efforts to repair and rehabilitate damaged infrastructure. Reductions were made in spending on health, population, and welfare, in line with the tendency to reduce spending on social sectors in the aftermath of disasters. Given the priority accorded to social sectors in the poverty reduction strategy, such reallocations need to be carefully considered because they may be inappropriate.

Two important consequences of the 1987 and 1988 floods were (a) a comprehensive review of flood policy by the government of Bangladesh and the international community, and (b) deregulation of private agricultural investment, which quickly led to more investment in lift irrigation and rapid growth in rice production.

A key difference between the earlier major floods and the one in 1998 was that in the more recent crisis, much more detailed information was available to assist planning, and management of the crisis was more transparent. The consequences of the 1998 floods were more closely examined within Bangladesh than was the case with the floods a decade earlier, and this greater understanding offered an opportunity to mitigate and manage more effectively the future effects of natural hazards. The experience of these flood crises highlights the need for standardized guidelines to assist with disaster damage assessment and reporting. The 1998 floods again exposed the uncertainties of postflood forecasting and the need for a full reassessment 18 to 24 months after the disaster (box B.1).

The Food Account and Food Operations

A distinctive feature of Bangladesh's public finances is the maintenance of a separate set of food accounts for public sector operations. The origins lie in the post-World

Box B.1 Uncertainties in postdisaster economic forecasting in Bangladesh

Following the 1998 flood in Bangladesh, some adjustments were made to annual economic forecasts for the year. Before the flood, there had been a sense of optimism, at least on the part of the government, that a high rate of growth would be sustained. The government had forecast an annual GDP growth rate of 6.3 percent for 1998/99 (Bangladesh 1999b). Other goals included containment of the inflation rate at 5 percent, the rebuilding of reserves to US\$2 billion, and a budget deficit held to 5.3 percent of GDP. The 1998 floods had a devastating impact on these plans. Total losses to output and infrastructure were estimated at US\$2 billion (Bangladesh 1999b), equivalent to 6 percent of 1997/98 GDP, and agricultural activities were disrupted. Rehabilitation costs were estimated at US\$1.5 billion (UNDP and Bangladesh 1998).

The government rapidly announced a series of measures intended to address the macroeconomic implications of the floods. These included pledges of balance of payment and other forms of external assistance, as well as steps by the government to raise revenue and reduce expenditure. Revised economic forecasts, released in October–November 1998 by the World Bank (1998a) and the International Monetary Fund, that took these measures into account estimated a GDP growth rate of 3.3 percent, an 8 percent rate of inflation, and year-end foreign reserves of US\$1.7 billion. Revised forecasts for 1998/99 released in April 1999 by the government were more optimistic, suggesting higher GDP growth (3.8 percent) and better visible trade performance than had been previously forecast.

Actual economic performance was even better than expected, with a growth rate of 4.9 percent. This outcome was primarily attributable to a record postflood crop of dry-season, irrigated boro rice and a bumper wheat crop. Agricultural output expanded by 4.8 percent in real terms, reflecting producer response to losses to the aman (main-monsoon-season) rice crop and a comprehensive program of agricultural rehabilitation. The volume of foodgrain production was 5.6 percent higher than in the preceding year, compared with a preflood projection of only 2.4 percent and initial postflood assessments of a 10 to 11 percent decline in output. Construction activity, boosted by the rehabilitation process, showed an annual growth rate of 8.9 percent. Recovery was less rapid in certain other sectors, particularly in the nonagricultural processing subsectors of manufacturing. Import growth was lower than had been expected in the aftermath of the flood, and foreign remittances increased more than anticipated. Export growth, however, was much lower than forecast, and foreign exchange reserves fell to US\$1,525 million in fiscal year 1999, the equivalent of only 2.3 months of imports. Annual inflation stood at 8.9 percent.

War II ration system and the country's historical reliance on food as commodity aid. In this study, our focus was on exploring (a) the extent to which food operations are related to disaster management and (b) whether a separate food account helps insulate public accounts (especially the development component) from damaging volatility, or whether it would now be preferable to incorporate the food account into the budget and apply conventional accounting practices.

Our conclusion is that food operations are an important, even essential, part of disaster management and poverty alleviation in Bangladesh. This is illustrated by the clear association between major natural disasters and foodgrain off-take or use of public supplies, both for sale (monetized) and for direct distribution (non-monetized). In the case of grain sales, the link is clearest for the 1984, 1987, and 1988 floods and the 1991 cyclone. Monetized operations played no role in the

government's response to the 1998 floods because private imports and nonmonetized distribution together kept domestic prices from moving above import parity prices. The direct distribution of food has become the key instrument in the government's disaster response, with peaks in direct distribution following all of the country's major disasters.

As to whether a separate food account remains a helpful means of managing public food operations, our conclusion is that there would be an advantage in properly incorporating food into the budget; food operations now represent a smaller share of public expenditure and revenue, and there are already close links between food operations and other budgets. Furthermore, financing of public food operations has become more complex over time. Adopting resource-based accounting would offer greater transparency and facilitate financial planning and budgetary control.

External Aid

External aid has been a major source of finance in Bangladesh, totaling US\$38 billion (in real 1999/2000 prices) between 1980/81 and 1999/2000. External loans and grants flow directly to the government and publicly owned bodies, as well as through NGOs. The government categorizes aid as project aid (which largely appears as approved development activities under the ADP), food aid received in kind for relief or development, and commodity aid (a residual category that includes balance of payments support). During the 1970s, food and commodity aid were the largest categories of external assistance, but in the 1980s, project aid emerged as the primary form of planned aid, accounting by 1999/2000 for 89 percent of total commitments and 81 percent of total disbursements.

There has typically been a substantial gap between projected aid and actual expenditure, reflecting factors such as procedural difficulties, changes in project staff, procurement delays, and lack of local resources for counterpart financing. In 1998/99 total aid commitments rose by 46 percent, but disbursements increased by only 22 percent. The available data suggest that many donors have responded to disaster crises by reallocating resources and bringing commitments forward. Foreign aid commitments have typically increased in the year of, or immediately following, a major disaster but have fallen sharply in the following year. Food aid commitments have generally peaked rapidly in response to major disasters. Project aid has tended to drop in disaster years, as aid is shifted to more quickly available emergency assistance, and this can delay the progress of ongoing projects and the start of new ones. This aspect of the relationship between disasters and foreign aid warrants further investigation.

A large, although highly variable, amount of aid now flows via NGOs rather than directly to the government. Data suggest that, in the period immediately following a major disaster, at least a quarter of all aid is channeled through NGOs, some of which operate as both funding and operational organizations and also support smaller NGOs with funding. NGOs have, in effect, established a parallel structure for international support for disaster relief and rehabilitation (R&R). Available evidence on the aid response to the 1998 floods confirms heavy involvement by NGOs in R&R; most of this involvement

represented additional funding for R&R and additional overall expenditure. The developing role and importance of aid channeled through NGOs, and issues of coordination and of the information basis for aid action and allocation, also merit further investigation.

Public Agencies and Financial Institutions

Although this study is focused on central government operations, other important bodies are involved in public finance operations, and natural disasters also affect them.

Local Governments

Government in Bangladesh remains highly centralized. Local governments lack substantial sources of revenue of their own, and local investment is so reliant on central funding that decisions on its allocation and priorities have been influenced by the central authority. This, in turn, has led to unequal access to services. The Fifth Five-Year Plan envisaged extensive decentralization of policies, but little practical action has been taken, despite the transfer of some major urban flood prevention responsibilities to local agencies. A fuller exploration of the implications of disasters for local governments would be helpful.

State-Owned Enterprises

There is extensive state ownership of industrial and trading enterprises in Bangladesh. Profits from these enterprises could in principle be an important source of nontax revenue. In practice, state-owned enterprises (SOEs) have generally had persistent and mounting losses, placing a continuing burden on public resource management. Disasters may have contributed to the poor performance of SOEs, and assessments of the full public cost of disasters need to include the impact on SOEs and the knock-on effects on public finance.

Financial Institutions

Despite a financial liberalization policy and increased private sector activity, the public sector continues to be substantially involved in the financial sector. The long

history of subsidized credit, loan amnesties, and debt restructuring has imposed heavy costs on the budget—although there is a lack of transparency as to the precise level of public support to the banking system following disasters. A major shift in policy in response to disasters took place after the 1998 flood. Although agricultural credit was increased significantly in 1998, it was also made clear that payments on existing loans would be deferred but no longer waived, as they had been during the floods of the 1980s. Case studies, perhaps focusing particularly on banks specializing in agriculture and industry, are required to investigate the impacts of disasters on financial institutions and the lessons to be learned.

Microfinance Institutions

Microfinance institutions (MFIs) were pioneered in Bangladesh in 1976. Currently, more than 1,000 NGOs operate microfinance programs, and there is substantial public sector involvement, through government departments, public agencies, and banks, as part of a broad strategy for tackling poverty. MFIs can play a very constructive role in poverty reduction efforts, but they are vulnerable to damaging liquidity problems in times of disaster. Further analysis is needed to explore ways of improving their resilience to disasters, while maintaining responsible attitudes toward debt repayment and ensuring access to credit to those most affected by disasters.

Disaster Mitigation, in the Long and Short Term

The government of Bangladesh and the international community have made substantial investments in disaster mitigation and preparedness, focused historically on flood protection, drainage, and irrigation. This emphasis reflects a strategy first applied when Bangladesh's population and economy were almost entirely rural. The objective was to protect and encourage agricultural development and, in particular, to promote self-sufficiency in foodgrains. A multipurpose approach was taken, with the aim of mitigating the effects of all four main disaster types. The cyclone protection strategy for high-risk coastal areas at the time of the cyclones in the 1960s,

1970, and 1991 was based on the construction of safe areas and solidly built community shelters. Many people survived the 1991 cyclone by taking refuge in public buildings. The evacuation strategy was even more successful when a cyclone of similar intensity struck in May 1997; only 100 fatalities occurred. The strategy now is to design and rehabilitate cyclone shelters for multi-purpose use, mainly as schools.

Rethinking the Strategy for Mitigation and Preparedness

Inherited strategies have been reviewed in the light of social and economic transformation (population shifts from rural to urban areas, and the increased economic importance of industry and services compared with agriculture) and of a critical evaluation of the effectiveness of the strategy following the floods of the 1980s and 1990s. The new (2001) strategy for water management gives priority to protection of concentrations of people and high-value assets in urban and periurban areas against extreme floods, cyclones, and river erosion. The strategy for rural areas is still being formulated, but coastal areas are a priority. Overall, there is a fresh emphasis on a more decentralized approach, on the involvement of disaster-prone communities themselves, and on disaster preparedness. The strategy that seems to be emerging would be more financially realistic. Central government investment requirements are reduced, and the otherwise unbridgeable gap between O&M requirements and revenue budget resources is addressed by introducing a policy of beneficiary responsibility and cost contributions to help meet O&M costs. These necessary radical changes pose major challenges for the government and for civil society.

Land Use Controls and Building Regulation

The most effective mitigation strategy against all major hazards, drought excepted, is strict land use zoning and building regulation. Because of social pressures, no serious attempts are being made to restrict the use of highly vulnerable rural areas for economic activity or human occupation. The need for controls in urban areas is well understood. Urban planning directorates, such as the Dhaka and Chittagong Improvement Trusts, were

given the responsibility for regulating the siting and method of construction of buildings. The trusts, however, have been unable to carry out this task because of massive problems of governance. Instead, the response of the government has been to provide protection through structural measures, such as embankments and, in coastal storm surge areas, cyclone shelters. Building regulation, particularly in relation to seismic hazard, has been an issue of mounting concern. Serious risk was taken into account in the design of, for example, the Jamuna Bridge in the late 1980s, and a seismic zone map was incorporated into the national building code in 1993. Further investigation is needed into the hazard risk posed by the rapidly expanding stock of domestic and communal buildings in the main urban areas.

Decisions on Rehabilitation and Reconstruction

A potential problem in the aftermath of disasters is that in the haste to fast-track assistance, new projects are not properly designed or appraised. The opportunity costs of investments in terms of other investment forgone are not considered. It may be entirely appropriate to review investment priorities, but care should be taken to ensure that disaster-related projects do not displace other high-priority activities in the ADP that are more viable and affordable, as well as necessary for supporting long-term growth.

Financing Future Disaster Costs: Insurance and Risk-Spreading

Historically, in Bangladesh and in other countries, there has been heavy reliance on donor funding to meet disaster-related costs. Donor resources are now declining globally, and countries are beginning to explore alternative ways of meeting these costs. The World Bank has been at the forefront in helping to develop and apply appropriate risk transfer mechanisms to cushion against costs related to natural disasters. Mechanisms under consideration typically involve some form of market-based insurance, entailing a large share of reinsurance in order to transfer risks to the international market. Various insurance methods might apply, including conventional catastrophe damage insurance and

more innovative tools, such as weather derivatives and catastrophe bonds.

In Bangladesh it is useful to distinguish between localized hazards, which affect one or another part of the country each year, and more severe, less frequent disasters. Costs relating to the former are met (largely on an ad hoc basis) from the revenue budget. There is a strong case for allocating more preassigned funds for this purpose. The World Bank has suggested establishing a disaster sinking fund in the revenue budget, financed from regular appropriations and external financing. Surplus funds in any particular year could be used to build up reserves.

In years of more severe disasters, resources beyond the means of the government are required. Financial risk transfer mechanisms could potentially play a major role in helping manage costs and spread related expenditures over time. At present, there is little use of even conventional catastrophe insurance by either the public or the private sector. Total annual insurance premiums amount to only US\$0.61 per capita; natural hazard coverage, which is not included in basic fire and allied policies, is much less. A significant increase in hazard insurance would require structural reform of the insurance industry to be viable. At present, the industry is highly regulated and is almost entirely domestic. Furthermore, a full 50 percent of reinsurance has to be placed with the state-owned reinsurer. Flood or weather index-based insurance may present insuperable problems in Bangladesh because of the practical difficulties in defining appropriate trigger events and determining entitlement to compensation. Initially at least, there may be more scope for insuring assets—agricultural machinery, commercial buildings, and so on—in urban and rural areas.

A possibility, because of the moral hazard issue that has dogged all credit programs, is to build some form of highly subsidized insurance into formal, already subsidized, lending. Microcredit is a possible priority area for, at least, pilot schemes. If there were even a partial insurance element in the contract, this might encourage, when losses occur, an orderly response based on an entitlement to refinancing, rather than a damaging, disorderly collapse in recovery rates.

Insurance coverage against losses in the event of a disaster can be developed and applied successfully only

if the government and people of Bangladesh are convinced of its merits. Thus far, additional external assistance appears to have been available to meet the costs of disasters. But this study has shown that ultimately, disaster-related external assistance is very largely not additional but displaces funding for development.

Main Preliminary Findings and Policy Options

- Major disasters have had clearly demonstrable negative macroeconomic impacts on Bangladesh. The relative severity of the impacts has diminished considerably since the 1970s, largely because of structural change in the economy. Agricultural output is more resilient, nonagricultural sectors are more important and are less severely affected, and trade liberalization and integration of food markets are reducing price effects.
- There have been improvements in disaster response by the government, donors, and civil society. Still, some reorganization of public finance reporting (e.g., on food operations) would help clarify and perhaps improve budgetary practice.
- Handling of the 1998 floods by the government of Bangladesh and by NGOs was better than in earlier disasters. Foreign aid was substantial and timely. Improved assessments of losses helped.
- The aggregate effects of disasters on public finance have been progressively contained. The response, however, has largely involved reallocations of budgeted spending to relief, often by cutting expenditure across the board without regard to the effects on longer-term economic growth. Development projects funded through the ADP have been particularly affected.
- There is increasing recognition of the need to reflect policy objectives such as poverty reduction in the development of strategies for disaster management and mitigation.
- Investment planning and project prioritization need to be strengthened. Disaster mitigation should be part of project design. Increased expenditure on O&M could be a cost-effective means of reducing disaster impacts.

- Much foreign aid has involved reallocating and bringing forward commitments, rather than providing additional funding. There have been shifts from project aid to food and commodity aid, and concern that some donors have followed their own project priorities rather than considering wider implications.
- Newer forms of spreading the financial costs of disasters, including disaster-earmarked contingency reserves and market-based instruments for risk-spreading, merit further consideration. Risk-spreading could safeguard more public finance resources for development and also strengthen microfinance operations, which have a key role in the poverty reduction strategy.
- There is a need for better assessment of natural hazard risk, including that from earthquakes, and for strengthened regional cooperation.

Research Implications

- The consequences of the 1998 floods were much more closely examined than was true of the floods a decade earlier, and this helped mitigate and manage the effects. There is a need for agreed on and generally adopted guidelines covering postdisaster and mitigation assessments. This is a task for Bangladesh.
- Further economic research into natural disasters would be valuable. The use of regression analysis to quantify the short-term impacts of disaster shocks on national accounting aggregates could be applied to public finance and external assistance. It would also be useful to extend quantitative economic investigations to consider the public expenditure and revenue implications of disaster shocks.
- The specific focus of future investigations of disaster impacts should be on the composition of public expenditure to identify key areas of capital and recurrent expenditure that need to be protected, as well as areas where additional spending is needed to assist immediate crisis management, recovery, and disaster mitigation.
- The full cost of disaster impacts should embrace public enterprises and agencies and public finance

operations. Case studies are needed to explore this area more fully because a useful composite analysis is not possible with the limited data available.

- A full inventory of aid from all external donors and agencies and of the ways they assist following disasters would be a useful contribution to the integration of disaster reduction into longer-term development

strategy. The classification of types of aid also needs to be updated.

- Natural hazards are extremely complex. State-of-the-art scientific and technical advice is needed to make sense of many issues. A review of the adequacy of support for research on and monitoring of hazard vulnerability is desirable.

Malawi and Southern Africa: Climatic Variability and Economic Performance

The study summarized here was undertaken between November 2001 and July 2002. It focused on climatic variability and the usefulness of climatic information in southern Africa and included a country study of Malawi. The study area was chosen because of the reported progress in seasonal climatic forecasting, the attention given to the El Niño phenomenon, and concern about long-term climatic change.

Malawi is a small, landlocked country in southern Africa with an estimated population of 10.8 million in 2000. It is one of the poorest countries in Africa; about 65 percent of the population is below the national poverty line, and 28 percent is in extreme poverty. Health and social indicators are among the lowest in Africa. Infant mortality in 2000 was 134 per 1,000 live births, compared with an average of 92 for Sub-Saharan Africa. Average life expectancy (now 37 at birth) is declining as a result of HIV/AIDS, which in 1999 affected 16 percent of the adult population and 31 percent of women in antenatal care. Adult literacy is under 60 percent, and only 78 percent of children attend school. Agriculture accounted for some 40 percent of GDP in 2000; its share of GDP has been increasing since the early 1990s as a result of industrial stagnation and the contraction of the public service sector. About 89 percent of the economically active population is classified as rural. Malawi is heavily dependent on maize, which is the main food staple and in a normal year probably accounts for about three-quarters of the population's calorie consumption. Export earnings are dominated by tobacco (61 percent), tea (9 percent), and sugar (8 percent). This dependence on rainfed crops makes Malawi vulnerable to variations in rainfall and temperature, as well as to commodity price shocks.

Malawi's 2002 Food Crisis: How Might Better Climatic Forecasting Have Helped?

The 2002 food crisis in Malawi, which was emerging during the time of the study, highlights both the important potential gains that good climatic forecasting offers, in terms of managing the risks associated with climatic variability, and the problems that need to be overcome to develop and make full, effective use of meteorological monitoring and forecasting in the region. It provides a highly relevant starting point for examining the linkages and issues at the heart of the study.

The impetus for improving drought risk management at a regional level for southern Africa—an effort involving regional bodies, national governments, and the international community—stemmed from the droughts of 1991/92 and 1994/95. By 1997/98, a formal process for consensus-based, long-lead or seasonal climatic forecasting had emerged, managed through the Southern African Regional Climate Outlook Forum (SARCOF). Within Malawi, the Department of Meteorological Services was providing 10-day bulletins on rainfall, temperature, and sunshine for the meteorological stations under its control. Despite this progress, the meteorological input into anticipating and assessing the scale of the emerging crisis seems to have been limited. SARCOF's forecasts were for above-average rainfall in the region in 2000–01 and for broadly average rainfall in 2001–02. Because the overriding concern in the region has traditionally been the risk of drought, the potential negative impacts of higher-than-average rainfall were not recognized. Policy decisions taken in Malawi were therefore predicated on a normal or favorable climatic outlook and on what turned out to be an overoptimistic view of the likely maize crop. In apparently favorable conditions,

a poverty reduction scheme that provided all small-scale subsistence farmers with a minimum package of seeds and fertilizer was halved in order to reduce public expenditure. As a result, many farmers were unable to respond to the early onset of the main rains, and this contributed to reduced production. Furthermore, on the advice of the IMF, and with World Bank agreement, Malawi sold two-thirds of its strategic grain reserve, which in 2000 was near capacity, to reduce its debt. The decision was taken prematurely, while planting was still under way and the size of the maize crop was uncertain. In the event, crop yields were low, with dangerous consequences for food security, and the government had to make replacement purchases of grain that wiped out the savings from the sales.

The 2002 crisis was the outcome of many factors, of which climate was only one. But a better understanding of agro-meteorological relationships, reliable crop production data, and less generalized climatic forecasts for informing economic and food security decisions would undoubtedly have helped avoid some of the extreme consequences of the low crop yields. There was apparently little understanding of how fragile Malawi's society and the economy had become, and there was insufficient appreciation of the sensitivity of the maize and tobacco crop to weather conditions *throughout* the season and the damaging effect of erratic rainfall levels. In the region at large, an overconcentration on the risks of drought was in evidence, leading to "undue confidence," given the highly generalized forecasts of average or above-average rainfall. Because of financial and human resource constraints, data collected from meteorological stations within Malawi were not analyzed and interpreted to draw out the agro-meteorological linkages or permit the closer monitoring of weather on a local basis throughout the growing season. This more robust data monitoring is essential in order to assess and deal with the vulnerability of the important small-holder agricultural sector.

As the 2002 crisis demonstrates, major benefits can be derived from strengthening climatic forecasting regionally and at the country level. Using evidence up to the late 1990s, this study:

- Reassesses the economic consequences of climatic variability in the light of experience such as the El Niño event in 1997/98

- Takes stock of the current capacity of climatic forecasting and of progress in research to review the range of potentially useful outcomes
- Examines the institutional capacity and financing issues that arise if effective use is to be made of strengthened forecasting ability.

Climatic Variability, Agriculture, and Economic Performance in Southern Africa

The droughts of 1991/92, 1994/95, and 1997/98 were all associated with El Niño events. Climatologists have established a highly significant relationship between the El Niño–Southern Oscillation phenomenon (ENSO) and interannual variations in rainfall in southern Africa. (See note 3 in chapter 1 for an explanation of ENSO and related events.) But it is not a simple canonical relationship: not every El Niño event brings low rainfall, and in some years extremely low annual rainfall is not clearly linked to El Niño events. Much less well understood oceanic-atmospheric interactions in the Indian and South Atlantic Oceans are now recognized as important influences on rainfall patterns.

Cereal production, especially maize production, is central to food security in southern Africa. It is also highly sensitive to drought and to climatic variation more generally. In a crisis, ensuring maize supply is likely to take priority over other trade considerations and in public spending decisions. So, it makes sense to look first at the impact of climate on cereal and maize production and how that affects the economies of southern Africa. South Africa is by far the largest agricultural producer in the region, accounting for 64 percent of cereal production and 62 percent of maize production during the period 1993–98. Cereal production in South Africa and the rest of the region is correlated, generally moving in the same direction.

The relationship throughout the region between volatility of production and climatic events is striking. But the pattern is more complex than one in which a drought caused by El Niño results in low crop yields. Different sequences in drought impacts at the country level—some of them ahead of El Niño–linked droughts—are reflected in year-to-year changes in maize yields and in agricultural GDP. In 1997/98 the risks associated with the strong El Niño event led climatologists to forecast

severe drought in southern Africa and very low crop yields. In fact, although regional crop yields were lower than normal, the rainfall associated with oceanic activity in the Indian Ocean resulted in more favorable conditions in countries in the north of the region, and crop yields were higher than had been anticipated by scientists using only El Niño-based models. The conclusion we draw from this is that total rainfall is a better explanatory variable than ENSO for analyzing crop yield variations. Obviously, there are other important factors. Nevertheless, focusing on rainfall and output makes for better understanding of the consequences of climatic variability historically and in the future, with implications for food security and economic policy.

Drought has been commonly seen as the main climate issue in the region. The recent disastrous floods in Mozambique, however, and the role that the extremely high rainfall in 2000/01 played in the lead-up to the food crisis of 2002, have highlighted the risks associated with high rainfall. Plotting annual cereal and maize outputs against the southeastern African rainfall index suggests that outputs plateau at rainfall levels about 15 percent above the mean levels for 1960–90. Above that, there is increased probability of reduced production. A parallel analysis for Zimbabwe showed a similar pattern. In Malawi, which is at the northern margin of the climatic region, there was no significant relationship between crop yields and either the regional rainfall index or ENSO variables. There was, however, a link between crop yield and country-specific rainfall levels for the critical month of February, rather than for the year. Our conclusion is that climatic forecasting and early-warning systems need to give more attention to the likelihood of extremely high rainfall events and that localized monitoring and agrometeorological interpretation of data are needed to reflect the significant variations between and within countries in the region and to inform critical decisions.

The wider economic impacts of droughts in the region largely reflect multiplier and linkage effects from the agricultural sector and are felt in the subsequent year with a lag of 6 to 12 months.

Costs of Climatic Shocks

As is the case with most natural hazard risks, the livelihoods most affected when disaster strikes are those of

the poorest in the population. The clearest impacts of drought are on cereals and especially on production of and trade in maize. The extreme 1991/92 drought reduced maize production by 10 million metric tons, and it cost US\$1 billion in cereal losses at import parity prices and US\$500 million in the actual logistical costs of importing cereal into affected southern African countries. There were also severe wider impacts on GDP and the agricultural sector of at least double this magnitude over 12 months. The climatically less severe 1994/95 drought involved costs of US\$1 billion in cereal losses because of higher prices in a tighter international cereal market. The 1997/98 El Niño event caused significant but less serious losses. The effects of the 2002 crisis are beyond the scope of the study, but the development of another El Niño has led to emergency cereal import costs that exceeded losses in 1997/98. Costs of this scale require action at the national, regional, and international levels to prepare an economic strategy and to coordinate aid policy. The value of climatic forecasting lies in offering early evidence of enhanced risk of a major shock and in anticipating the costs and the scale of measures that may be needed at the national and regional levels.

Climatic Variability and the Malawi Economy

Periods of below-average or erratic rainfall were less extreme and less general in their effects in the 1970s and 1980s than in the 1990s. The droughts of 1991/92 and 1993/94 had very severe impacts on agriculture in Malawi, and in particular on the smallholder sector, which accounts for the largest share of maize production. Maize production declined by around 60 percent in 1991/92, to the equivalent of only 45 percent of average production levels in the previous five years. High and well-distributed rainfall, combined with policies for assisting smallholders, resulted in a bumper maize crop and a record tobacco crop in 1992/93. To avoid the producer disincentives that might result from these very high yields, Malawi's Agricultural Development and Marketing Corporation (ADMARC) made record purchases (over 375,000 metric tons) of maize, adding to the financial pressures on the government. But in 1993/94, following low and erratic rainfall in key growing areas, maize production again fell sharply. In 1994/95,

when South Africa and Zimbabwe were affected by low, poorly distributed rainfall, Malawi's agriculture largely recovered. These zonal differences in the pattern and timing of drought impacts in 1994 and 1995 highlight important climatic variations both within the country and regionally. In 2000/01, following exceptionally high rainfall and widespread flooding, maize production fell by 30 percent and tobacco was down 16 percent.

The wider economic consequences of drought in a Sub-Saharan African economy like Malawi's include direct impacts on agriculture and on other productive sectors that rely on water, such as hydroelectricity, as well as indirect multiplier relationships. The overall pattern of drought impacts on public finances in Malawi has been broadly consistent with standard expected patterns. Drought severely reduced agricultural production toward the end of one financial year, and the financial effects of relief and recovery assistance followed in the next financial year. Flawed or problematic data have made it difficult to undertake in-depth sectoral or wider economic analysis of the effects of climatic shocks or to isolate the effects of drought. Nevertheless, the evidence suggests that Malawi's economy was among the most sensitive to drought shocks of any in the region.

Before the 1991/92 drought, there were signs of improvement in the economy, with export revenue rising and public expenditure falling. In 1991, however, the combined effects of several factors—the refugee and trade impacts of the Mozambique conflict; increasing political difficulties within Malawi that temporarily halted nonrelief development aid; and the extreme drought in 1991/92—resulted in a near-chaotic budgeting situation. Public expenditure rose by 30 percent in real terms between 1991/92 and 1994/95, and the rate of inflation jumped from 12.5 percent in 1990/91 to 75 percent in 1994/95. Fiscal measures, combined with better agricultural performance, led to a temporary stabilization in 1995/96 and 1996/97. Nevertheless, public finances in Malawi have continued to be volatile. Upward pressures on expenditure have intensified in recent years. Foreign aid levels, on which development funding depends, have been influenced by political and governance issues, as well as by economic and humanitarian considerations, and this has

been a factor in Malawi's relatively unstable public finances.

Climatic Variability in Southern Africa and the Links to Wider Climatic Processes

At a general level, the effects of destabilizing climatic hazards are increasingly well understood and predictable, but there are still important gaps in our knowledge. The study examined climate variability and links to wider global processes in the light of recent research and events in the study area.

In the predominantly semiarid southern African region, rainfall varies significantly from year to year, with a pronounced seasonal cycle. The rainy season generally extends from October–November to April, reaching a peak between December and February. Rainfall distribution during the rainy season is variable, depending on the interplay between tropical and midlatitude weather systems and convective variability. As a result of increased temperatures and higher water evaporation rates, future global climate change is likely to alter short-term climatic variability and change rainfall patterns, reducing water availability. Rainfall during the peak of the wet season is likely to increase, but with offsetting decreases in the drier months. Both droughts and floods may become more likely, but uncertainty will be greater.

Fluctuations in seasonal rains are linked to regional sea surface temperatures and the global ENSO phenomenon. The links between ENSO and the regional weather system are robust and are relatively well understood. Models can predict ENSO up to a year in advance, and, using that information, useful predictions of southern African rainfall can be made at lead times of up to five months. During El Niño events, southeastern Africa is likely to experience a 50–60-millimeter shift toward drier conditions. During La Niña events, models show above-normal rainfall in southeastern Africa for all rainy season months except February. By contrast, equatorial eastern Africa is likely to experience relatively wetter periods during El Niños and relatively drier phases associated with La Niñas. The severity of the impacts depends on the specific pattern of an extreme ENSO event. Climatic zones, of course, do not follow national boundaries: Malawi lies between the core zones of southeastern and equatorial eastern Africa, increasing the difficulties

of climate forecasting for that country. Moreover, it is changes in the distribution of rain during the wet season associated with El Niño events, rather than total rainfall amounts, that are crucial to understanding agricultural impacts. These changes are complex and difficult to predict, limiting the precision of forecasts.

ENSO is not the only factor that affects rainfall in southern Africa; regional sea surface temperatures and topography are also important. Predictions of sea surface temperatures of the Indian and Pacific Oceans are used to produce seasonal forecasts for South Africa, and South Atlantic temperatures also help shape atmospheric circulation. Despite advances in forecasting capability, for some areas of southern Africa predictability, or the “skill” of the forecast, may still be relatively low. Certainly, there are complex relationships that go beyond the influence of El Niño that need to be taken into account in reviewing the potential and actual roles of climatic forecasting.

As noted, drought has been seen as the main climatic hazard. This is reflected in the importance accorded to drought management in macroeconomic policy and in the institutional arrangements for disaster management. But more recent events, including the 2002 food crisis in Malawi, have highlighted other important climate risks:

- Erratic rainfall, particularly an extended halt in rains at the critical flowering time, can considerably reduce crop yields, even if total annual or seasonal rainfall is at or near normal. Food security implications are particularly serious if there is excessive dependence on a single crop, such as maize. Further investigation is needed into the extent and frequency of the phenomenon of midseason dry spells. With increasing cultivation of marginal lands, a useful climatic-forecasting product would be a probability assessment of the likelihood of an erratic rainfall pattern and the risk of extended dry periods. Are extended dry periods at critical points in the growing season closely linked to below-average overall rainfall, or are there other influences on the short-term distribution of rainfall?
- Extremely high rainfall can also reduce crop yields through flooding, or perhaps because of reduced solar radiation as a result of more extensive and denser cloud cover. Cloud cover is not regularly monitored

in terrestrial meteorology, so this effect can be confirmed only by correlating remote-sensing and agronomic data. Excessive rainfall also disrupts infrastructure and communications, with associated costs.

- The emphasis on drought risks is understandable, given the devastating effect of drought. It has, however, led to a perhaps undue concentration on and oversimplified interpretation of the impact of El Niño events on southern Africa’s climate, and to an assumption that if drought is not a prospect, the agricultural season will be good. As another example, a water management strategy in southern Africa focused on building up capacity to ensure adequate flows in the dry season; in 2000, emergency releases from overfull reservoirs then exacerbated downstream flooding in Mozambique.
- Households and the national food system are operating within increasingly narrow margins because of socioeconomic pressures—demography, the HIV/AIDS pandemic, and economic adjustment. They are potentially more fragile and more sensitive to erratic intraseasonal distribution of rainfall, which is difficult to predict.

In summary, drought remains the most likely source of food crisis and climate-related economic shock. Nevertheless, it is now clear that the food system, the livelihoods of the poor majority of the largely rural population, and the wider economy are sensitive to *any* destabilizing climatic risks. In these circumstances, the value of well-coordinated work, supported by adequate resources, to improve understanding of the evolving weather situation and build climatic-forecasting capacity for the region is clear.

Climatic Forecasting

There has been considerable progress toward better integration and strengthening of meteorological systems within the Southern African Development Community (SADC). SARCOF now provides a formal process for consensus-based, long-lead or seasonal climatic forecasting. The SARCOF forecasts rely heavily on forecasts from global statistical models (which partly reflect the behavior of ENSO), with additional details from national meteorological services. They are made seasonally, in

September for October–December and for January–March, with the January–March forecast reassessed in December. SARCOF provides forecasts in three broad probability bands for below-normal, near-normal, and above-normal total rainfall for the relevant periods, and forecasts are shown for spatial zones with similar rainfall response.

The precision of SARCOF forecasts is still very limited, and probabilities are more difficult to assign for zones farther away from the core areas of south-eastern Africa. For example, in the 2001/02 forecasts, the assigned probabilities varied between 20 and 60 percent, with about a 40–50 percent probability for the most likely outcome band. The forecasts are difficult to downscale and are imprecise as to the risks of erratic rainfall patterns that have a critical effect on crop performance. Implicitly, the focus has continued to be on the risk of major drought. The greater attention now paid to forecasting and monitoring weather through the season, however, ensures that scientific data on a 10-daily basis are more rapidly available to inform assessment and decisions. Global climatic developments are also closely watched, and assessments are quickly disseminated through the Internet. A problem is that decisionmakers would like very clear predictions (“This climatic event will lead to this pattern of weather in the coming months”), particularly when food security depends on good crop-growing conditions. The reality is that because of the complexity of weather patterns and impacts, forecasts often have to reflect uncertainty. For example, forecasters identified a high probability of a relatively weak El Niño event toward the end of 2002, but there was great uncertainty about what this might mean for the 2002/03 wet season. In effect, the models were saying that decisions about an already difficult food security situation had to be taken in circumstances of more than usual uncertainty.

Although it is difficult to place a robust value on climatic forecasting, qualitatively its usefulness is clear. Climatic forecasting work has:

- Provided a process for scientific consensus
- Integrated and strengthened meteorological systems in the region
- Established systems for closer monitoring and reporting of weather throughout the year

- Identified priorities for further research to improve forecasting ability
- Created systems for assessing climatic risk that can feed into decisionmaking.

This study has not assembled complete costing for forecasting work. The financial costs attributable to the whole forecasting effort for southern Africa are around US\$5 million, spread across services and research institutions within and outside the region. These costs are modest compared with the economic costs imposed by climatic variability in the region, which are estimated to be at least US\$1 billion a year. Regional climatic forecasting needs to be sustained as a learning process. Although long-lead forecasting is still in its infancy, climatic research is making rapid progress—for example, toward including the oceanic influences of the Indian and South Atlantic Oceans in forecasting models. An important point is that the benefits are not confined to the region. The private sector, the international donor community, and financial institutions are all involved in managing the effects of climatic variability.

The ultimate test of the usefulness of information is whether and how it is used, and with what results. A survey of potential and actual users of forecasts, undertaken as part of the study, has confirmed the value of forecasting. First of all, country-specific forecasts can alert international and national agencies and NGOs to the need for precautionary measures to safeguard food security and water supplies and to reduce the cost of crisis measures, which could be financially destabilizing. But the survey also highlighted problems that at present limit the value of forecasts. For example, the spatial scale is often not detailed enough; there is insufficient detail about the distribution of rainfall within the wet season; information about the start and end of the rains is needed; there needs to be sufficient time to respond to forecasts; and users would like more information about the accuracy of past forecasts. At present, only some commercial farmers are able to respond to more specific seasonal forecasts. Smallholders lack the technical options and resources to modify significantly their choice of crop, seed variety, or traditional planting practices. The use being made of climatic forecasting is promising, but considerable institutional strengthening and technical capacity building, more systematic application of current scientific

knowledge, and investment in data and equipment are still required.

Conclusions and Recommendations

The findings that emerge from the study of Malawi and southern Africa pertain to the interplay between climatic variability, agriculture, and economic performance; the value and limitations of climatic forecasting; and the need for better information on climate. Recommendations are proposed as appropriate.

Climatic Variability, Agriculture, and Economic Performance

The agriculture and economies of southern Africa are highly sensitive to climatic variability—more so than had been recognized. The 2002 food crisis underscored the vulnerability of the region, and especially the rural poor, to food insecurity resulting directly from climatic instability and shocks, and not just drought.

The intense impact of droughts between 1981/82 and the mid-1990s led to a too-narrow preoccupation with drought at the expense of the broader problem of climatic variability. But agricultural performance is also sensitive to rainfall 25 percent or more above average and to intraseasonal variations in the distribution of rain. Agriculture in the region is likely to perform best when annual rainfall is within a 90 to 120 percent band of long-term mean total rainfall. High rainfall, as well as drought, should signal the need for increased concern about regional food security.

Both El Niño and La Niña are important influences. An increased risk of an extreme El Niño event should put the region on the alert for a possible drought and a related food crisis, particularly in countries near the core of the southeastern African climatic region. But El Niño events alone are not good predictors of agricultural performance; the floods and the poorer agricultural year in 2000/01 were associated with a La Niña event. Countries to the north of the region are more sensitive to erratic intraseasonal rainfall distribution than to relatively rare low-rainfall or drought years. Climatic variability at the country and subregional levels needs closer monitoring.

Southern African agriculture is becoming more sensitive to climatic shocks. There is evidence of increasing volatility in agricultural indicators such as maize yields and in macroeconomic performance. Factors contributing to this fragility include:

- *Unsustainable agricultural practices.* Cereal production is stagnating due to failure to follow cropping patterns that sustain soil nutrient levels or to increase fertilizer applications to compensate for the effects of intensified land use and environmental degradation.
- *Structural change in agriculture.* A shift in production to smallholders has not been accompanied by sufficiently successful efforts to establish a viable credit system, provide support in the form of seeds and other inputs, and create a supportive marketing structure for smaller producers.
- *Institutional weaknesses* that constrain smallholder agriculture and contribute to food insecurity and malnutrition.
- *Political instability* in the region.
- *Foreign aid* that has been influenced by political and governance issues, as well as by directly economic and humanitarian needs.
- *The effects of HIV/AIDS on human resources*, which are insidious but are so far largely unquantified.

Climatic change may affect the area's hazard risk. Although there is as yet no conclusive evidence that the region is becoming drier or is suffering more frequent extreme climatic events, both are anticipated as consequences of global climatic change. A fuller understanding of the environmental and socioeconomic consequences of variability is needed in order to isolate the forms of climate change and their implications.

Climatic Forecasting and How to Increase Its Usefulness

There is an urgent need to reduce vulnerability to climate variability and the threat posed by climate change. Critical to achieving reduction in vulnerability is improvement in the information that forms the basis for decisions at all levels, from smallholders to national and international bodies. The study looked at what has been achieved and what remains to be done and asks whether climatic forecasting should be a priority for international aid and for

the use of scarce human resources within southern Africa. Among the findings are the following:

- Efforts to improve regional forecasting and provide better frameworks for disseminating information are continuing.
- The costs of forecasting (presently estimated at around US\$5 million for long-term forecasting for southern Africa) are modest compared with the very high economic losses caused by climatic variability. Even a small reduction in losses through improvements in public decisions and private risk management justifies investment in strengthening forecasting.
- Although there is no doubting the usefulness of forecasting, there is some disappointment about what has been achieved so far. The discovery of El Niño effects created unrealistic expectations about the power and precision of forecasting; the full extent of the increasing sensitivity of the region's agricultural economy to variability in general, rather than just to drought, had not been appreciated; and although users can see the value of forecasting, their ability to respond is often limited.

Forecasting needs to be focused on climatic variability more broadly. This requires more research, downscaled to zonal levels and intraseasonal timescales.

More specific information about the evolving weather situation would be useful to specific groups such as water system managers, commercial farmers, and public institutions and NGOs working with small farmers.

Closer agronomic-meteorological collaboration is needed to help national and international institutions make more effective use of forecast information in their decisions, including decisions on food security and agricultural support.

More rapid reporting of variability would facilitate quicker responses to an evolving situation.

More systematic research is needed into the relationship between crop performance and erratic and very high rainfall.

Information and Public Action

Poor-quality information was an important factor contributing to the 2002 food crisis in Malawi and perhaps in southern Africa at large. Weaknesses in statistical data—meteorological, agricultural, and economic—which hampered this study, have become more serious during an extended period of budgetary near-chaos in Malawi and underfunding of statistical and scientific information systems. The HIV/AIDS epidemic may also be eroding the human resources needed for this work.

The availability of good-quality, trustworthy data is a necessary condition for effective management of natural disaster risks (and indeed, in all areas of public action). Strengthening and sustaining information systems as a public good in low-income countries has to be an international priority.

Much remains to be done to make better use of climatic information in public policy at the country, regional, and international levels. As soon as there is evidence of an enhanced risk of an extreme event, the international community, as well as SADC countries, must use the available information to prepare for aid policy discussions and to develop economic strategies for the countries involved. The experience of the 1991/92 drought led to greater efforts to ensure food security, assess the need for humanitarian aid, and prepare for wider economic and financial consequences, but the 2002 crisis demonstrated that the situation is not yet satisfactory.

Notes

Chapter 1

1. See, for example, Atkins, Mazzi, and Easter (2000) and the authors' case studies for Fiji (Benson 1997a) and Montserrat (Clay and others 1999).
2. Despite the considerable literature on disasters in Bangladesh, that country is not exceptional. The public finance dimension had received little attention except for official postdisaster assessments of individual events such as the floods in 1998.
3. An El Niño event is a periodic warming of the surface waters in the equatorial zone of the central and eastern Pacific that is linked to a reversal of the normal ocean currents within the Pacific. There are teleconnections or associations between El Niño (and the obverse—a La Niña event) and abnormal weather worldwide (Stockdale and others 1998; Zebiak 1999). One such association, especially when an El Niño is intense or sustained, is an increased risk of low and erratic rainfall across much of southern Africa (Clay and others 2003).
4. For example, an official assessment of the costs of the 1998 floods in Bangladesh aggregated capital losses such as damage to infrastructure with rice crop losses. An assessment of Hurricane Lenny in Dominica in 1999 included costs of physical damage and reductions in income from small-scale fisheries. This practice is quite general: the widely cited estimates of disaster-related “direct damage” in the Emergency Events Database (EM-DAT) of the Centre for Research on the Epidemiology of Disasters (CRED) include crop losses (reductions in the flow of agricultural output), along with damage to stocks of assets such as infrastructure and housing (IFRC 2002).
5. There is no generally accepted definition of vulnerability beyond recognition of sensitivity and resilience as component aspects (Alexander 1997).
6. Although there is no accepted term covering both atmospheric (or climatic) and hydrological hazards, *World Disasters Report 2002* uses the term “hydro-meteorological” to characterize events resulting from atmospheric and oceanic processes that are recurrent, widespread, and dynamic, under the influence of global climatic change (IFRC 2002).

Chapter 2

7. The case studies are discussed in more detail in appendixes A, B, and C and are documented in full in the separate case study reports.
8. Other broadly comparable countries made a more rapid but similar transition, leaving Dominica the least developed of the former British Caribbean island colonies.
9. Because bananas are highly sensitive to damage from winds of 40 miles per hour or more, even the fringe impacts of less severe tropical storms can cause serious damage. Smallholders are ill equipped to bear heavy losses because of their limited assets and lack of access to credit. Recovery of banana plantations, however, takes only 9 to 12 months, even when crops are totally devastated. So, where finance for replanting is available and marketing channels are not disrupted, bananas are highly resilient. By contrast, production of copra, Dominica's other major commercial crop in 1979, took three to four years to recover.
10. Most of Dominica's road system runs along the narrow coastal strip very near the shore, rendering it highly vulnerable to storm damage. Other key infrastructure networks—telecommunications, electricity, and water transmission and distribution—run alongside the road and are similarly vulnerable.
11. The deepwater port at Woodbridge Bay, built between 1974 and 1978, illustrates the value-for-money case for designing new infrastructure and buildings to withstand hurricane damage.
12. Formally, hydro-meteorological hazards are determined by highly complex, chaotic climatic processes, as illustrated by the well-known El Niño–Southern Oscillation.
13. The base period for climatic analysis is 30 years (currently, 1961–90). A much longer run of data is required to assess climate-related risks. Two examples from case study countries illustrate the potentially costly consequences of expectations formed on the basis of short-term experiences. In Dominica, which had not experienced a direct hit from a Category 3 or more hurricane for over 40 years prior to 1979, there was widespread underestimation of the levels of storm-proofing required in buildings and infrastructure. In southern Africa the decision

rules established in the relatively wetter 1970s for managing water levels in Lake Kariba failed to provide sufficient reserves to prevent the 1991/92 drought from disrupting electric power supplies to Zimbabwe (Benson and Clay 1998).

14. Manufacturing and exports of coconut-based soap products, encouraged by a Caribbean Community and Common Market (CARICOM) agreement, increased during the 1990s in Dominica. The destruction of coconut trees and reductions in yield as a consequence of a hurricane in 1995 had little impact on manufacturing production. By then, a substantial share of copra was being brought in from overseas because of high domestic prices and Dominica's very limited production. By contrast, in Zimbabwe during the early 1990s, strong intersectoral linkages transferred the impacts of the agricultural sector's increased vulnerability to drought to the rest of the economy.

15. The governments of Botswana and Namibia have had sufficient resources of their own to finance substantial relief programs, reflecting the importance of the extractive mining sectors in both countries (Drèze and Sen 1989; Thomson 1994).

16. Socioeconomic change related to development can lead to the breakdown of traditional familial support, declines in traditional ways of life and the associated coping measures, and the increased occupation of more hazardous land. These processes are in part associated with urbanization. Increased provision of infrastructure and services may also alter vulnerability and even heighten it. For instance, construction of arterial roads from rural to urban areas can shift cropping patterns away from lower-yielding and less marketable but more hazard-tolerant, traditional crops and toward more marketable but higher-risk crops. Kelly and Khan Chowdhury (2002) explore these issues for Bangladesh.

17. The gradual integration and deregulation of food markets in Bangladesh have helped reduce the macroeconomic effects of major disasters. By contrast, the deliberate rundown of maize stocks in Malawi in 2001 proved highly costly, partly because the private sector had failed to respond to previous deregulation. The export of maize stocks by Zimbabwe before the 1991/92 drought offers an uncomfortable parallel. In Fiji sugar reserves have been used to maintain export earnings and prevent loss of export markets in the aftermath of natural disasters (Benson 1997a).

18. Bangladesh faces severe global competition in the export of ready-made garments. By contrast, it was the world's primary jute producer and, as such, was a price setter on the international market. Disruption to the production of ready-made garments could result not only in the direct loss of export revenue but also in the loss of markets overseas.

19. Case study evidence for Dominica and Montserrat indicates that both capital and labor mobility are realities in the Caribbean region.

20. Preliminary investigations for Indonesia, when it was being considered as a possible country case for this study, similarly indicated that it might be difficult, because of the country's physical size, to isolate on a national scale the effect of disasters that had a large provincial impact.

21. Some of the environmental and geographic factors studied are climate, location (coastal or landlocked), availability of natural resources, agricultural productivity, and incidence of disease (see, for example, Diamond 1998; Gallup and Sachs 1999).

22. For example, farmers in more hazard-prone ecosystems of Bangladesh, Vietnam, and other South and Southeast Asian countries have been less well placed to take advantage of higher-yielding but less hazard-tolerant strains of rice (Catling 1994; Hossain, Bose, and Chowdhury 2001). Similarly, some combination of greater incidence of natural hazards and (related) higher incidence of poverty can influence the choice of location of investments. In Vietnam, for instance, this choice is contributing to widening regional disparities, as some more hazard-prone regions have received disproportionately small shares of both private and public investment and external assistance (Benson 1997c).

23. The postdisaster shift out of agriculture is explained by a combination of a gradual reduction in larger-scale production (because of failure to invest fully in replacement), a movement of smallholders into employment in other sectors, and, following Hurricane David in 1979, off-island migration. Hurricane David resulted in the temporary exodus of almost 20,000 people, equivalent to about a quarter of the predisaster (1978) population. Among those who left were many school-age children, and 20 years later, the population had still not recovered to its 1978 level. The fisheries sector in Dominica, which provides livelihoods for many poor families, contracted with each major disaster. Capital losses are high in every major storm, and some fishermen, lacking insurance, fail to replace damaged boats and equipment.

24. Writing a decade earlier, Khan and Hossain (1989: 144) also concluded that "inadequate infrastructural facilities constitute a serious obstacle to the economic and social development of Bangladesh" and that "the physical infrastructure is in urgent need of rehabilitation and expansion" (181).

25. The continuing volcanic crisis in Montserrat provides an extreme example of the long-term impacts of a disaster. The present eruption, which began in 1995, has had a devastating impact on the economy, with serious implications for the island's

medium- and long-term development. Most of Montserrat's administrative, commercial, and industrial facilities have been destroyed, and the crisis has forced fundamental changes in the economic structure. It has also had serious ramifications for financial institutions, precipitating high rates of default on outstanding loans. The economy will not be viable in either the short or the medium term without large-scale subsidies from the United Kingdom. At the individual level, Montserratians have faced loss of livelihoods and of other assets, including savings. Demographic effects have also been massive; over 50 percent of the residents have left. The country has been fragmented by mass migration and relocation, and community and household structures have broken down (Clay and others 1999).

26. In Zimbabwe, for instance, goats are often kept as a form of savings to pay for secondary education. In the aftermath of the 1991/92 drought, a number of households were forced to sell their goats to sustain short-term levels of consumption, with implications for longer-term investment in human capital (Hicks 1993).

27. This process of pauperization is well documented—for example, in drought-prone areas in the Ethiopian highlands (Devreux, Sharp, and Amare 2002).

Chapter 3

28. The authors have so far been unable to identify any other in-depth retrospective analysis of disasters and public finance, apart from single-event studies.

29. For example, despite the 1988 floods, Bangladesh's overall budget deficit for 1988/89 was actually *lower* than had been originally projected. Total revenue was higher, both relative to budgeted figures and compared with actual revenue in all earlier years during the 1980s. Meanwhile, recurrent expenditure on public food operations, via the Food Account, and on the revenue budget (effectively, all recurrent expenditure) was only marginally higher than budgeted, despite increased flood-related expenditure.

30. The block allocations, which are comparatively new, are substantial and increasing. For example, in the 1998/99 budget they totaled 11.2 billion taka (Tk), or 7 percent of the total gross revenue budget. Of this, Tk 5.3 billion was allocated for unexpected expenditures.

31. The most serious pressures on the separately administered Food Account were not felt until 1989/90, when stocks were rebuilt. Meanwhile, revenue was boosted by the introduction of

additional measures to counteract the budgetary impacts of the floods, including the imposition of a 6 percent surcharge on income tax; the collection of an additional surcharge of 5.1 percent on excise duties on certain items; deduction of a 4 percent relief and rehabilitation levy from dividend and interest incomes on balances in savings and fixed-deposit accounts; and a levy of 4 percent on telex and telephone bills. Expenditure on the Annual Development Program (ADP) was almost 20 percent lower than budgeted, despite flood-related expenditure, implying that spending on some projects was much lower than planned.

32. Before the eruption, Montserrat had a resident population of 12,000 in an area of 100 square kilometers. It was a middle-income country, with GDP per capita of US\$3,600 in 1994. In 1997 revenue receipts (excluding budgetary assistance in the form of a special grant) totaled only 59 percent of the 1993–94 average, and only 35 percent of the figure for 1998. Meanwhile, government expenditure increased by 56 percent in real terms, despite a decline in population. As a consequence, Montserrat became the recipient of budgetary support for the first time since 1981. According to British government procedures, if an overseas territory receives budgetary aid on a regular basis, or is likely to do so, the finances of that territory must come under the supervision and, in effect, control of the secretary of state for international development. Accordingly, as a direct consequence of the volcanic crisis, the island's government lost any semblance of financial independence (Clay and others 1999).

33. For instance, according to a UN damage assessment undertaken in the wake of the 1998 flood in Bangladesh, US\$186 million was required for the repair of damage to roads and highways alone, yet the 1999/2000 ADP contained no projects in this sector whose titles indicated that part or all of the expenditure was intended to address damage resulting from the flood.

34. In Dominica capital investment projects relating to post-disaster rehabilitation and reconstruction are typically not identified as such in annual budget statements. But a large part of the increase in capital expenditure between 1983/84 and 1985/96—that is, up to seven years after Hurricane David—could be attributed to major road investment projects necessitated in part by the hurricane. Part of this increase in capital expenditure would have been required in any case to make up for years of inadequate maintenance and low investment.

35. The figure of 20 percent should be put in context. Actual ADP expenditure is, in any case, typically lower than planned; over the period 1980/81 to 1998/99, it averaged 89 percent of the budgeted amount.

36. In the particular case of Bangladesh following the 1988 flood, the World Bank commented that “while this is a prudent approach, it is not necessarily desirable in all situations, particularly when (as at present) domestic demand is stagnant, the inflation rate is declining, the banking system has adequate liquidity, and there are substantial donor resources available to assist in flood rehabilitation that are likely to be under-utilized because of shortages of local funds. In this situation, increased deficit financing can be helpful to the economy, provided that the government is prepared to take subsequent measures to increase revenues and restrict expenditures so that the economy does not overheat” (World Bank 1989: para. 2.19).

37. In 1988 the government of Bangladesh lifted restrictions on the import and manufacture of agricultural pumping equipment, encouraging an accelerated expansion of private investment in lift irrigation and an associated rapid growth in production, especially in output of boro (dry-season) rice. The benefits of this expansion were particularly noticeable in terms of agricultural resilience in the aftermath of the 1998 floods.

38. The accounting treatment of bonds for investment, recapitalization, and replacement of nonperforming loans is also ambiguous. Foreign aid is shown as a receipt for financing the ADP, but the loan component of aid is not included in public debt (World Bank 1996). A further issue concerns the practice of cash accounting, in which any internal transactions go unreported.

39. The Electricity Commission of Malawi (ESCOM) incurred losses as a consequence of the drought because tariffs did not keep pace with inflation. Nonpayment also peaked in the crisis year of 1992. The National Railways of Zimbabwe ran a deficit in 1992/93 owing to increased operating costs as a direct consequence of the drought-related import program that, among other impacts, obliged it to hire wagons from South Africa and elsewhere (EC 1993).

40. In Bangladesh the basic medium-term planning exercise is the five-year plan. A three-year rolling plan was introduced in fiscal 1991, with the terminal year of each plan coinciding with the first year of the next. The two types of plan are used as the basis for drawing up the ADP. Projects within the ADP are examined in terms of their compatibility with these plans, as well as their cost, technical quality, and economic viability, but political pressures and the availability of external assistance for particular activities also play a role. Thus, development priorities may already be compromised before the occurrence of a disaster. Problems are exacerbated by the slow process of formalizing budgetary allocations and reallocations; postdisaster expenditure is sometimes undertaken before it has been formally approved. Some flexibility (varying among ministries) in the use

of funds is permitted, again potentially contributing to a deviation away from stated objectives in the wake of a disaster.

41. Foster and Fozzard continue: “Unfortunately, such indiscriminate cuts ignore spending priorities and the differing composition of expenditure, particularly as regards non-discretionary items. Where a substantial proportion of sector expenditure is dedicated to payroll, as in the case of the social sectors, cuts on discretionary items are likely to be more severe than in the sector with a smaller payroll component. In all sectors, cuts will be directed at consumables. In some cases this will mean that staff continue to be paid although they lack the basic materials necessary to deliver services. Investment projects are another common target of cuts in expenditure, leading to the postponement of projects or the failure to meet commitments with donors for the financing of internal contributions” (2000: 18).

42. The ProVention Consortium is “a global coalition of governments, international organizations, academic institutions, the private sector and civil society organizations dedicated to increasing the safety of vulnerable communities and to reducing the impact of disasters in developing countries” (from the ProVention Website, www.proventionconsortium.org/index.htm; accessed November 5, 2003).

43. In Bangladesh the budgetary difficulties resulting from the 1988 floods made it exceptionally difficult to prepare the budget for the fiscal year 1989/90 because of the implied additional financial demands and the uncertainties created by the crisis. At one point during the preparation of the 1998/99 budget, it was even suggested that there would be a deficit in the revenue (recurrent) budget, implying no surplus—or resources—for the ADP. The ADP had to be reworked again and again as priorities and estimates of the available budgetary envelope changed.

44. As Foster and Fozzard (2000: 12) state, “The budget cycle needs to be nested within a longer term policy and planning process, which provides a clear link from planning to the allocation of resources . . . an annual budget is too short a time frame for addressing development priorities, which require sustained implementation of policies and reforms over a medium to long term period.”

45. Fozzard and others (2001) report that many OECD governments have already introduced a medium-term expenditure framework (MTEF) and that a number of developing countries are also embarking on this process. The MTEF consists of a top-down resource envelope consistent with macroeconomic stability and explicit strategic priorities; a bottom-up estimate of the current and medium-term costs (both recurrent and investment) of existing and new policies, which are also reviewed to verify their consistency with overall government priorities and

spending limits; and an iterative decisionmaking process that matches these costs with the available resources.

46. In 1999, 20 years after Hurricane David had inflicted severe damage, and almost a decade after the first comprehensive sea defense protection plan was completed, Hurricane Lenny again exposed the inadequacies of sea defenses and the vulnerability of the road network and other infrastructure along the coast.

47. The study demonstrates the potential benefits of structural mitigation through a retrospective analysis of public and private projects in the Caribbean that have suffered damage from tropical storms. One project examined was the deepwater port in Dominica, which was constructed by the government to handle banana exports more efficiently and to lower the handling costs of imports. A year after completion of the facility, Hurricane David struck, causing reconstruction costs equivalent to 41 percent of the cost of the original port. The study estimated that had the original facility been built to a higher standard, able to resist Category 4 hurricanes (an option rejected on grounds of cost), investment costs would have been only about 12 percent higher (Vermeiren, Stichter, and Wason 1998).

48. Bangladesh is arguably a notable exception, at least to the extent that considerable public resources have been invested in flood control under the highly interventionist flood control, drainage, and irrigation (FCDI) strategy launched in the 1960s. It is difficult, however, to estimate total spending on disaster-related activities, other than in terms of the substantial proportion of development expenditure absorbed by the water resources sector. Furthermore, the proportion of FCDI accounted for by disaster reduction is difficult to isolate. Expenditure on mitigation of other hazards, most obviously earthquakes, may be far too low from an economic perspective.

49. There is “a significant bias toward capital expenditures, driven by governments which perceive the current coverage of services and infrastructure to be inadequate and the expansion of service networks as a priority. . . . One of the results of this capital bias is to reduce the funds available for O&M, leading to inadequate funding of service provision and the gradual degradation of capital investments and the quality of public services” (Fozzard and others 2001: 46). The project bias of aid toward additionality favors investing in new physical and human resource development rather than making up for inadequate recurrent spending.

50. The Dominica government states that “the fiscal burden [of natural disasters] has been significant necessitating the diversion of scarce resources from programmed activities” (Dominica 2000: 4). To achieve one of its principal goals of economic diversification, the government has placed particular emphasis on the

provision of infrastructure to support growth in agriculture, manufacturing, and tourism. The weak infrastructure base has been consistently identified as a critical constraint on the pace of development, limiting the country’s ability to attract and sustain new productive investment. Part of this weakness relates to the continuing vulnerability of the internal transport and communication network to adverse weather systems, necessitating expenditure to rehabilitate roads in the aftermath of storms. The indirect fiscal impact of disasters has been an additional factor contributing to limited government saving and restricting the availability of counterpart financing. The lack of counterpart financing is reported to have “led to the non-implementation or the deferral of important projects in the social sector, notably in housing, water and sewerage” (Dominica 1998: 24).

51. The strains that the Philippines’ rising population places on the country’s ability to provide sufficient classrooms and other social infrastructure have been exacerbated by the damage inflicted by natural hazards. Indeed, the National Physical Framework Plan, 1993–2022, lists this damage and the consequent redirection of resources (which in turn hampers the implementation of other infrastructural projects), as one of six key issues and concerns in the development of infrastructure (Philippine NLUC 1992).

52. In the Philippines the 1990 earthquake and the 1989–90 drought were reported to have contributed to a 6.7 percent increase in total external debt in 1990 and a 22.4 percent increase in debt owed to official creditors alone (Ernst & Young 1991). An examination of the impact of the mid-1980s drought on external borrowing in six Sub-Saharan African countries revealed that the growth rate in total debt stocks accelerated during the year of most severe drought in five of the six (Benson and Clay 1998). The exception, Zimbabwe, had been pursuing a deliberate long-term policy of debt reduction.

53. The Japanese Overseas Economic Cooperation Fund (OECF) extended a loan to the Philippine government for the construction of rural roads in northern Luzon that were subsequently damaged by typhoons (Benson 1997b). Such loans cannot be canceled.

54. By 1991, Zimbabwe’s economy had failed to meet certain extended SAP targets, most notably falling 0.6 percentage point below the target GDP growth rate. Some commentators believed that the economy was unlikely to meet target performance indicators in 1992, either, and by the end of 1991 the government was beginning to warn of adverse short-term conditions as an unavoidable part of the structural adjustment process. The subsequent drought certainly impeded the progress of adjustment, and a number of the original economic targets for 1992

and 1993 were not achieved. In particular, the drought hampered efforts to reduce the budget deficit (and thus to reduce domestic borrowing) and to restructure the civil service and parastatal bodies. As a consequence, the expected domestic supply-side response to the reform program, which was critical to its success, was partly curtailed. But the drought was retrospectively seen by the Zimbabwe government, as well as by the World Bank and the IMF, as the principal cause of the economic difficulties experienced in 1992, rather than as a factor exacerbating existing problems. Cynics might even argue that the drought provided a convenient scapegoat for the country's economic difficulties, allowing the IMF and the World Bank, which were keen for a "success" story of adjustment, to continue to hold up Zimbabwe as a potential triumph. Meanwhile, the drought enabled the Zimbabwe government to sustain the reform process by avoiding a large decline in public support (Benson 1998).

55. John Roberts, Overseas Development Institute, personal communication, February 2003.

56. General contingency reserves are often used to meet the cost of any public sector wage increases negotiated during the year.

Chapter 4

57. Recent important theoretical and policy contributions to the subject include Kaul, Grunberg, and Stern (1999) and Ferroni and Mody (2002). The work by Cornes and Sandler (1996) is widely regarded as the fullest statement of the theoretical framework on which these discussions are based.

58. The World Bank (2001) estimated total annual average aid commitments during the period 1995–98 at US\$5 billion for core IPG and US\$11 billion for complementary activities, yielding a total of US\$16 billion. On a narrower basis, te Velde, Morrissey, and Hewitt (2002) estimated total annual average IPG commitments during 1996–98 as US\$9 billion, the equivalent of 9 percent of ODA.

59. The spatial scale of forecasts is often not detailed enough, and there is insufficient detail about the distribution of rainfall within the wet season. Information about the start and end of the rains is needed. There also needs to be sufficient time to respond to forecasts. Finally, users would like more information about the accuracy of past forecasts.

60. The International Development Association (IDA) grants concessional assistance to low-income countries. It and the International Bank for Reconstruction and Development (IBRD) make up the World Bank.

61. For example, there is a large gap between import and export parity prices for cereals in the landlocked countries of southern Africa. Failure to recognize the increasing risks of an impending poor production season has resulted in decisions to run down national food security stocks of maize, necessitating costly imports as replacement stocks. This happened in Zimbabwe in 1991 and in Malawi in 2001. Liberalization of internal and external markets for cereals shifts part of the decisionmaking to the private sector. If the private sector misjudges the situation, governments and the international community face the contingent liability of ensuring food security and preventing famine at almost any cost.

62. Even more problematic than the shelter program has been the construction and maintenance of the network of coastal embankments to mitigate the effects of storm surges. There can be, for example, rivalry between rice producers, mostly small farmers, and large-scale shrimp producers, who sometimes breach the embankments to admit saline seawater, thus jeopardizing the protective function of the works.

63. In 2001 the government of Bangladesh contributed 56 percent of the recurrent operational costs (totaling US\$460,000) of the Cyclone Preparedness Program managed by the Bangladesh Red Crescent. The International Federation of Red Cross and Red Crescent Societies covered the remainder (IFRC 2002).

64. Monitoring units have been installed, one in each participating country. Such a project raises problems of sustainability, and trust funds amounting to US\$50,000 have been agreed on for the maintenance of each unit. In the light of the damage suffered by some units during Hurricane Lenny, further expenditure will be required to improve storm resistance (information derived from www.cpacc.org).

65. As yet, there are no models that integrate real-time meteorological information for upstream areas in India to predict flood hazards in Bangladesh. Warnings depend on direct assessments by dam and river engineers that go through official channels within India and are then passed on to authorities in lower riparian Bangladesh (Chapman and Rudra 2002).

66. Since 1967, three national risk zone maps have been produced for Bangladesh. The latest (1993) version is reproduced in Benson and Clay (2002a: map 3). Local geologists acknowledge the tentative nature of these assessments, which are based on the inadequate available data. In addition, visual inspection suggests that the latest Bangladesh map is inconsistent with the seismic hazard map produced in India for neighboring West Bengal State.

67. The SRU is an autonomous entity within the University of the West Indies, St. Augustine Campus, Trinidad. Its core funding

is provided by Trinidad and Tobago; 20 percent of the funding comes from Barbados, and 30 percent comes from six other jurisdictions: Antigua, Dominica, Montserrat, St. Lucia, St. Vincent and the Grenadines, and St. Kitts and Nevis. Additional funds are obtained from specific contracts such as that for providing seismic monitoring for Netherlands overseas territories. The SRU has faced pressures to reallocate core staff to university teaching (Clay and others 1999). The islands of Martinique and Guadeloupe, between which Dominica is sandwiched, are part of the French national monitoring system and are not in the same seismic network as Dominica. The U.S. territories rely on the U.S. Geological Survey. The Caribbean Disaster Emergency Response Agency (CDERA), an organization that supports disaster preparedness and disseminates information, is confined to the former U.K. colonies and the remaining U.K. overseas territories. The OAS, which supports disaster mitigation and loss reduction, does not include European overseas territories.

68. H. Alderman, lead human resource economist, Africa Region, World Bank, personal communication, November 2002.

Chapter 5

69. Insurance payouts can be made in as little as 24 hours after a disaster if the adjusters can be organized quickly.

70. The law of demand states that the lower the price of a product, the greater the amount demanded. The position and shape of a consumer's demand curve—that is, the amount of a product demanded for a given price—will depend on ability to pay, as determined by the financial resources at the consumer's command, and on willingness to pay, as determined by the utility (satisfaction or need fulfillment) derived from consumption of a particular quantity of a good. Demand curves for all consumers in a market can be aggregated to produce a market demand curve showing the total amount consumers would like to purchase at each price.

71. For example, the World Bank (1998b) recommended complementary actions by both the public and the private sectors to help overcome problems relating to the safety of insurance coverage in the Caribbean region. Companies and households in the region should be encouraged to establish financial reserves to supplement insurance and cover uninsurable losses. Governments should consider the establishment of reserve funds that could be drawn on for infrastructure repairs. The OAS has similarly recommended both incentives and requirements for the creation of financial reserves in the Caribbean region.

72. The World Bank is providing a contingent credit line to a compulsory earthquake insurance scheme established in certain areas of Turkey in the wake of the 1999 Marmara earthquake. The credit line provides initial capitalization of a newly created insurance pool, ensuring its financial solvency should an earthquake occur while funds are being accumulated.

73. The one apparent exception, United Insurance, has actively promoted structural mitigation. Premium discounts of up to 40 percent are available for retrofitted commercial properties, with reductions of 17 to 25 percent for retrofitted domestic properties. The program, which was officially introduced only in 1997, has already achieved impressive results. The average cost of claims on affected risks following Hurricane Jose in Antigua in 1999 was equivalent to 10 percent of the total sum insured but to only 4.75 percent of the sum insured in the case of retrofitted projects. Although the program was not intended as a marketing tool, it has generated new clients for the company in Antigua. But although United has considered making its mitigation program mandatory for all its insurees, as the sole company offering such a scheme it has concluded that, on balance, it would probably lose clients if it did so.

74. This coverage was estimated by an insurance industry spokesperson at about 90 percent of businesses (including factories) and 18–20 percent of households in 1996. The securing of mortgages is conditional on the acquisition of cyclone insurance, which can be obtained only on presentation of a certificate confirming compliance with the 1985 National Building Code. Even then, the system may break down in a softer market. As of early 1996, the Fiji insurance market had become highly competitive following record profits in the previous (disaster-free) year. This attracted new entrants who were rumored to be demanding no cyclone-proofing certification for issuing cyclone insurance policies.

75. Following an escalation in August 1997 of Montserrat's continuing volcanic crisis, international insurers suddenly canceled most insurance policies on the island. Because the small economy was a marginal part of their business, they could exit with little impact on their overall portfolios. With the cancellation of insurance policies, mortgaged assets immediately assumed a zero value, resulting in the effective collapse of the country's only building society, the locally registered Montserrat Building Society, and this had multiplier impacts throughout the economy, as well as severe societal effects (Clay and others 1999).

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