INSURANCE AS AN ADAPTATION STRATEGY FOR EXTREME WEATHER EVENTS IN DEVELOPING COUNTRIES AND ECONOMIES IN TRANSITION

NEW OPPORTUNITIES FOR PUBLIC-PRIVATE PARTNERSHIPS

Prepared for the Agency for International Development
Bureau for Economic Growth, Agriculture and Trade
Office of Environment and Science Policy
Climate Change Team

by

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The loss of forests, fresh water and biodiversity, inadequate and inefficient use of energy, and the explosive growth in the world's urban centers undermine long-term economic growth and threaten ecological systems. They also endanger human health, and increase developing countries' vulnerability to natural disasters and conflict.... Long-term economic growth depends upon managing a country's natural resource base, using energy to increase human productivity, helping cities to provide services and markets, and having predictable seasonal and long-term climatic conditions.

– U.S. Agency for International Development (2002)

PREFACE & ACKNOWLEDGMENTS

This report was commissioned by the U.S. Agency for International Development, with the joint aims of characterizing the insurance and reinsurance markets in developing countries and economies in transition, exploring the implications for changing patterns of extreme weather events (be they the result of natural variability or anthropogenic climate change), and, finally, identifying possible public-private initiatives to further engage the insurance sector in the process of sustainable development.

The research represents a fusion of literature from several fields: development, disaster relief, climate change, energy systems, and insurance and risk management. Sources include the insurance trade press, grey literature and reports, peer-reviewed journals, as well as primary data (especially from Swiss Re and Munich Re – the world's two largest reinsurance companies – widely regarded as the definitive sources of global insurance market data).

In this report we use the term "emerging [insurance] markets" to encompass both developing countries and economies in transition. Emerging markets are those with low insurance penetration, and are typically characterized by rapid growth in the use of insurance, and high vulnerability to natural disasters in comparison with industrialized countries. This is the parlance of the insurance industry, and is thus useful language for communicating with the insurance community. Moreover, the terminology encourages consideration of economic implications and demographic, rather than strictly geographical, patterns of vulnerability

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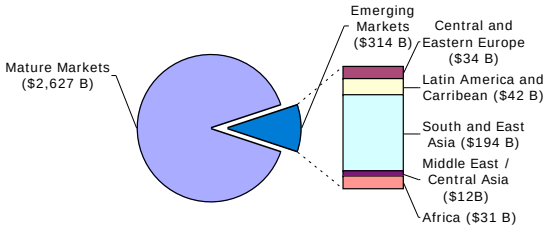
SYNOPSIS

The insurance industry[1] can play a material role in decreasing the vulnerability of developing countries and economies in transition to weather-related natural disasters while simultaneously supporting both its own market-based objectives and the objectives of sustainable development. Although insurance is not a "silver bullet" for the problems posed by natural disasters in emerging markets, public-private partnerships can enhance insurance's ability to spread the risks and manage the costs of weather-related disasters as well as to increase the pool of people who have access to coverage. (For simplicity in this report, the phrase "emerging markets" is intended to encompass developing countries and economies in transition.) Promising strategies for emerging markets involve establishing innovative products and systems for delivering insurance and using technologies and practices that both reduce vulnerability to disaster-related insurance losses and support sustainable development (including reducing greenhouse gas emissions). These strategies can enhance sustainable development efforts and increase the insurability of risks, making insurance markets in emerging markets more viable.

Emerging markets are especially vulnerable to extreme weather events, which impede development by causing physical damage, compromising human and ecosystem health, diverting scarce resources to disaster relief and recovery, and deterring future investment and insurance availability by amplifying the risks faced by foreign interests. An average of 300 million people are affected or killed each year by weather-related disasters in emerging markets. Characteristics of emerging markets contributing to their particular vulnerability in contrast to developed nations include: greater frequency of poverty; weaker lifelines (transportation, communication, utilities, emergency response, and hospitals); poorer quality of construction and absence of or deficiencies in building codes and other regulations; and high dependence on resource-based industries (e.g., agriculture). Natural disasters such as drought often dislocate large groups of people, amplifying their vulnerability to future disasters. Development itself can compound these vulnerabilities by promoting population growth, urbanization, intensive coastal development, and concentrations of climate-sensitive physical and health-related hazards.

Eleven Percent of $2.9 Trillion/year Global Insurance Market is in Developing Countries and Economies in Transition: 2003

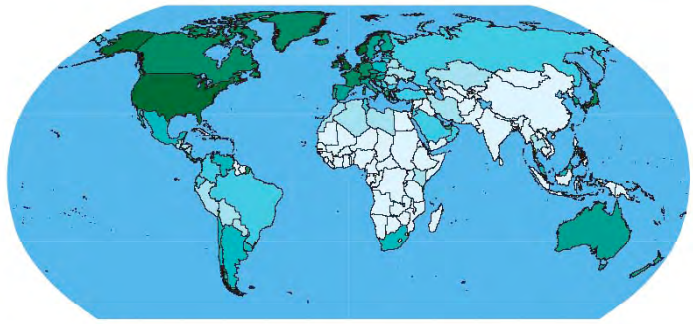


Source: Swiss Re, Economic Research & Consulting, Sigma No. 3/2004 [Swiss Re (2004)]. Includes property/casualty and life/health insurance.

With its pool of financial reserves, the global insurance market provides considerable adaptive capacity for weather-related damage to property, life, and health. The global insurance market—perhaps the world's largest industry—represented $2.9 trillion in premiums in 2003, or approximately eight percent of global gross domestic product (GDP). To put this in perspective, the insurance industry's revenues make it equivalent to the third largest country in the world in terms of GDP.

In 2003, total premiums in emerging markets represented $314 billion (up from $270 billion just a year earlier) or 11 percent of the global total, with growth rates often dramatically higher than those in the industrial world (twice as high, on average, between 1980 and 2000) and often exceeding GDP growth rates. Emerging markets are poised to represent half of world insurance premiums by the middle of this century.

The Use of Insurance varies Widely Around the World (non-life premiums/capita)



Uninsured group: US$ 0–5
Basically insured group: US$ 6–25, US$ 26–50
Well insured group: US$ 51–100, US$ 101–500, US$ 501–1,000, US$ 1,000+

Source: Munich Re

[1] Unless otherwise noted, the terms "insurance" and "reinsurance" are used synonymously in this report.

Insurance premiums are rising in part because the economic costs of natural disasters are growing, as is the insured share (up from a negligible level in the 1950s to approximately 20 percent of the total today). Insurance market conditions vary regionally. Current insurance penetration (premiums per GDP) is lowest in Africa and Asia and highest in Latin America. Premiums as a percent of GDP are lowest in the Middle East/Central Asia and Latin America and highest in Africa. The smallest market by total premiums is the Middle East/Central Asia, and the largest is South and East Asia (excluding Japan).

The economic costs of weather-related events are high, totaling $1 trillion worldwide from 1980 through 2003. During this period, insurance covered four percent of total costs of weather-related disasters in emerging markets compared to 40 percent in high-income countries. While relatively small, insurance payments to people in emerging markets associated with these losses were three-times the magnitude of international aid. The potential for changes in weather patterns, including both average conditions and extreme events, would likely raise the demand for insurance whether the changes are a result natural variability or human-induced climate change. At the same time, increases in weather-related damage create uncertainties and challenge insurers' ability and willingness to assume or affordably price these new risks. Sustainable development can contribute to managing and maintaining the insurability of these risks and thereby reduce the need for individuals and governments to absorb the costs.

Because of the multi-national structure of the insurance and reinsurance markets, and other factors, the economic consequences of extreme weather events are becoming increasingly globalized. The growth of foreign insurers' premiums in emerging markets averaged more than 20 percent per year through the 1990s. During the late 1990s, the U.S. alone was collecting approximately $40 billion in premiums each year for policies placed in other countries. This globalization of the risks and consequences of natural disasters is a significant reason for the insurance industry to seek to reduce the risks of claims worldwide.

Cost-effectively mitigating the damage from (and thus the costs of) natural disasters would be a boon not only to the insurance industry and developed nations but to public health and sustainable development in emerging markets. One of many strategies is curtailing deforestation, which reduces risks of wildfire, malaria, mudslides, and flooding as well as reducing greenhouse gas emissions. Sustainable energy technologies can also mitigate risk; for example, distributed power systems coupled with efficient energy end-use technologies reduce business interruptions resulting from damage to the power grid.

In sum, involving the insurers of extreme weather events in the development and execution of strategies that contribute to public health and sustainable development would enhance disaster resilience, reduce the magnitude of losses, and thus help increase insurers' willingness to establish, maintain, and expand a constructive presence in emerging markets. We offer the following principles for establishing priorities:

- Focus on efforts that enhance the fundamental insurability of weather-related risks.
- Couple insurance efforts with core development activities.
- Foster efficient domestic government and private insurance risk sharing.
- Utilize public-private partnerships.
- Build domestic/local insurance and risk-management capacity.
- Discourage complacency in response to insurance availability or government aid.
- Respond to insurers' regional priorities.
- Address life and health insurance issues along with those related to property damage.
- Raise awareness within the insurance sector.
- Harness market-pull forces (e.g., foster aggregated demand for insurance products).
- Understand insurers' relationship to the security implications of climate change.

Using these principles, this report outlines a sampling of specific initiatives that could be undertaken to develop improved information and analysis, sustainable technologies to enhance resilience to disasters, and innovative insurance products and services. Specific criteria should be developed to help prioritize the opportunities. As insurers have many "fires to fight," and environmental issues such as natural or human-induced climate change must compete for attention among other strategic concerns, key target markets (economic, demographic, and geographic) should be identified, and proposed initiatives should clearly define their relevance to the insurers. It is incumbent on public entities seeking partnerships with insurers to establish and demonstrate the value of these partnerships. This study is a step toward that goal.

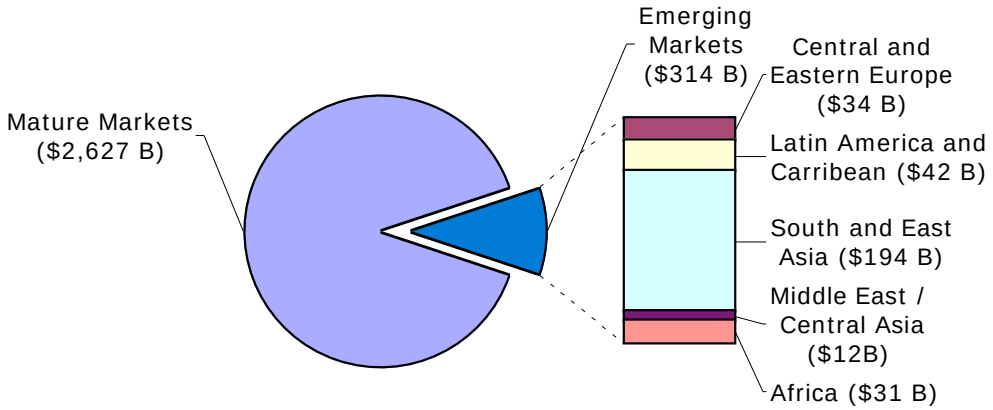
EXECUTIVE SUMMARY

The Insurance Industry[2] Can Play a Material Role in Decreasing the Vulnerability of Developing Countries and Economies in Transition to Weather-Related Natural Disasters while Supporting its Market Objectives and Sustainable Development.

Traditional responses to the impacts of extreme weather events, such as emergency relief, are critical but woefully inadequate. International aid today absorbs only one percent of total weather-related disaster costs and is consistently less than the amounts requested by impacted countries. With the rate of weather-related losses increasing dramatically, rising natural-disaster costs in aid-receiving countries, and growing demand for other forms of aid, relief aid is unlikely to absorb a greater share of the costs of natural disasters in the future. However, growing interest in an integrated notion of development and disaster relief (UNDP 2002) could leverage the funds that are currently directed toward development so that they also address disaster resilience and sustainable development.

Insurance is a promising vehicle for complementing international aid and improving the adaptive capacity of developing nations and economies in transition (referred to together as "emerging markets" in this report) to respond to natural disasters. Insurance activity in emerging markets is three-times that of international aid, in terms of insurance payouts versus aid funds expended, and availability and use of insurance is growing while international aid levels remain roughly level. Nonetheless, the penetration of insurance in emerging markets is low compared to that in industrialized countries. Insurance premiums in emerging markets as of the year 2003 totaled approximately $314 billion (up from $270 billion just a year earlier), or 11 percent of the global market (Figure ES-1).

Figure ES-1. Eleven Percent of $2.9 Trillion/year Global Insurance Market is in Developing Countries and Economies in Transition: 2003



Source: Swiss Re, Economic Research & Consulting, Sigma No. 3/2004 [Swiss Re (2004)]. Includes property/casualty and life/health insurance.

Although insurance is not a panacea for the problems posed by weather- and climate-related risks, it can help absorb costs that cannot be addressed by international aid or local governments or citizens. Almost all "lines" of insurance are vulnerable to climate risks, whether they be direct property losses from natural hazards or business interruptions from the disruption of electricity grids or environmental liability claims caused by water contaminated by flood-related runoff from farms. Limitations to insurance's effectiveness in addressing these costs include the short time frame of insurance contracts and the ease with which insurers can withdraw from or increase prices in markets perceived as overly risky. Moreover, the insurance industry itself is vulnerable to extreme weather events and climate change, and its capacity to absorb risk varies depending on recent losses and other market factors. Nonetheless, insurers have historically used risk-management and loss-prevention techniques to reduce business risks in particular market segments; these strategies can be applied in emerging markets and productively coupled with sustainable development strategies.

The success or failure of insurance in emerging markets depends to some extent on the political, fiscal, and regulatory environment in those markets.[3] That is, the ability of foreign insurers to enter a new market depends on local political and regulatory protections, and domestic insurers may also require enabling regulation. Examples of regulatory interventions include restrictions on pricing, the types of investments insurers can make, limitations placed by host countries on access to international markets, and allowable reserve accumulations (Auffret 2003). Effective insurance regulation must strike a balance between allowing insurers an attractive return on their business activities and ensuring their solvency (and ability to pay claims) in the event of major disasters. Other needs include regulatory policies that support fiscal transparency and responsibility, and measures that can garner the trust of the insurance-buying public.

Three key types of activities could support the coupling of insurance and sustainable development:

- Generating information, training, and analysis to help make emerging markets attractive (i.e., less risky) for insurers;
- Identifying and deploying sustainable technologies to help emerging markets adapt to and mitigate natural disasters; and
- Fostering innovative insurance products and financing mechanisms to increase this form of risk spreading.

A major challenge is in setting priorities and developing the public-private partnerships necessary for success.

[3] For example, the introduction of tax-deductible life insurance premiums boosted the premium growth rate in Mexico and in Brazil (Swiss Re 2003a). In contrast, financial crises can dampen insurance markets in various ways (Swiss Re 2003a).

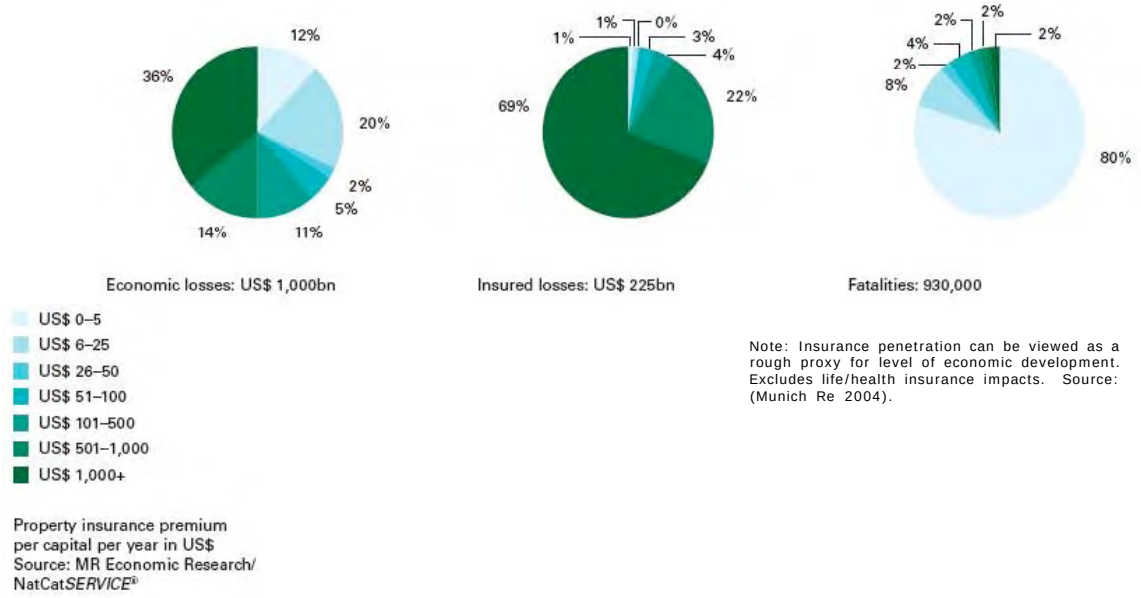
Emerging Markets are Particularly Vulnerable to Extreme Weather Events and are Constrained in their Ability to Adapt.

Extreme weather events and natural disasters can transform the physical, social, and economic landscapes of nations. They also create an impediment to development by causing physical damage, death, and disease; disrupting residents' livelihoods; diverting scarce resources from development to relief and recovery; and deterring future investment because they increase the risks that foreign interests face.

Development, especially if it excludes risk management, can compound vulnerability by, for example, increasing populations in urban, coastal, and other vulnerable regions (UNDP 2004).

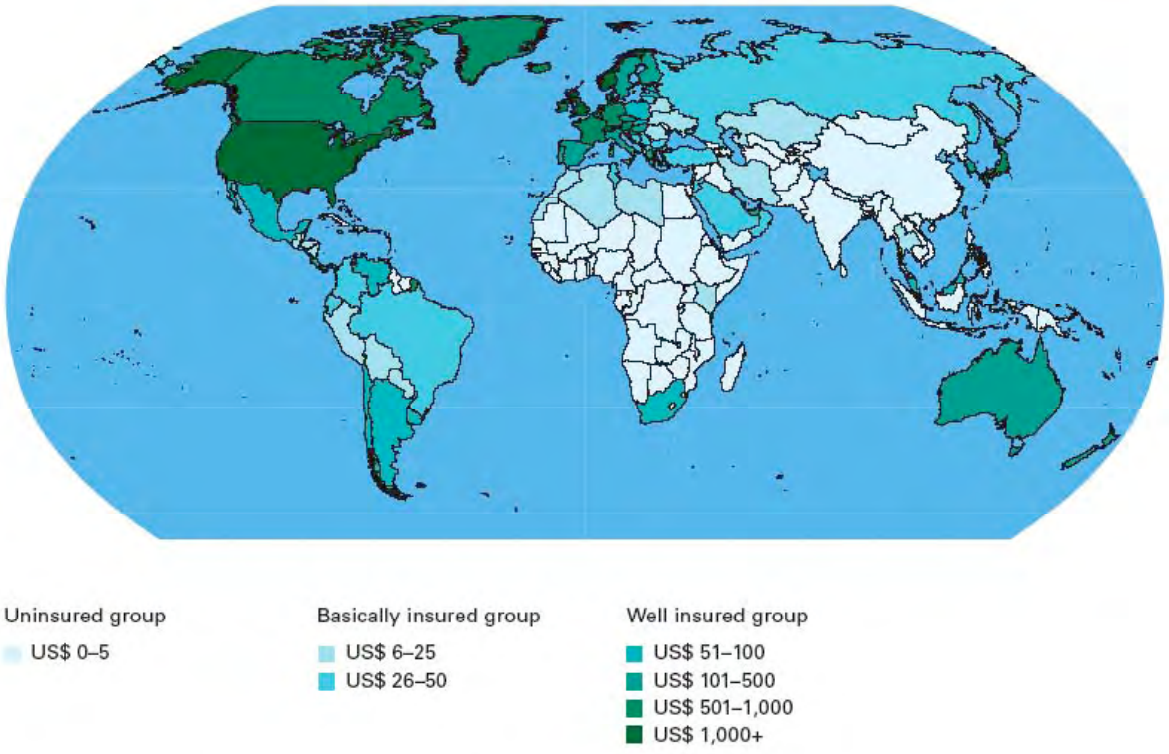
The economic costs of natural disasters fall disproportionately on the relatively wealthy, but the social costs – death and disease – fall largely on the poor. Wealthy countries experience more than 90 percent of the insured losses from natural catastrophes but only four percent of the deaths associated with these events (see Figure ES-2, which uses premiums per capita as a proxy for wealth).

Figure ES-2. Weather-Related Disasters - 1980-2003: The Economic Costs of Natural Catastrophes Fall Primarily on Wealthy Populations; the Loss of Life Primarily on the Poor



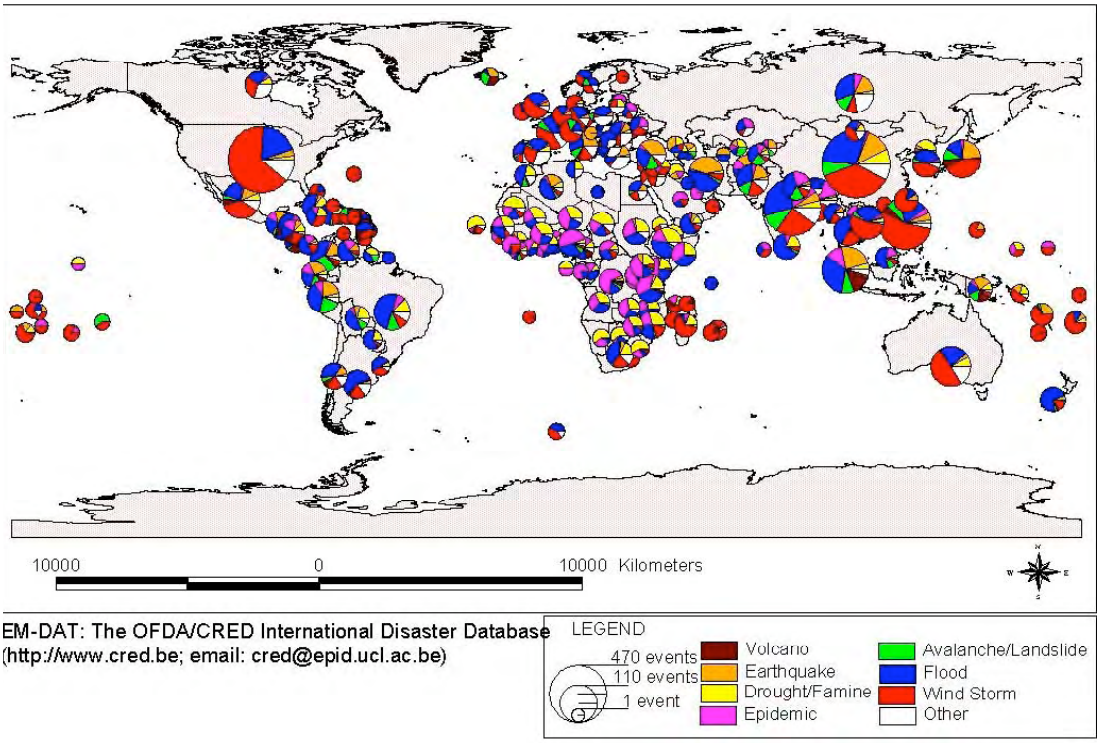
Although absolute costs are relatively low, economic impacts of natural disasters are greater in poorer nations; the costs of natural disasters between 1985 and 1999 equaled 13 percent of gross domestic product (GDP) in the poorest countries versus only two percent in the wealthiest countries (UNISDR 2003). The penetration of insurance varies considerably around the world, as does the type and scale of disasters (Figure ES-3).

Figure ES-3. The Use of Insurance varies Widely Around the World



Property insurance premium (non-life including health) per capita per year in US$
Source: MR Economic Research/NatCat*SERVICE*®

The Type and Scale of Natural Disasters are Distributed Unevenly: 1975 to 2001



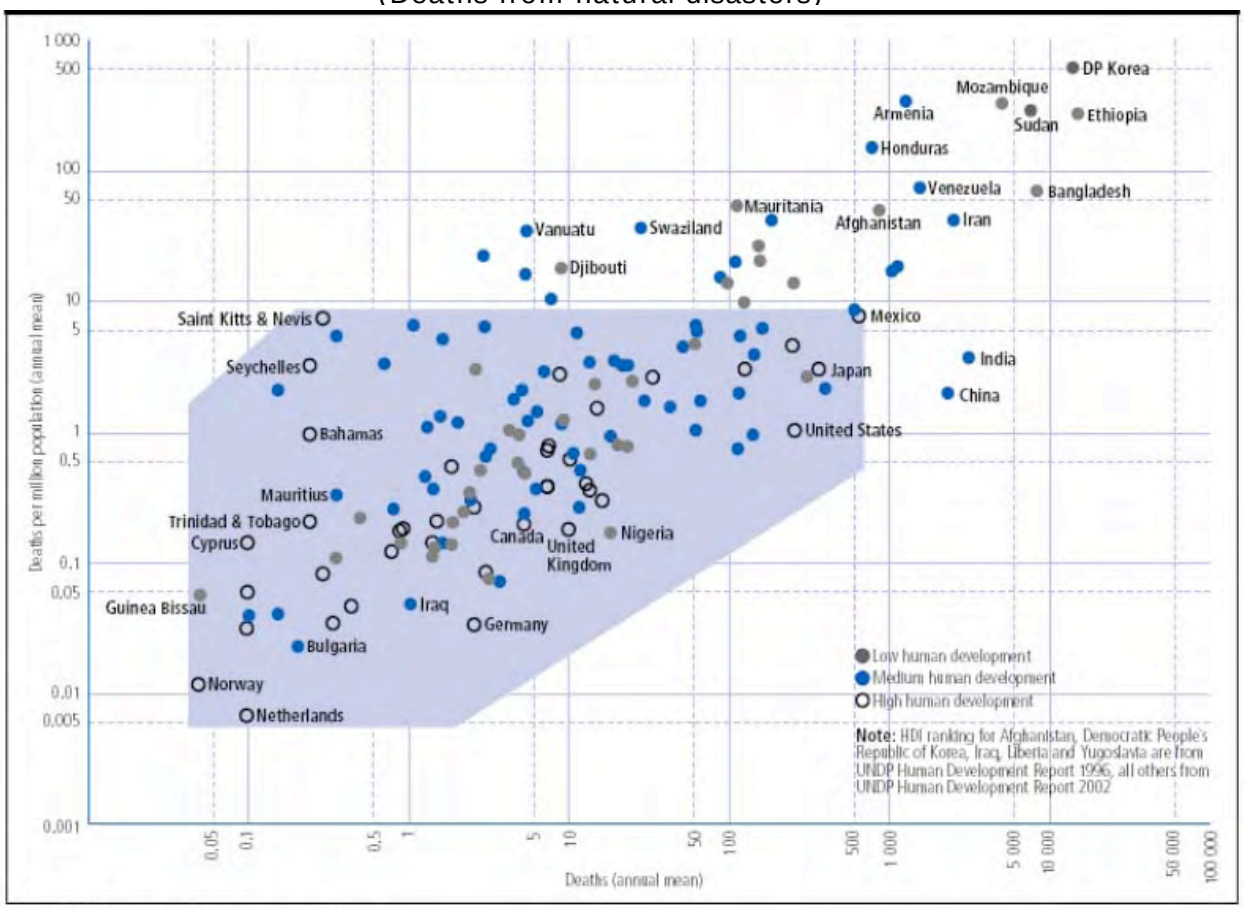
The ability to adapt to extreme weather events is lowest in the poorest segments of society and in countries where resources, information, and skills are limited; technology is often unavailable; institutions are unstable or weak; and empowerment and access to resources is inequitable (Smit et al. 2001).

Vulnerability (evidenced by numbers of people affected and death rates from natural disasters) is, not surprisingly, highest in emerging markets (Figures ES-4).

Among the many reasons for the vulnerability of emerging markets to natural disasters are population growth, urbanization, intensive coastal development, high geographical concentration of certain types of climate-sensitive physical and health-related hazards (e.g., tropical cyclones and infectious or water-borne diseases), susceptibility to damage because of the absence of building codes, and relatively heavy economic reliance on the particularly vulnerable agricultural sector.

The weather-related subset of disasters (excluding earthquakes, volcanoes, and disasters caused by people) corresponds to 98 percent of the people affected by disasters of all types.

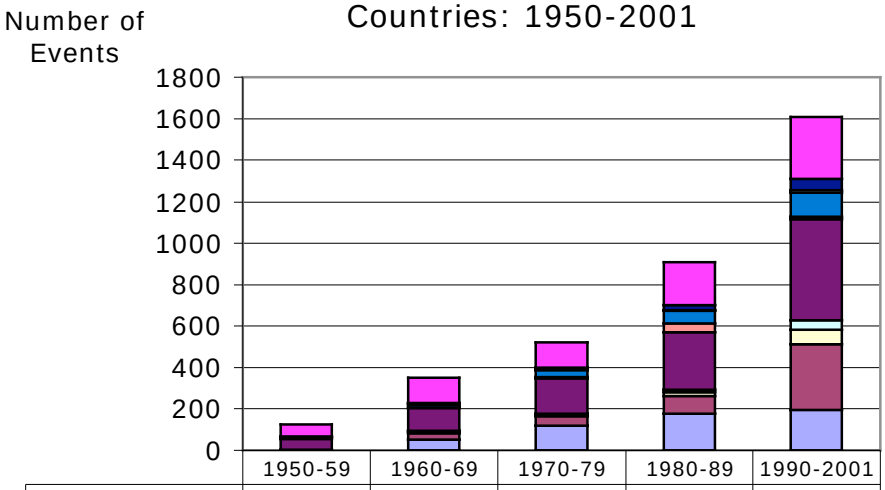
Figure ES-4. Vulnerability is Higher among Lower-Income Countries (Deaths from natural disasters)



Source: EM-DAT OFDA/CRED International Disaster Database From UNISDR (2003). Note that scales are logarithmic.

According to statistics in the Emergency Events Data base (EM-DAT), compiled by U.S. Agency for International Development Office of Foreign Disaster Assistance (USAID/OFDA) and the Center for the Research in the Epidemiology of Disasters (CRED), the number of weather-related natural disasters has risen sharply during the past 50 years (Figure ES-5).[4] The incidence of weather-related disasters per decade has risen from approximately 100 to 1,600 events during the past 50 years in less-developed countries, with the number of people impacted or killed per decade rising steadily from 15 million during the 1950s to four billion during the 1990s. These trends are a result of changes in the nature of natural hazards and demographic factors bringing greater numbers of people into harm's way.

Figure ES-5. The Frequency of Weather-Related Disasters Has Risen in Less-Developed Countries: 1950-2001



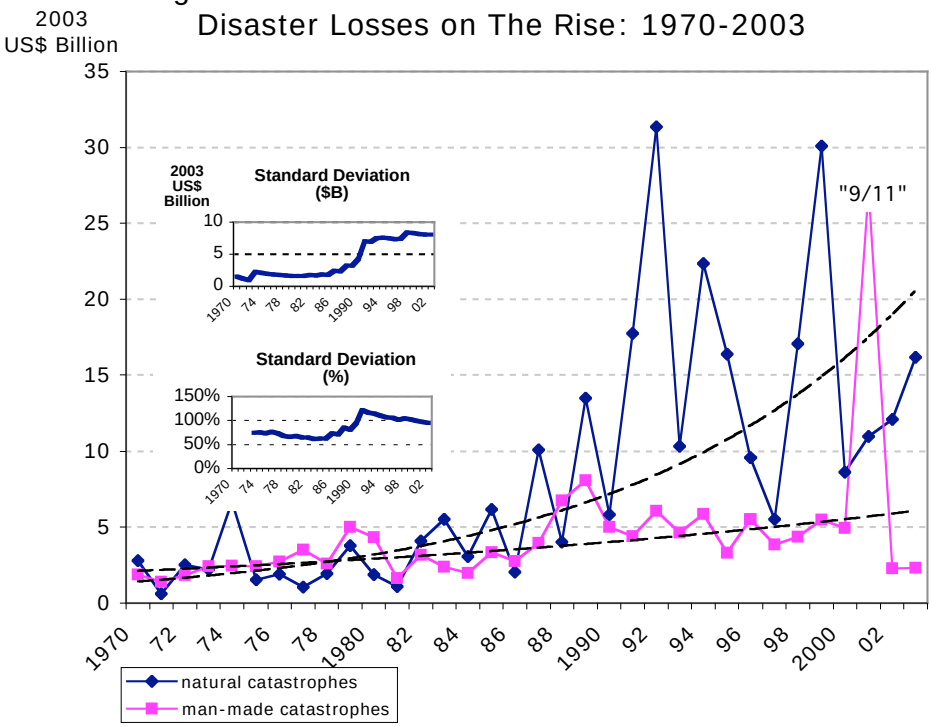
	1950-59	1960-69	1970-79	1980-89	1990-2001
Wind storm	59	121	121	207	300
Wild fire	0	4	11	25	54
Wave/surge	2	5	2	3	12
Slide	11	15	34	63	114
Insect infestation	0	1	6	43	13
Flood	50	110	170	276	489
Famine	0	2	4	11	45
Extreme temp	4	10	9	19	70

Sources: OFDA / Center for Research in the Epidemiology of Disasters (CRED) "Natural.xls" Intl database of Disasters (http://www.cred.be/emdat/intro.html) and U.S. Census Bureau's International Database (http://www.census.gov/ipc/www/idbagg.html). From analysis completed by Padco's Climate Change Solutions Group for USAID's Global Climate Change Team. "Population Impacted" includes those persons that have either been killed, injured, left homeless, or otherwise adversely affected.

[4] As with all such datasets, caveats apply with respect to uniformity over time in data collection methods, data quality, comprehensiveness, etc. A discussion of the EM-DAT data provided by Brooks and Adger (2003) concludes that analyses based on data from 1970 forward are "fairly robust."

Although all losses have increased in absolute terms, the rise in the relative incidence of weather-related events (such as wildfire, extreme temperature episodes, and epidemics) compared to non-weather-related ones (such as volcano eruptions or earthquakes) is particularly notable (Vellinga et al. 2001). The costs of so-called "man-made catastrophes" have also risen more slowly than those of natural catastrophes (Figure ES-6), as has variability.

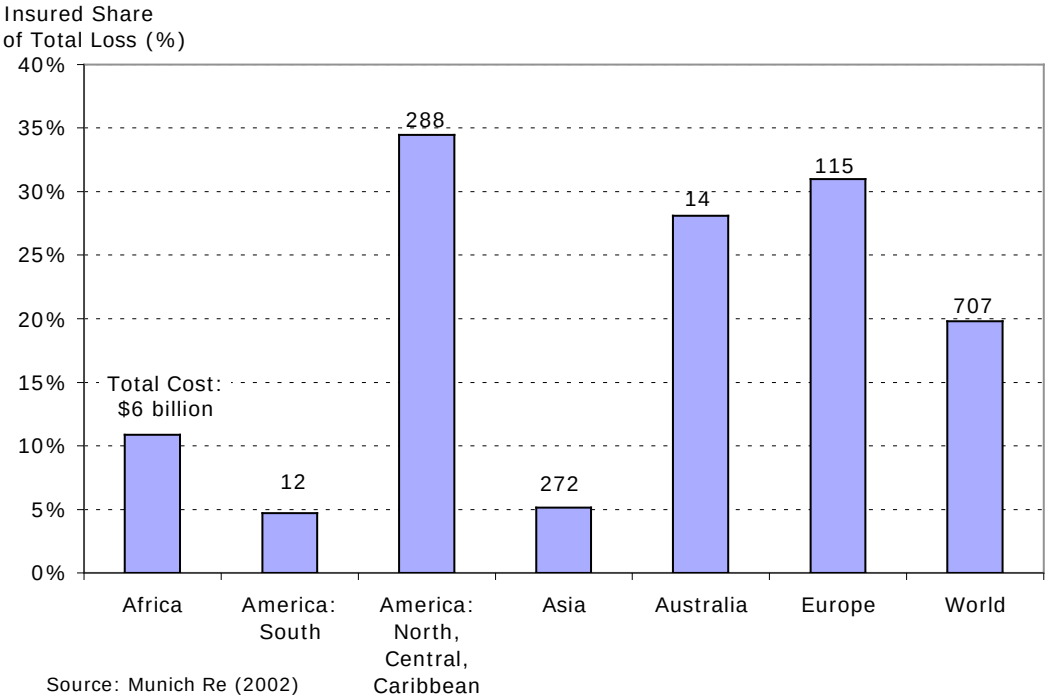
Figure ES-6. Global Inflation-corrected Insured Disaster Losses on The Rise: 1970-2003



Per Swiss Re's conventions, losses reported here are a subset of the total, including events with losses in excess of $35.1 million or total economic losses in excess of $70.2 million or 20 dead or missing, 50 injured, or 2000 homeless. Source: Swiss Re, Economic Research & Consulting, sigma 1/2004 [Swiss Re (2004)]. Excludes life/health insurance impacts. Growth rate of weather-related natural catastrophes is greater than that of non-weather-related ones, e.g. earthquake and volcano. Trendlines added.

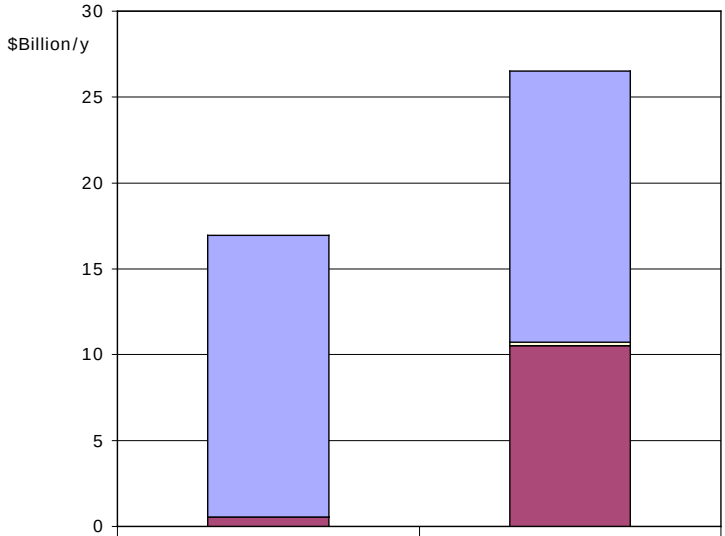
From 1980 through 2003, the economic costs of all weather-related natural disasters totaled $1 trillion, divided approximately 40/60 between wealthy and poor countries, respectively (Munich Re 2004). Over this period, insurance covered four percent of the total costs of weather-related disasters in low-income countries and 40 percent in high-income countries (Figures ES-7, ES-8). Associated insurance payments were three-times the amount of international aid provided. Social costs have increased more quickly than economic costs (death rates have increased fifteen-fold compared to a fivefold increase in economic costs) in the emerging markets. According to the Intergovernmental Panel on Climate Change (IPCC), costs are rising because of a combination of changes in the nature of natural disasters and the increasing vulnerability of society to these disasters (IPCC 2001). Costs not absorbed by domestic governments, foreign aid, or insurance fall on impacted citizens and businesses.

Figure ES-7. A Greater Share of Weather-Related Losses are Insured in Mature Markets than in Emerging Markets (1985-1999)



Source: Munich Re (2002)

Figure ES-8. A Small Proportion of Weather-Related Disaster Costs Are Absorbed by Insurers in Lower-Income Countries



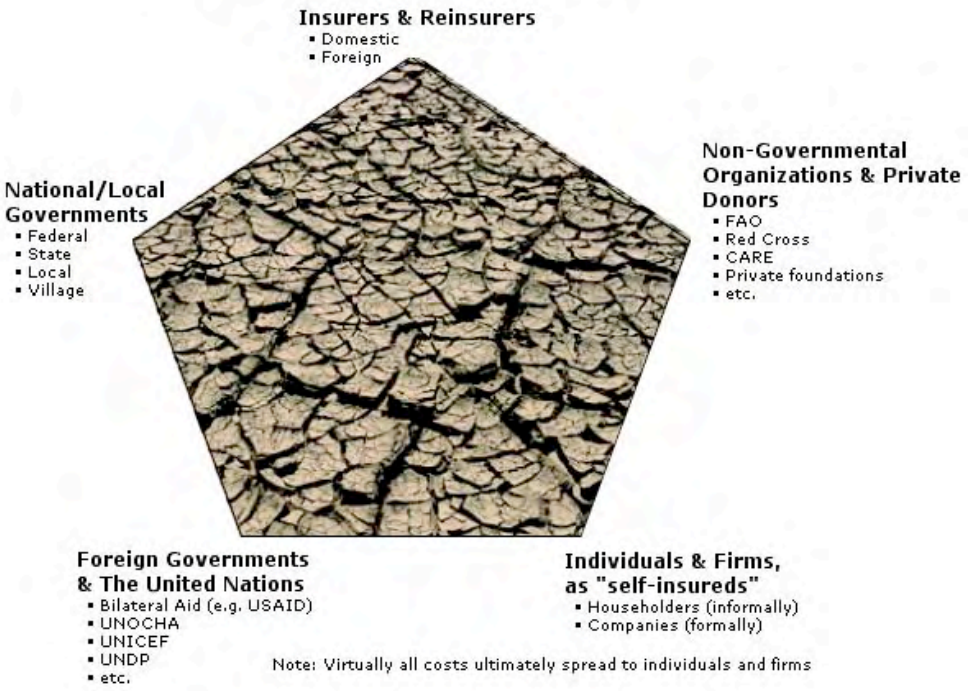
	Low Income Countries	High Income Countries
Domestic governments & Individuals	16.40	15.79
Internationnal Aid	0.00	0.20
Insurers & Reinsurers	0.55	10.53

Notes: Periods over which yearly averages are determined: Total: 1980-2003, Insurance: 1980-2003, AID: 1992-2003. Sources: http://www.reliefweb.org (disaster relief); Munich Re 2004 (insurance and total econom c costs; low-income defined as property/casualty premiums of $100/capita-year or less). Value for domestic governments & indiv duals is the res dual. A d donors include those tabulated by OCHA: UN Agencies, donor governments, internat onal organizat ons, the Red Cross, and NGOs (excludes purely mil tary a d).

The Costs of Weather-Related Risks are Widely Spread Among Governments, Insurers, & Individuals.

Risks from natural disasters are spread among five distinct groups: insurers and reinsurers; domestic governments (local/national); individual foreign governments and cross-national bodies such as the United Nations (UN); non-governmental organizations (NGOs) and private donors; and the individuals and firms ultimately impacted when no form of assistance is available (Figure ES-9). International relief for natural disasters covers only a small fraction of the cost of these disasters, and, during the past two decades, overall aid, as defined by the United Nations Office for the Coordination of Human Affairs (UNOCHA),[5] has been roughly constant (and declining in terms of aid/donor gross domestic product) while the costs of weather-related disasters have tripled in real terms. Although, as noted above, more people are impacted by weather-related events than any other type of event that precipitates the mobilization of emergency relief, the majority (86%) of emergency relief funds are directed toward non-weather-related events, particularly the so-called "complex emergencies" such as civil conflict.

Figure ES-9. Extreme-Weather Risks Are Spread in Five Directions



Even in wealthy nations, governments are increasingly seeking to limit their financial exposures to natural disasters (e.g., the U.S. National Flood Insurance Program will pay out no more than $250,000 per loss per household (McDonald 2003)). The problem is worse in emerging markets where governments are hard pressed to absorb the large costs of natural disasters (which are unpaid by insurers, aid, or individuals). Disruption of economic activity and diversion of government funds to prepare for and recover from natural disasters constrains development.

Insurance is the only source of adaptive capacity that is clearly increasing.

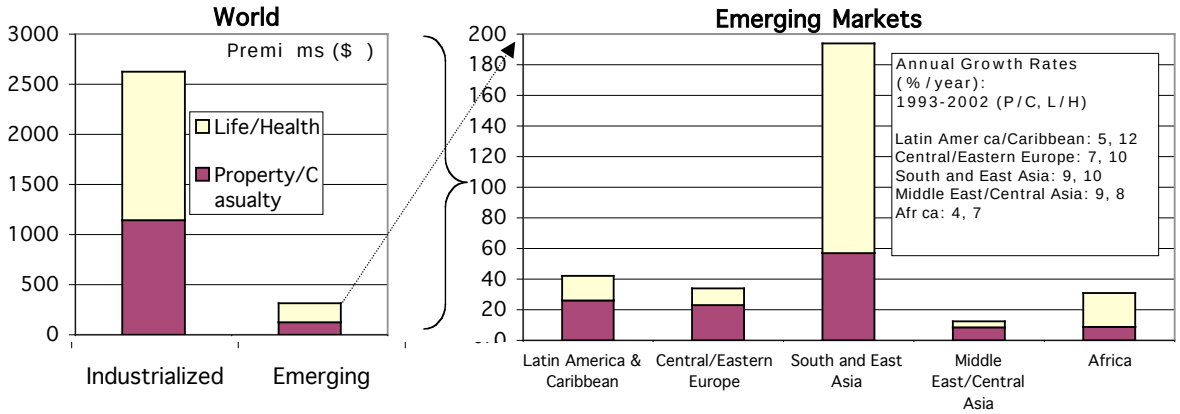
[5] Includes The Organization for Economic Cooperation and Development (OECD)/Development Assistance Committee (DAC), multilateral, and non-DAC sources. Excludes purely military aid. See http://www.oecd.org/dac/htm/online.htm.

The Global Insurance Market Offers Considerable Adaptive Capacity.

Worldwide, insurance companies collected $2.9 trillion in premiums in the year 2003 or about eight percent of global GDP.[6, 7] To put the size of the insurance industry in perspective: comparing the industry's revenues to national GDPs shows that it is equivalent to the third largest country in the world. The insurance sector perhaps is the world's largest industry.[8]

The distribution of annual insurance premiums paid among emerging markets is as follows: 62 percent of premiums originate from South and East Asia, 13 percent from Latin America and the Caribbean, 11 percent from Central/Eastern European, 10 percent from Africa, and four percent from the Middle East and Central Asia (Figure ES-10). The mix of life-health versus property-casualty insurance vary widely among nations, with a 40/60 ratio on average (Figure ES-10), but the magnitude and growth rates of life insurance tend to be greater than those of property insurance. In response to the confluence of economic growth, population growth, and market liberalization, the insurance sector is growing rapidly (significantly faster than GDP) in emerging markets (Figure ES-11). During the past two decades, premium growth in emerging markets has consistently exceeded, by a factor of two on average, premium growth in industrialized economies where insurance saturation is greater.[9] At current growth rates, emerging markets will represent half of world half of world insurance premiums by the middle of this century.

Figure ES-10. Global Insurance Market Summary: 2003



Source: Swiss Re (2004)

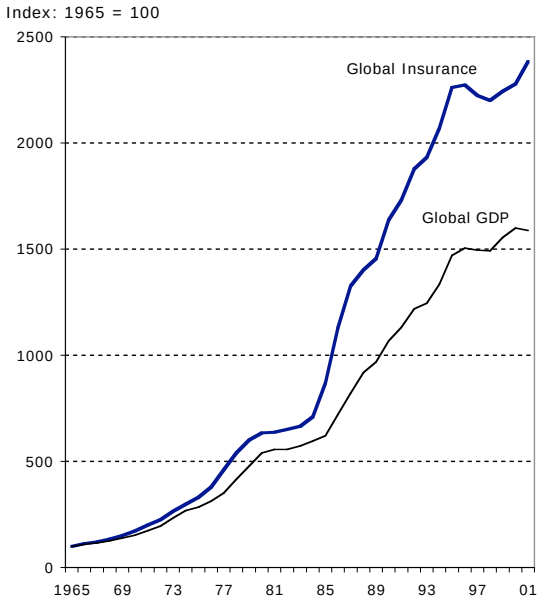
[6] Detailed country-by-country statistics (in U.S. dollars and local currencies) are published in Swiss Re's annual "World Insurance" reports (e.g., Swiss Re 2004a).

[7] Data presented in this report represent western-style insurance and do not include the premium-equivalents that are collected from alternative systems, such as *Takaful* methods used in the Muslim world or so-called "self-insurance" which is often formalized and represents considerable capacity.

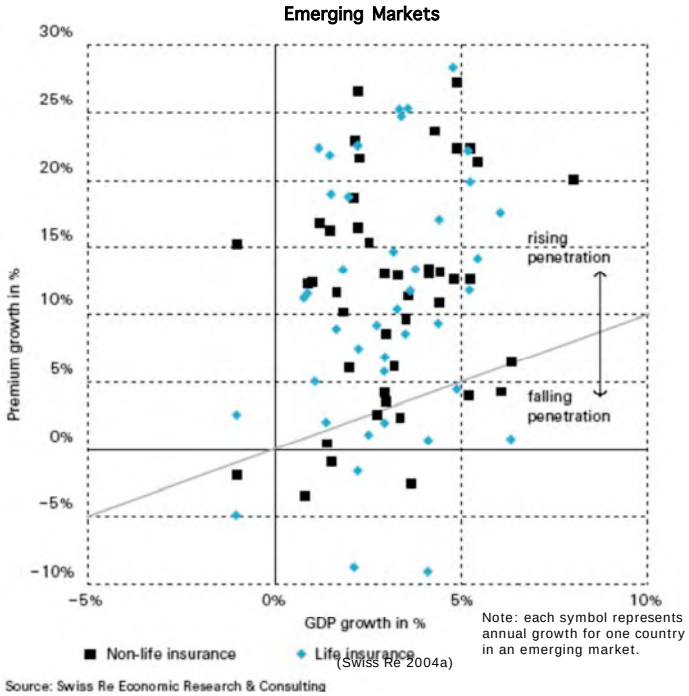
[8] The world oil market, for example, is $970 billion/year at current production levels of 76Mbod and $35/bbl price; world electricity market in 1996 was $1.3 trillion at 13 trillion kWh generation assuming $0.10/kWh unit price; tourism receipts were $445 billion in 1998; world military expenditures were $800 billion in 1995 (Source: 1999 Statistical Abstracts of the United States).

[9] For the period 1980 to 1998, South and East Asia was the fastest growing region with 15 percent per year growth for non-life insurance and 25 percent for life insurance. In Latin America, growth was 10 percent and 15 percent,

Figure ES-11. Insurance Demand is Growing Faster than GDP, Particularly in Emerging Markets



Source: Swiss Re, Economic Research & Consulting; WEFA



Because of growing demand and affluence in developing countries and economies in transition, insurers from industrialized countries are rapidly moving into those markets. Insurance systems, however, are already challenged by natural disasters in wealthy countries where risk management and disaster preparedness are well developed. The outcome of this tug of war is key to determining the ultimate global role that insurers will seek to play in absorbing the costs of natural disasters.

Historical data on the degree to which insurance is used to pay for extreme weather events show that approximately 30 percent of costs are insured in industrialized economies while only five percent are insured in emerging markets (Vellinga et al. 2001). In both developing and industrialized countries, the penetration of insurance by type of event varies, with most coverage for storms and least coverage for flood[10] and "other" events such as drought and wildfire. Approximately 45 percent of global storm-related losses were insured over the 1985-1999 period versus five percent of flood and 13 percent of "other." Some events go uninsured; e.g., global losses from drought and heat wave reached nearly $7 billion in 2002, and little or none of these losses was insured (Best's Review 2003).

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and in Africa five percent and 15 percent, respectively. Trends in Eastern Europe were highly erratic for the post-1992 period for which data are available (Swiss Re 1999a).

[10] There is a common misconception that floods are entirely uninsured. Typically one-quarter of flood losses are paid by insurance, depending on the country in which they occur and the nature of the impacts. More than half of the economic losses from the massive Central European floods in 2002 were insured (Best's Review 2004). Definitional ambiguities often class flood-related losses as (insured) "storm" losses (Swiss Re 2003c).

The argument has been made that insurance can play a substantial role in managing and spreading risks, both because of its financial capacity and its ability to encourage loss-reducing behaviors more effectively than public-sector efforts (World Bank 2002b). By pooling risks among all those insured, insurers reduce the potential exposure of any individual to a manageable level; this effective risk spreading helps ensure that funds are available to pay for losses.[11] In addition to pooling risks, insurers are often proactive risk managers, e.g., by endorsing (or requiring) loss-prevention behaviors or technologies. Examples include insurers' historical role in creating building codes, fire departments, and Underwriters Laboratories product-safety labeling (Mills et al. 2001). More recently, insurers have begun to promote practices that enhance sustainability, particularly in energy use and management (Mills 2003b). Examples include promoting distributed electricity generation to reduce risks of power disruptions and energy-efficiency strategies that reduce vulnerability to freeze damage and provide off-grid lighting or water purification (which are important in disaster recovery). By helping spread the risks and costs of damages and by fostering disaster resilience in the face of rising losses, the insurance industry can help build adaptive capacity in emerging markets.

The Consequences of Extreme Weather Events are Becoming Increasingly Globalized, in Part Because of the Structure of Insurance Markets.

As explained above, the costs of natural disasters in emerging markets are partly transferred to wealthier nations. This will be increasingly true in the future. Wealthier nations pay these costs because primary insurers are foreign-owned, locally domiciled insurance companies are reinsured (most reinsurers are based in industrialized countries), and international aid is provided in response to disasters.

Insurance is an integral part of the trend toward globalization, and U.S.-based insurers are leading the way, as measured by the magnitude of their participation in foreign markets. Current trends toward deregulation and liberalization in Asia and Eastern Europe as well as increasing wealth are fueling the growth of insurance.

Experience to date suggests that participation of foreign insurers will be important for the development of new insurance markets in developing countries and economies in transition. A statistical review by Swiss Re (2000b) found that growth of foreign insurers' premiums in emerging markets averaged more than 20 percent per year during the 1990s. During the late 1990s, the U.S. alone was collecting approximately $40 billion in premiums for policies placed overseas, with an average annual growth rate of 10 percent between 1990 and 1998 (III 2003).[12] Between 1990 and 2000, the market share of insurers that were either partly or fully foreign owned tripled in Latin America and Central and Eastern Europe[13] to 47 percent and 41 percent,

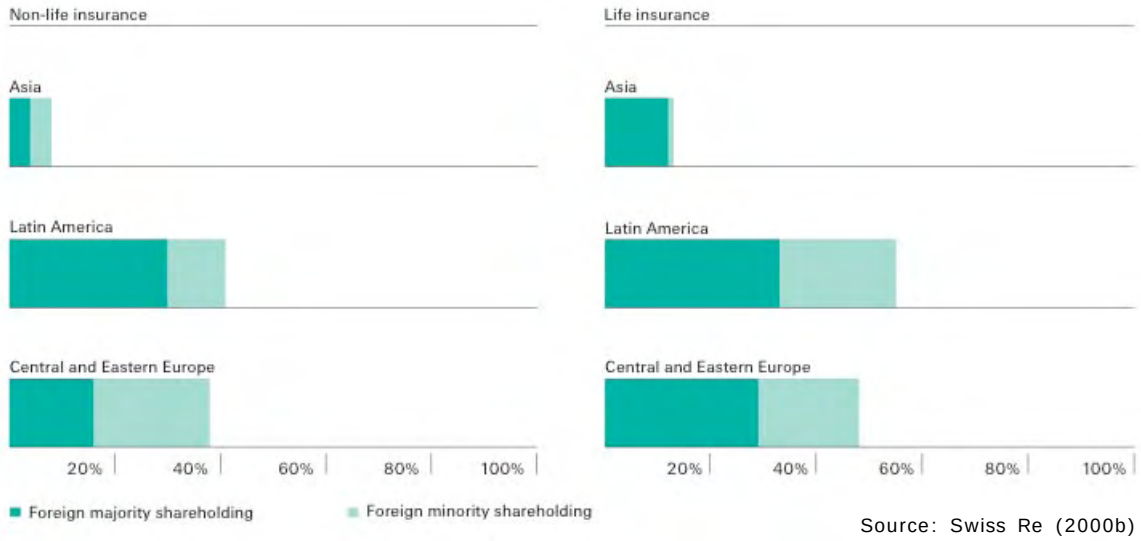
[11] Of course, insurers can become insolvent following catastrophic events although this is the exception to the rule, and solvency is less of an issue for insurers than for individually "self-insured" households or businesses.

[12] The leading insurers in this category include Aetna, AIG, CGU, Chubb, Cigna, Metropolitan Life, New York Life, and Prudential (Swiss Re 2000b).

[13] Data for additional Central and Eastern European countries are provided in Munich Re (2000b) and Swiss Re (2001b).

respectively, and to 12 percent in Asia (Figure ES-12) (Swiss Re 2000b).[14] Although they enjoy the considerable business potential of emerging markets, foreign insurers must also help pay the growing costs of extreme weather events, including the costs of flood, drought, wildfire, and the health impacts of these disasters.

Figure ES-12. Foreign Participation in Ownership is Important in the Insurance Market: 1998



Source: Swiss Re (2000b)

Insurers domiciled in industrialized countries are also vulnerable to extreme weather events in less-developed countries through insurance of property or activities associated with international trade or commerce. Types of coverage affected range from political risk insurance to marine insurance and coverage for other weather-sensitive energy-sector activities such as those associated with the oil trade (SAI 2000). Natural disasters can also have ramifications for distant economies by disrupting supply chains and other increasingly interconnected market systems. In addition, insurance observers note that much-discussed government caps on emissions could result in liabilities for polluting companies, which could, in turn, manifest in product liability, business interruption, or Directors and Officers insurance exposures (Aldred 2004a,b).

Reinsurance is another important element of global risk spreading. Reinsurance is the purchase of insurance *by* insurers, typically for losses in excess of a pre-agreed amount, and is the means by which many insured risks (both life and non-life) are ultimately distributed (Reitz 2003b). Because a given reinsurance company will assume risks from thousands of insurers around the globe, reinsurance is an inherently global segment of the industry. The world reinsurance market

[14] Chile and Mexico have the highest penetrations. In Asia, the greatest shares are found in Malaysia, the Philippines, Indonesia, and Singapore (Swiss Re 2000b). In Central and Eastern Europe, Hungary and Poland have the highest penetration of foreign insurers.

is projected to nearly double from $106 billion in premiums in1995 to $194 billion in 2010 (Duffy 2001).

Meanwhile, as noted earlier, international aid—a key pathway through which extreme-weather risks are becoming globalized—has not kept pace with the growth in demand for natural disaster relief. Importantly, international aid has been flat in the past two decades (at approximately $60 billion per year) and declining as a percentage of donors' GDP, while the inflation-corrected economic costs of natural disasters has increased eightfold. Moreover, most (if not all) aid goes toward recovery, and little is directed to proactive and preventive measures. In addition, foreign policy considerations mean that the majority of aid is designated for events other than natural disasters.

The Potential for New Patterns of Extreme Events Resulting from Climate Change will likely Increase Demand for Insurance while Challenging the Industry's Ability to Assume New Risks.

Over the past 30 years, insurers have seen property-casualty claims from natural disasters (corrected for inflation) rise considerably compared to other losses (Figure ES-6). (Corresponding life-health insurance loss trend data have not been published.) Coupled with the growing rate of losses, insurers expanding into emerging markets also encounter actuarial uncertainties posed by the increasing volatility of weather events associated with global climate changes as well as the greater exposures and vulnerabilities of emerging markets to these disasters.

Regardless of whether climate change is a result of human activities or natural variation in weather patterns, the observed increase in uncertainty regarding the intensity, frequency, and location of extreme weather events confounds the fundamental actuarial processes that underlie well-functioning insurance markets. Increased uncertainty can thus call into question the insurability of certain risks, which may limit the availability of insurance. Climate change is a significant concern for both the property-casualty and life-health segments of the industry, perhaps more so for the latter segment because of its relatively larger size and growth rate.

The view that climate change is a strategic business risk is more prevalent in the insurance industry than any other component of the financial services sector (UNEP and Innovest 2002). However, according to a group of 90 concerned insurance companies working under the auspices of the United Nations Environment Programme (UNEP), insurers and reinsurers have not yet broadly responded to calls to help emerging markets prepare for and respond to climate change. The UNEP insurers' group argues that proactive steps would be in the industry's financial interest and consistent with the industry's underlying principles of risk management.

Insurance for Extreme Weather Events can be Coupled with Strategies that Contribute to Sustainable Development and Enhance Disaster Resilience.

Public-private partnerships can enhance the efficacy of both insurance and increase the pool of people who have access to it. In a relatively straightforward example, commercial insurance

companies in the U.S. are introducing flood insurance to complement that provided by government programs (McDonald 2003). More innovative examples include systems for delivering insurance to the poor (e.g., micro-insurance or small-denomination/low-cost weather hedges) combined with technologies and practices that simultaneously reduce vulnerability to disaster-related insurance losses and support sustainable development and reductions of greenhouse gas emissions. A strategy combining these elements was piloted in the Caribbean where USAID/OFDA and NGOs provided trained homebuilders to construct hurricane-resistant housing, banks provided financing for construction, and insurers made coverage available where it had not previously been. Other relevant products include insurance for predicted energy savings (Mills 2003c) and coverage for carbon-trading contracts, which is being developed by major insurers, including Aon (Aon n/d). Insurers have stated their receptivity to arrangements like these, noting the new imperatives presented by climate change (Munich Re 2004).

Strategies that contribute to public health and sustainable development by cost-effectively mitigating damage from (and thus costs of) natural disasters include curtailing deforestation, which reduces risks such as wildfire, malaria, mudslides, and flooding while also reducing emissions of greenhouse gases. Other strategies involve an intriguing combination of adaptation and mitigation; e.g., methods of reducing the vulnerability of buildings and their occupants to urban heat-island effects and acute heat catastrophes also tend to increase energy efficiency, thus curtailing greenhouse gas emissions.

New initiatives with the insurance community can be part of a quilt of strategies involving a diversity of public and private stakeholders. Before considering which initiatives to undertake, specific intervention criteria should be developed to help prioritize efforts. Particular markets (economic, demographic, and geographic) should be identified to target first. The relevance of the proposed initiatives should also be clearly explained to insurers sought as partners. Insurers have many fires to fight in the regulatory and business arenas, and climate change is rarely perceived as the most important one, so public entities seeking partnerships with insurers must establish and demonstrate the value of these partnerships.

Based on the findings of this study, we offer the following principles to consider in establishing priorities and creating effective projects:

- ***Focus on Efforts that Enhance the Fundamental Insurability of Weather-Related Risks –*** A constructive starting point for enhancing market opportunities for insurance of natural disasters is to address conditions that cause insurers to perceive current risks as uninsurable. Sustainable development can create a more fertile environment for insurance (e.g., undertaking activities that reduce vulnerability to drought or disease), helping to prevent insurance availability from stagnating or receding.

- ***Couple Insurance Efforts with Core Development Activities –*** The development and relief communities increasingly agree that sustainable development efforts will fail if not coupled with broader development objectives (increased economic growth, healthcare, quality of life, etc.). Encouraging a culture of risk management is one example. Insurers will place more value

on sustainability-driven initiatives that enhance disaster resilience if there is a corresponding risk reduction that makes markets more attractive to do business in. Environmental initiatives and insurance can be coupled to increase the availability of financing for economic development.

- ***Foster Efficient Domestic Government and Private Insurance Risk Sharing –*** Certain risks may not be insurable without risk sharing with public-sector entities (e.g., investment in disaster preparedness or disaster-recovery funds). Effective combinations of government/private insurance are essential; for example, government "backstop" reinsurance of risks can enable private insurers to assume the initial "layer" of losses (as has been observed in the case of terrorism insurance following the events of September 11, 2001).

- ***Utilize Public-Private Partnerships –*** As a corollary of the preceding point, sharing the cost of investment to reduce risk between the public and private sectors will be essential to successfully engage insurers in reducing vulnerability and increasing adaptive capacity to extreme weather events now and in the future (Kunreuther 2000). Governments can contribute to making risks insurable, e.g., by establishing land-use planning requirements and funding infrastructure or forest-management practices to reduce flood or wildfire risks. Insurers have called for this in the case of flood insurance, stipulating that government's role is to reduce the hazard such that commercial insurance is viable. Another example is in the handling of soil subsidence risks in Texas and other states resulting, in part, from groundwater depletion. In this instance, groundwater-removal permits are reviewed with respect to their potential impact on subsidence; government in turn provides a reinsurance mechanism and requires insurers to offer primary coverage (Cole et al. 2004).

- ***Build Domestic Insurance and Risk-Management Capacity –*** In some settings, insurance does not exist (i.e., is not available to certain populations), so the goal is to enable its introduction. Government initiatives can help create a fiscal and regulatory environment conducive to the entry of insurers. This has been seen in the dramatic growth of insurance in China and India, and, more recently, Central and Eastern Europe, as liberalization has enabled private market-oriented insurers to replace government-financed insurance systems and allowed for the entry of foreign insurers.

- ***Discourage Complacency in Response to Insurance Availability or Government Aid –*** Many observers have noted that efforts to manage risk can inadvertently encourage complacency or increased risk taking. This phenomenon is well known in relation to flood insurance where analysts have found that more people build homes in at-risk areas if insurance is available to cover their losses (Heinz Center 2000). The traditional way of dealing with this is to utilize deductibles or other mechanisms that require the insured to pay for a higher portion of their losses. Government-provided aid is seen to foster complacency and impede the ability of insurers to assume flood risks in the U.S. and Europe (Hodge and Zolkos 2003).

- ***Respond to Insurers' Regional Priorities –*** Insurers, especially those likely to partner with public-sector entities, have considerable experience with risk management, possess key data, and are the ultimate judges of which projects will make a material difference in reducing losses

and increasing the insurability of risks. Figure ES-3 illustrates how insurance penetration and losses from natural disasters vary by region. Insurers will assign greatest importance to markets in which the potential for insurance is large, demand is growing rapidly, and weather-related disaster exposures and vulnerability are high. As an illustration, insurance premiums in Africa have reached $30 billion per year and are growing at approximately four percent per annum, and there is a distinct concentration of impacts from flood, drought, famine, and epidemics. Those seeking to partner with insurers should identify and cultivate activities in the intersection of that industry's priorities and their own.

- ***Address Life and Health Issues as Well as Those Related to Property Damage –*** The majority of information available on climate-change issues in the insurance industry focuses on the property-casualty side of the business. (Most of the loss data in this report exclude health impacts because data are not systematically tabulated by insurers, and this class of insurable events tend to occur in diffuse patterns rather than in single large and easily documented catastrophic events). However, life insurance markets are growing more quickly than property-casualty markets, and the vulnerabilities and adaptation issues facing life and health insurers are quite different than those facing property insurers (Campbell-Lendrum et al. 2003). Issues range from incremental and diffuse impacts such as the erosion of water quality and availability to abrupt impacts such as disease epidemics or heat catastrophes, as well as the mental and cognitive health consequences of the consequences for physical health. The severity and/or ranges of at least 18 diseases are linked with climate factors (WHO 2004). One public-private effort to study these issues is a health-scenarios project that has been initiated by Swiss Re and UNDP, with the work being performed by the Harvard Medical School. The project is examining the insurance implications of drought, flooding, heat waves, malaria, Nipah Virus, West Nile Virus, pollen and molds, agricultural pests and pathogens, coral and bivalve disease, wildlife diseases, and forest pests.

- ***Raise Awareness within the Insurance Community –*** In the press of day-to-day business, many insurers have not made the time to focus on the kinds of issues discussed here. In their most significant and recent study on the issue, the UNEP Insurance Industry Initiative's top recommendation for financial services companies and governments is that greater efforts be made to increase awareness within the financial services sector of extreme-weather and climate risks and associated issues (UNEP and Innovest 2002).[15]

- ***Harness Market-Pull Forces*** – As with other forms of market transformation, changes on the demand-side for insurance products can be as significant as proactive initiatives from insurance companies. Insurance brokers are important intermediaries who can work with consumer groups to aggregate demand for new insurance products and services. The use of micro-finance and micro-insurance is one example.

- ***Understand Insurers' Relationship to the Security Implications of Climate Change*** – The linkages among environmental degradation, natural disasters, and security are increasingly

[15] The UNEP/III is an insurance-industry-led group of approximately 90 insurance companies from 26 countries, convened under the auspices of UNEP.

being recognized (Schwartz and Randall 2003). A key trigger is the potential reduction in carrying capacity as a result of abrupt or incremental changes in climate and weather. Insurers bear the risks of these exposures in many forms, including: political-risk insurance claims, which can be triggered by social disruptions arising from natural disasters and by international conflict over the control of water, energy, and other resources likely be effected by climate change.

THE INTERPLAY BETWEEN NATURAL DISASTERS AND DEVELOPMENT

> *Development efforts are frequently disrupted by natural disasters. These extreme events can cause sharp increases in poverty and slow the pace of social and economic development. Reducing disaster vulnerability may very well be one of the most critical challenges facing development in the 21st Century.*
>
> – The World Bank (2002)

> *Disaster reduction policies and measures need to be implemented to build disaster resilient societies and communities, with a two-fold aim: to reduce the level of risk in societies, while ensuring, on the other hand, that development efforts do not increase the vulnerability to hazards but instead consciously reduce such vulnerability. Disaster and risk reduction is therefore emerging as an important requisite for sustainable development to be included in the follow-up to Agenda 21.*
>
> – United Nations (2002)

Extreme weather events and natural disasters can transform the physical, social, and economic landscapes of nations (Perez 2001). They also create an impediment to development by causing physical damage, death, and disease; disrupting residents' livelihoods; diverting scarce resources from development to relief and recovery; and deterring future investment because they increase the risks that foreign interests face. As an example of prior work on this topic, Benson and Clay (2002) review indirect impacts of natural disasters on international trade, foreign direct investment, and economic growth.

The absolute costs of natural disasters fall disproportionately on the relatively wealthy while the suffering falls disproportionately on the poor (Figures 1 and 2). The wealthiest countries experience more than 90 percent of the insured losses from natural catastrophes but only four percent of the associated deaths. According to the United Nations Development Program (UNDP) (2004), although 11 percent of the world's population lives in at-risk areas, this group experiences 53 percent of the fatalities from natural disasters. The ability to respond to natural disasters is lowest in developing countries and economies in transition ("emerging markets") where economic resources are limited, technology is often unavailable, information and skills are deficient, institutions are unstable or weak, and empowerment and access to resources is inequitable (Smit et al. 2001). Moreover, because poverty often leads people to put substantial pressure on natural resources, poor areas have an elevated vulnerability to natural disasters.

Economic activity is an inadequate measure of the scale of a disaster, in part because recovery spending actually increases gross domestic product (GDP). Because of this limitation, the UN and others (such as Munich Re and Swiss Re, the world's largest providers of reinsurance) have used human rather than economic terms to define when disasters are "large" e.g., in terms of loss of life, and when they impede a region's ability to cope with the impacts.

Figure 1. Weather-Related Disasters - 1980-2003: The Economic Costs of Natural Catastrophes Fall Primarily on Wealthy Populations; the Loss of Life Primarily on the Poor

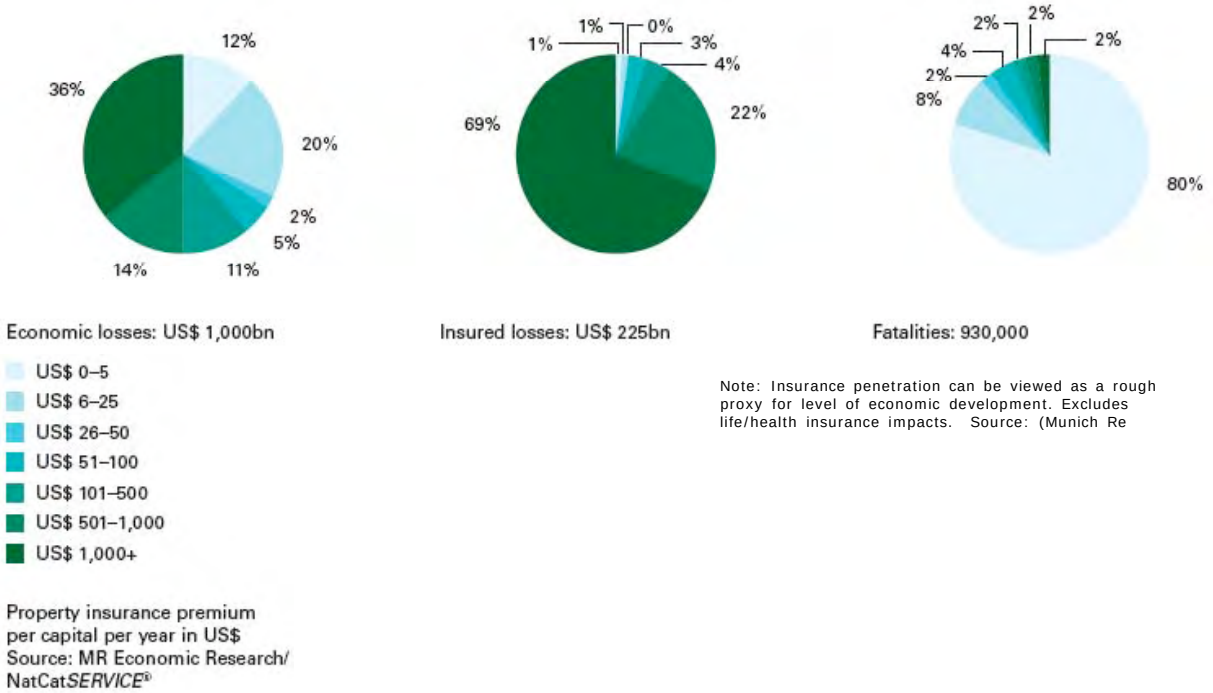
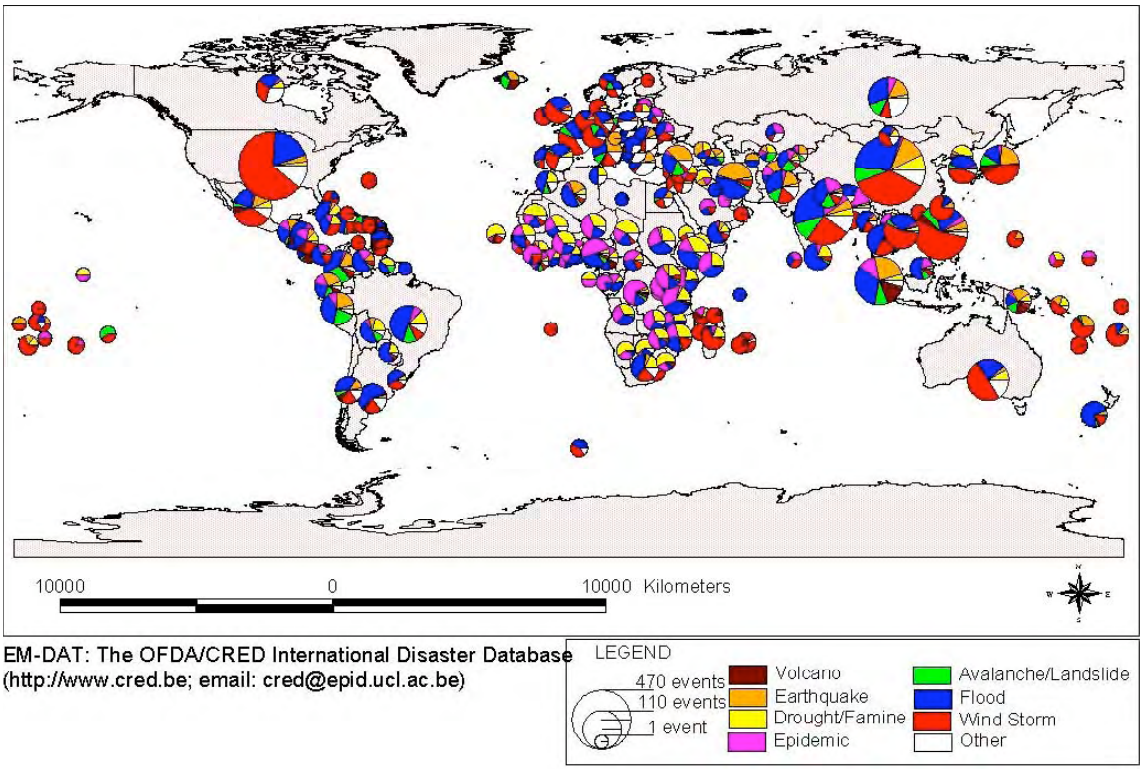


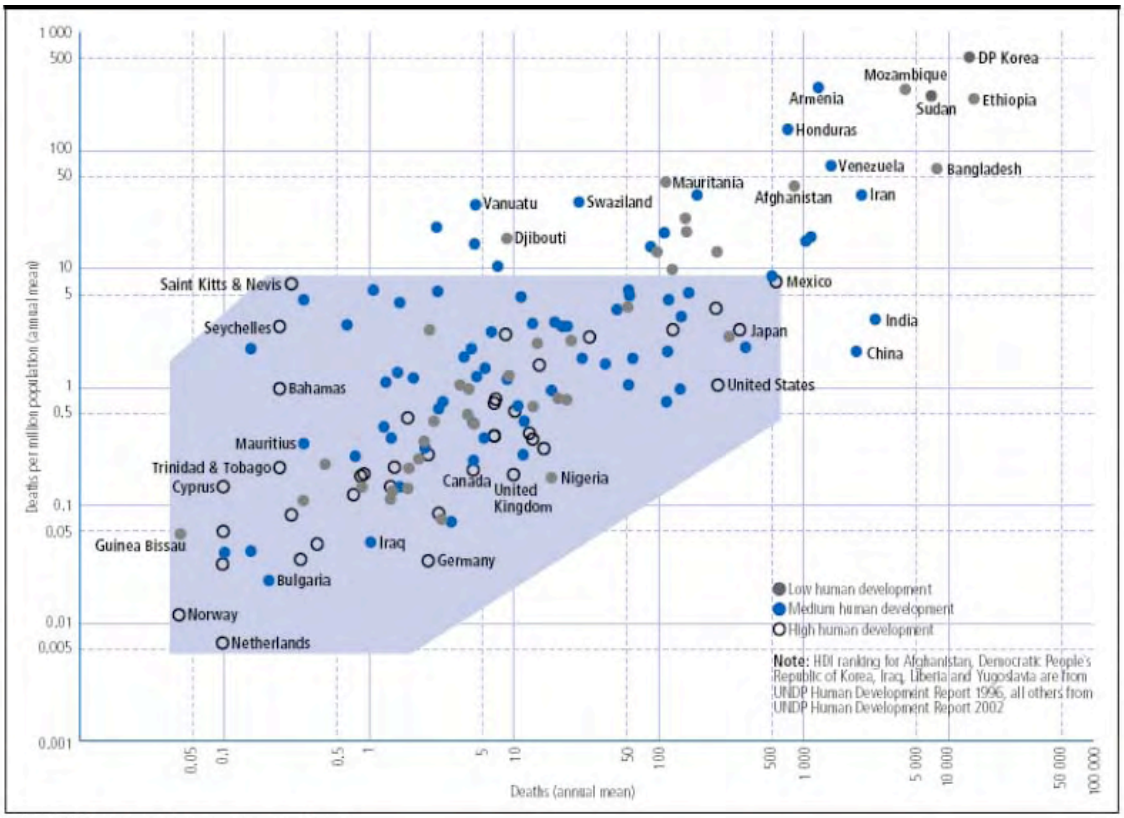
Figure 2. The Type and Scale of Natural Disasters are Distributed Unevenly: Number and Type of Events 1975 to 2001



EM-DAT: The OFDA/CRED International Disaster Database
(http://www.cred.be; email: cred@epid.ucl.ac.be)

Between 1993 and 2002, nearly 300 million people were affected each year by weather-related disasters; the vast majority of whom live in the least-developed countries (IFRC/RCS 2003). Of this total, death rates averaged 45,000 per year, with 50-*times* more deaths per event in developing countries than in wealthy countries. These totals and averages mask an extraordinary degree of variability, however. For example, only 0.4 percent of the U.S. population is affected by disasters in a typical year versus 41 percent in the Solomon Islands. Countries at similar stages of development also exhibit widely variable levels of vulnerability (see Figure 3) (UNDP 2004). Between 1993 and 2002, an average of 117 million people are affected or killed in China in a typical year, versus only 6 million in the entire industrialized world.[16]

Figure 3. Vulnerability is Higher among Lower-Income Countries (Deaths from natural disasters)



Source: EM-DAT OFDA/CRED International Disaster Database From UNISDR (2003). Note that scales are logarithmic.

In addition to the intrinsic vulnerabilities of poor and developing nations noted previously, shortsighted development practices can exacerbate a region's vulnerability to natural disasters (IFRC/RCS 2003; UNDP 2002). Examples of development practices that can increase exposure

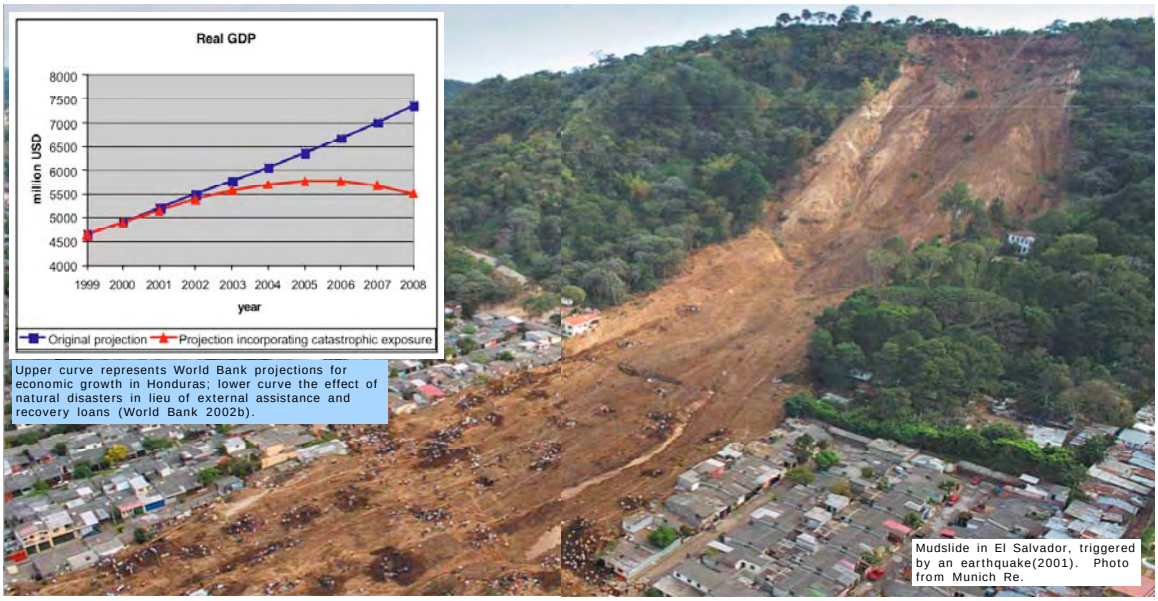
[16] Data presented in this report on population impacts from disasters come primarily from the Centre for the Epidemiology of Disasters (CRED), which defines a disaster as an event meeting at least one of the following criteria: at least 10 deaths, 100 people affected, a call for international assistance, and/or the declaration of a State emergency.

include rapid construction rates coupled with a lack of well-designed (and well-enforced) building codes, unsustainable exploitation of forest resources, and building (or rebuilding) settlements in harm's way.

In some instances, development creates a shift from known vulnerabilities to new, unfamiliar ones (Benson and Clay 2002; UNDP 2004). Developing economies can become vulnerable to a wider spectrum of losses, such as damage to communications infrastructure (Sclafane 2001a) and reliance on vulnerable electricity grids (Eto et al. 2001).[17] Development can also be accompanied by the erosion of social networks which provide "safety-net" services equivalent to life insurance (Swiss Re 2004a). The idea of sustainable development thus extends beyond the notion of minimizing environmental impact; it includes managing vulnerability and social factor, and promoting the ability to adapt and respond to natural disasters.

The economic costs of natural disasters between 1985 and 1999 equaled 13 percent of GDP in the poorest countries versus only two percent in the wealthiest countries (UNISDR 2003). In a striking illustration of the potential adverse impacts of extreme weather events, the Honduran prime minister stated that Hurricane Mitch – which killed up to 20,000 Central Americans in 1998 – set the country's economic development back 20 years (IFRC/RCS 2003) (Figure 4). Other examples include flooding in China in 1998, which produced losses of 5 to 7 percent of GDP; losses in Honduras from Hurricane Fifi, which amounted to 50 percent of GDP (Hooke 2000); and large earthquakes and associated landslides in El Salvador, which consumed 11 percent of GDP in 2001 (Munich Re 2002). Losses such as these may be compounded when the intervals between disasters are similar to the time needed for reconstruction.

Figure 4. Mudslides Can Have Devastating Impacts

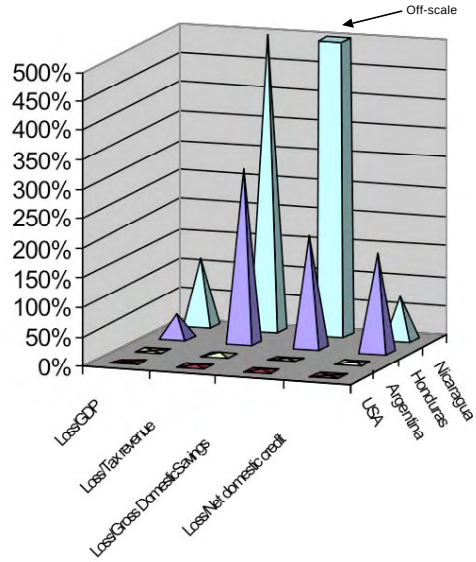


[17] The 2003 power outage in the Northeastern U.S. and Canada was estimated to have caused $6 billion in damages (Munich Re 2004).

Figure 5 illustrates the relative impacts of large historical disasters on economies at various stages of development. In poorer countries (Honduras and Nicaragua) the event costs exceeded the given year's government tax revenue, gross domestic savings, and (in the case of Honduras) net domestic credit. In Nicaragua, losses exceeded the GDP itself.

The resources of multilateral banks are often directed towards disaster-recovery. In the decade 1988 to 1999, an average of 5.6 percent of the loans from the Asian Development Bank were used for disaster recovery, with a peak of 20 percent in 1992 (Bouwer and Vellinga 2002). World Bank operations in the areas of disaster preparedness, mitigation, and reconstruction have amounted to $38 billion during the past two decades.[18] During this period as much as 35 percent of Mexico's lending earmarked for infrastructure was diverted to pay for natural catastrophes (Freeman 1999).[19] Natural disasters can have a significant adverse effect on long-run economic growth and poverty alleviation (Figures 5 and 6).

Figure 5. Natural Disasters Can Have A Major Impact on National Economies (chart shows largest single historic events for each country)



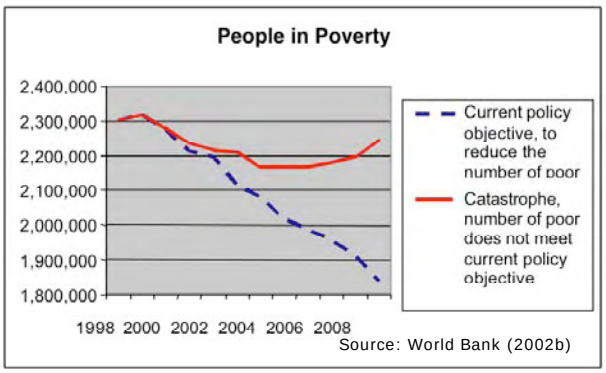
	USA	Argentina	Honduras	Nicaragua
GDP (millions)	7,834,000	293,005	4,725	2,024
GDP/percapita	29,267	8,214	790	433
Aid/GDP	-	0.03%	6.3%	20.3%
Largest historical Loss (millions)*	45,181	2,432	1,951	2,318
Loss/capita	168.8	68.2	326.1	495.5
Loss/GDP	0.6%	0.8%	41%	115%
Loss/Tax revenue	2.9%	6.7%	293%	499%
Loss/Gross DomesticSavings	3.6%	4.1%	189%	4044%
Loss/Net domestic credit	0.7%	2.8%	166%	71%

*USA: Northridge Earthquake 1994, Argentina: Floods 1998, Honduras: Hurricane Mitch 1998, Nicaragua: Earthquake 1972
All values in 1997 USD. Sources: World Development Indicators 2000, IADB 2001, Munich Re 1998, ECLAC 2000.

Source: World Bank (2002b)

Effectively absorbing the economic costs of natural disaster losses today, let alone in a world with an increased incidence of extreme weather events, is an elusive goal at best. Although insurance is not a panacea, it is an important component of a strategy to provide economic relief following disasters as well as supporting disaster preparedness. There are many opportunities for public-private partnerships involving insurers, following the lead of The World Summit on Sustainable Development's conceptual integration of disaster reduction within the agenda of sustainable development (UN2002).

Figure 6. Disasters Can Slow or Stall The Reduction of Poverty: Nicaragua



Source: World Bank (2002b)

Insurers have expressed concern about current natural disaster trends and their impacts on the financial services sector. According to a global insurance industry group studying the issue, economic costs associated with weather-related events are projected to triple to $150 billion/year by the year 2020 (UNEP and Innovest 2002).

[18] See http://www.worldbank.org/dmf/operations htm

[19] However, World Bank adjustment loans for emergency relief declined from $1B in FY2000 to $400M in 2001 and $180M in 2002 (World Bank 2002a).

TRENDS IN WEATHER-RELATED DISASTERS

> *In recent decades, insurers throughout the world have registered a steep upsurge in catastrophe losses. Of course there are more people on earth today (twice as many as in the 1950s) and these are increasingly gathered together in large cities (four times as many, in the Third World six times as many in 1950), which for the most part are also located in highly exposed regions, above all along the coasts. But these changes alone cannot explain the three-fold increase in the number of great natural catastrophes in four decades, the eight-fold increase in the losses generated by these catastrophes … and the phenomenal fifteen-fold increase in the losses carried by insurers.*[20] *In this context it is necessary to consider the undeniable increase in the vulnerability to catastrophe of the highly developed industrial societies … and it is no longer possible to ignore the mounting evidence that the influence of climatic and other environmental changes is growing. … [M]ore and more observations and increasingly reliable physical computer models show that many atmospheric and hydrospheric processes are advancing towards new extreme values.*
>
> – Munich Reinsurance Company (2003)

The number of large weather-related events, their costs, and the numbers of people affected by these events has increased precipitously since the 1950s (Figure 7).[21] Key factors in these increases include population growth, especially in high-risk areas, and other demographic factors as well as increasingly effective observation and statistical reporting systems. Even when we take into account these demographic factors, it is significant that weather-related losses have grown three-times more quickly than non-weather related ones (Vellinga et al. 2001), and the number of people affected has grown even more quickly. The increase in losses is seen *despite* considerable efforts made to fortify human settlements and implement early-warning systems[22] and other forms of disaster preparedness, a factor not often accounted for.

The view that natural disasters are rare "Acts of God," coupled with almost singular focus on extremely large catastrophes, obscures the financial importance of relatively small events (Aalst and Burton 2002). Although large headline-catching disasters are normally the focus of public and official attention, half of the economic and insured costs of disasters are attributable to relatively "small" events" (Vellinga et al. 2001). In Swiss Re's words (2002g), "unspectacular climatic anomalies, which the general public perceives as 'unusual,' rather than 'catastrophic' weather conditions, can cause losses on a scale normally associated with natural catastrophes."

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[20] Subsequent data from Munich Re (Figure 7) show an 8.6-fold increase in economic losses and a 17-fold increase in insured losses.

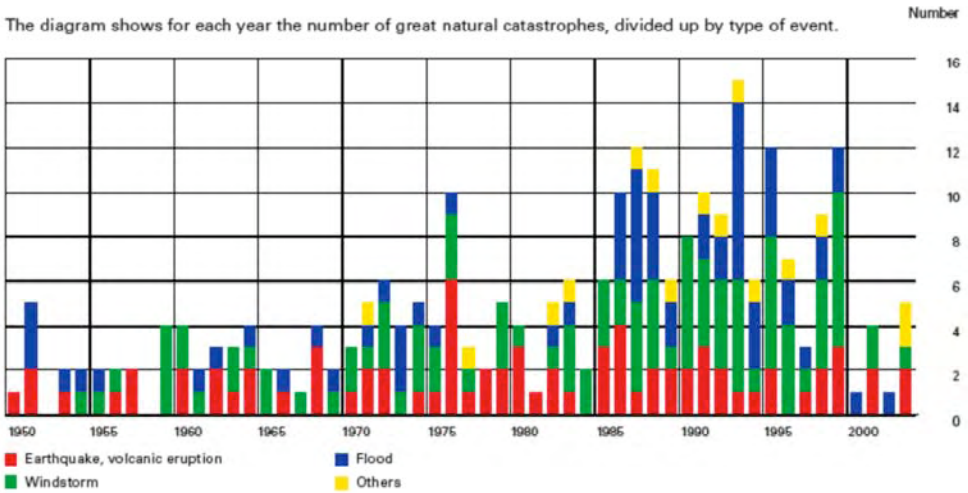
[21] Statistics on the consequences of natural disasters presented in this report are the best available at the time of writing. However, they are limited by definitions and incomplete reporting (e.g., small-sized events are not fully counted and relevant health-related impacts are not broken out). Methodological considerations and comparisons among various sources are discussed by UNDP (2004).

[22] For example, according to Swiss Re (2002g), millions of lives have been saved due to advances in predicting the tracks of tropical cyclones. Canadian insurers claim significant avoided property damages thanks to the diversion of hailstorms via cloud seeding.

Figure 7. Natural Disaster Losses Have Increased Dramatically: 1950-2000

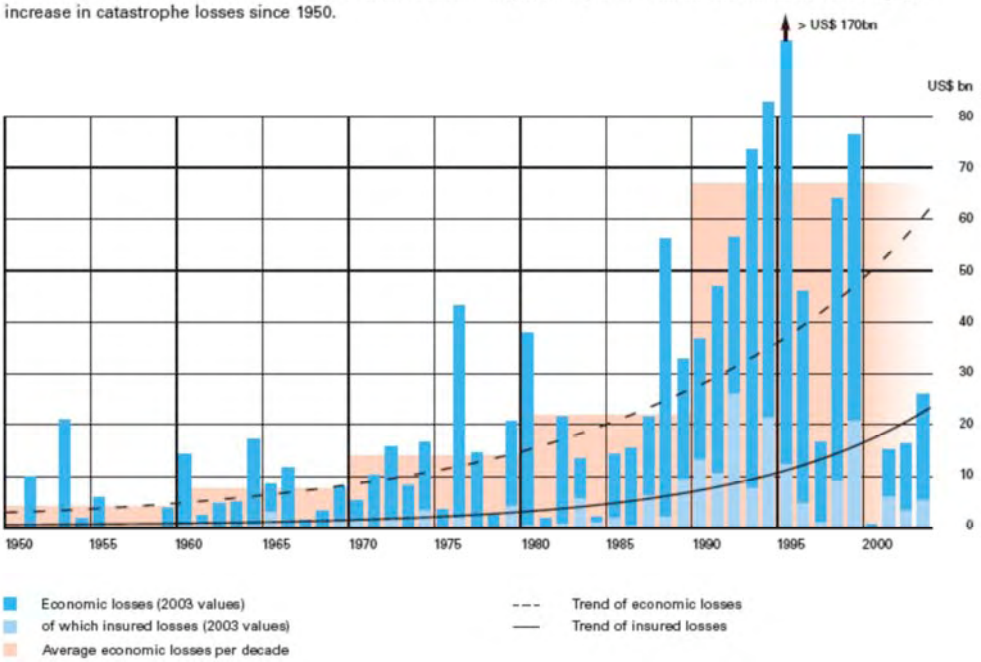
Number of events

The diagram shows for each year the number of great natural catastrophes, divided up by type of event.



Economic and insured losses with trends

The chart presents the economic losses and insured losses – adjusted to present values. The trend curves verify the increase in catastrophe losses since 1950.



Decade comparison 1950–2003

The table allows a comparison of the aggregate loss figures of recent decades. Comparing the last ten years with the 1960s makes the increase in natural catastrophes particularly clear. This applies both to the number of events and to the extent of the losses incurred.

Decade	1950–1959	1960–1969	1970–1979	1980–1989	1990–1999	Last 10 years
Number of events	20	27	47	63	91	60
Economic losses	42.7	76.7	140.6	217.3	670.4	514.5
Insured losses	–	6.2	13.1	27.4	126.0	83.6

Losses in US$ bn (2003 values)

The comparison of the last ten years with the 1960s shows a dramatic increase.

Last 10:60s
2.2
6.7
13.5

Source: Mun ch Re (2004). Excludes life/health insurance impacts.

Moreover, because the individual financial losses associated with each of these "small" disasters are relatively modest, the burden on primary insurers is rarely relieved by reinsurers (who typically cover losses in excess of a pre-agreed amount), and a larger proportion of the cost is also paid by (insured) victims via deductibles. Observers in North America (Bowers 2002) have seen the rate of smaller events "skyrocket" in comparison to large events and Swiss Re (2003) has observed this in the case of flood losses.[23] An increasing rate of settled soil-subsidence claims (which can be caused by drought, depletion of ground water, or thawing of permafrost) is another example (Cole et al. 2004). This class of events has historically been less well understood and poorly modeled (Bowers 2004). Health-related losses are particularly likely to come in diffuse patterns and "small" pulses.

A decade of data collection in Latin America has shown that the impact of "everyday disasters" is a major contributor to the high rate of weather-related fatalities in countries such as Guatemala (IFRC/RCS 2003). Localized events can adversely impact roadway safety; lightning strikes can interfere with electric power supply and damage electronic equipment; and small mudslides can interrupt commerce by damaging critical lifelines such as roads, water systems, and communication networks. Some events, such as drought, are spread over an entire season. The costs of these sorts of events do not appear in a single "moment" as they do with a hurricane or major flood, but their aggregate can be enormous. The largest single disaster in 2003 – in terms of economic costs – was the major drought across Europe, which had an aggregate cost of $14 billion (Swiss Re 200a). Another one of the largest droughts in recent history, in the U.S. in 1998, caused $13 billion in damage (Munich Re 2000a). Incremental and highly diffuse phenomena such as gradually rising sea levels, worsening water quality and/or availability, and expanding domains of infectious diseases can be as devastating and costly as extreme, abrupt events. Relatively comprehensive data (large and small events) are available for 1985 through 1999, showing total economic costs of $707 billion (Munich Re 2000).[24] Globally, "small" (non-catastrophic) weather-related losses roughly equal those tabulated for large events (Vellinga et al. 2001). For example, the aggregate cost of thunderstorms ($6 billion) is on a par with that of a single large hurricane (Bowers 2004).

Historical data show different trends for industrialized and developing economies (Figure 8). The penetration of insurance by type of risk also varies, with the greatest extent of coverage for storms and the least for flood and "other" risks such as drought and wildfire. About 45 percent of global storm-related losses were insured from 1985 to 1999, versus five percent for flood and 13 percent for "other."[25]

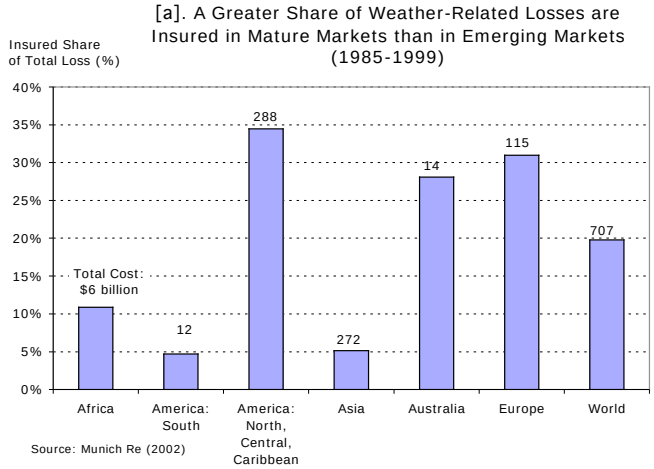
---

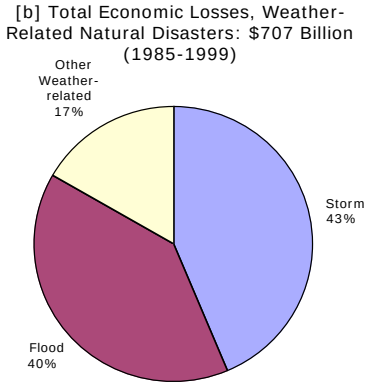
[23] In 2001 U.S. thunderstorms caused $1.9 billion in insured losses, a single hailstorm caused $1.9 billion in losses, wildfires cost $200 million, and tornadoes $700 million. The Great Ice Storm of 1998 caused $2.5 billion in losses (Munich Re 2000a). Lightning strikes are responsible for $5 to $6 billion in property damages (*Risk Management* 2002; Munich Re 2002).

[24] These values represent the weather-related subtotal of disaster statistics published by Munich Re. The costs of "man-made" events and non-weather-related events (e.g., earthquakes) increase these values.

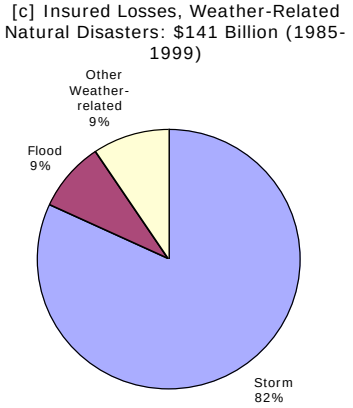
[25] Care must be taken in interpreting these statistics. For example, Swiss Re (2003c) has noted that events often characterized as "storms" result in significant flood-related losses, doubling the truly flood-related losses in recent years.

Figure 8. Total Economic & Insured Losses from Weather-related Events Vary Widely by Region: 1985-1999

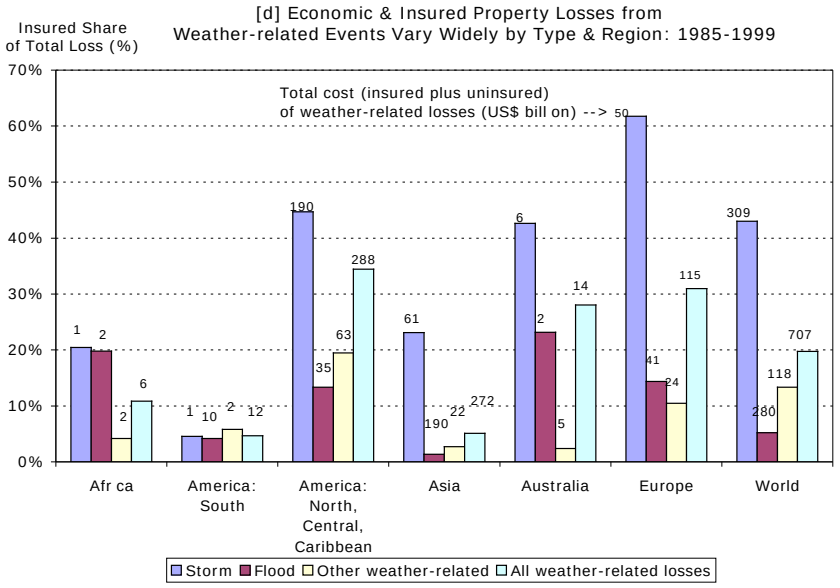




Source: Munich Re (2002)



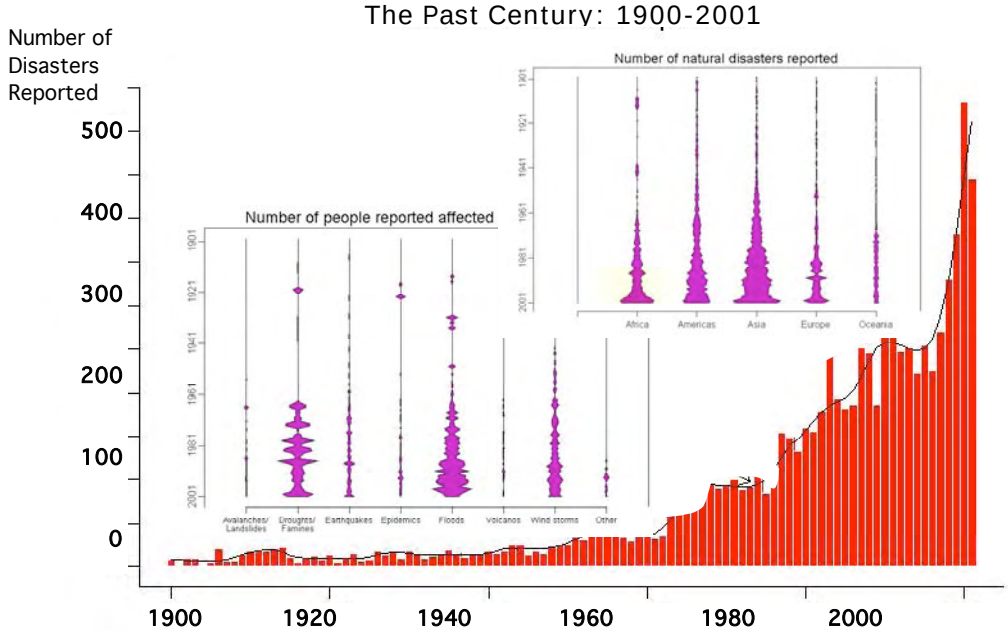
Source: Munich Re (2002)



Source: Vellinga et al. (2001), based on data from Munich Re. Excludes life/health insurance impacts.

The U.S. Agency for International Development (USAID) Office of Foreign Disaster Assistance (OFDA) and the Center for the Research in the Epidemiology of Disasters (CRED) have compiled detailed statistics on natural disasters from 1900 to the present (Figures 9a-b; Appendix 1). During the second half of this period, the per-decade incidence of weather-related disasters rose from approximately 100 to 1,600 in less-developed countries, with the number of people affected or killed rising steadily from 15 million during the 1950s to three billion during the 1990s (IFRC/RCS 2003). Although all losses have increased in absolute terms, the relative increases in incidence of weather-related events such as wildfire, extreme temperature episodes, and epidemics are particularly notable.

Figure 9a. The Number of Natural Disasters Has Grown Rapidly over The Past Century: 1900-2001



Source: EM-DAT: OFDA/CRED International Disaster Database

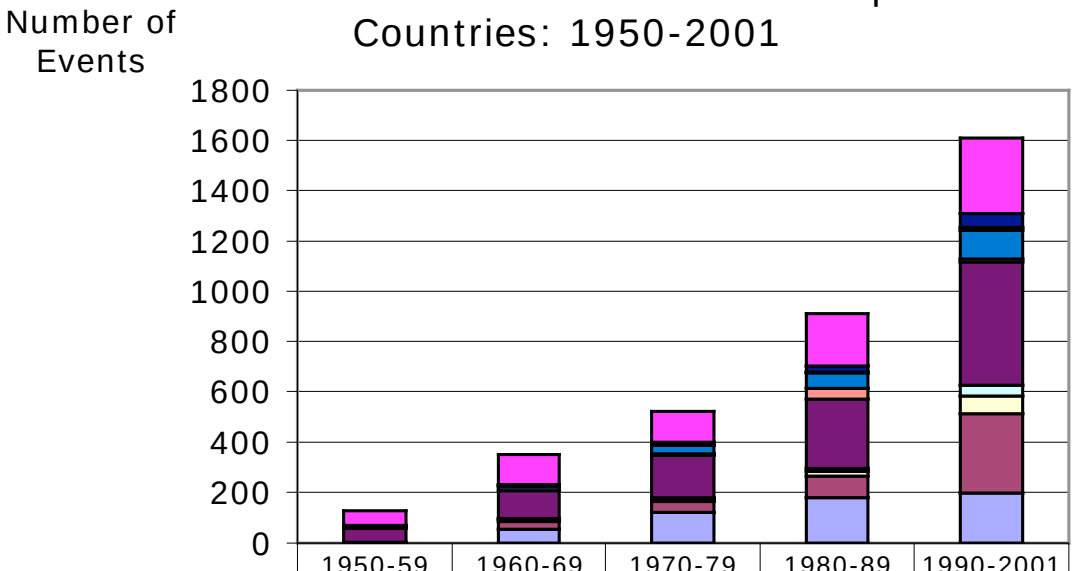
According to the UN's International Strategy for Disaster Reduction (UN 2002), "Asia is disproportionately affected with approximately 43 percent of all natural disasters in the last decade. During the same period, Asia accounted for almost 70 percent of all lives lost due to natural hazards. During the two El Niño years of 1991/92 and 1997/98, floods in China alone affected over 200 million people in each year[26]….[T]he risks posed by the increasing degradation of the environment, epitomized by deforestation, loss of biodiversity and associated knowledge, reduced water supply and desertification, can only contribute to increased concern on these issues."

Importantly for insurers, the *variability* of losses from year to year has also increased, with the standard deviation of global losses now roughly $9 billion annually, and the percentage standard deviation (coefficient of variance) increasing as well (Swiss Re 2002f). This figure is greater

[26] Approximately 900,000 people were killed by a great flood in China in 1887 (Munich Re 2000a).

than the absolute magnitude of inflation-corrected losses in any year prior to 1987. Variability and the implied uncertainties looking forward confound the fundamental actuarial processes that underpin insurance markets.

Figure 9b. The Frequency of Weather-Related Disasters Has Risen in Less-Developed Countries: 1950-2001



	1950-59	1960-69	1970-79	1980-89	1990-2001
Wind storm	59	121	121	207	300
Wild fire	0	4	11	25	54
Wave/surge	2	5	2	3	12
Slide	11	15	34	63	114
Insect infestation	0	1	6	43	13
Flood	50	110	170	276	489
Famine	0	2	4	11	45
Extreme temp	4	10	9	19	70

Sources: OFDA / Center for Research in the Epidemiology of Disasters (CRED) "Natural.xls" Intl database of Disasters (http://www.cred.be/emdat/intro.html) and U.S. Census Bureau's International Database (http://www.census.gov/ipc/www/idbagg.html). From analysis completed by Padco's Climate Change Solutions Group for USAID's Global Climate Change Team. "Population Impacted" includes those persons that have either been killed, injured, left homeless, or otherwise adversely affected.

Understanding Vulnerability and the Spreading of Weather-Related Risks in Developing Countries and Economies in Transition

> *The landslides that struck Venezuela in December 1999 and the storms that hit France at about the same time caused similar direct economic losses - approximately US$3 billion in damage to infrastructure in both cases. But there were 50,000 deaths in Venezuela versus 123 in France. And while Venezuela will be dealing with the effects for years to come, France is already recovering through an astute system of public and private crisis response and burden-sharing.*
>
> – James Wolfensohn, President, World Bank and Didier Cherpitel, Secretary General, International Federation of Red Cross and Red Crescent Societies

Risks from natural disasters are spread among five entities: insurers and reinsurers, domestic governments (local/national), individual foreign governments and the UN, non-governmental organizations and private donors, and the individuals and firms ultimately impacted when no other form of relief is available (Figure 10). Included in the last category is so-called "self-insurance." which ranges from informal absorption of losses to complex legal entities often referred to as "captives" or "risk retention groups."[27] For the period 1980 to 2003, international relief for natural disasters made up only one percent of the total economic cost of these events (Figure 11), and in recent decades overall aid has been constant while weather-related losses have tripled in real terms. Among wealthier nations, insurance absorbs about one-third of the costs of weather-related events whereas in developing countries and economies in transition the value is only three percent. For lower-income economies as a whole, insurance funding for disaster recovery exceeds aid funding by a factor of three.[28] In an illustrative example, after hurricane Gilbert, $413 million was paid in insurance claims and $104 million was paid in aid (UNDP 2004).

As noted in the previous section, vulnerability to extreme weather events arises from a combination of social and physical factors.[29] Developing countries and economies in transition are more vulnerable, both because the potential impacts are larger and because they have a lower capacity to adapt and respond. In some emerging markets, government-organized crop[30] and disaster insurance exists on paper, but because of large debt loads and weak economies, many of these programs are inactive (Vellinga et al. 2001).

---

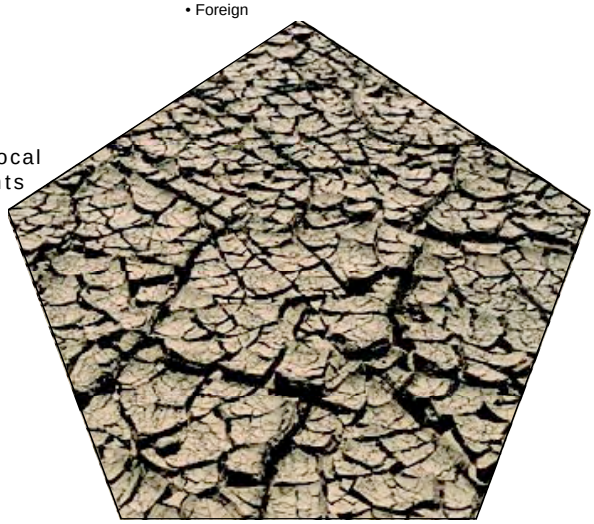
[27] A captive's business is insuring the risks of its parent rather than operating as a diversified insurance company. In the U.S., self-insurance is growing rapidly; today, it represents about half of the country's commercial market (Evans 2002).

[28] Data on the distribution of this assistance is not readily available although the beneficiaries of insurance are predominantly higher-income and commercial interests while beneficiaries of aid are more likely to be poorer individuals and families.

[29] Clark *et al.* (1998) provide an excellent review of the literature with applications to both developed and developing countries.

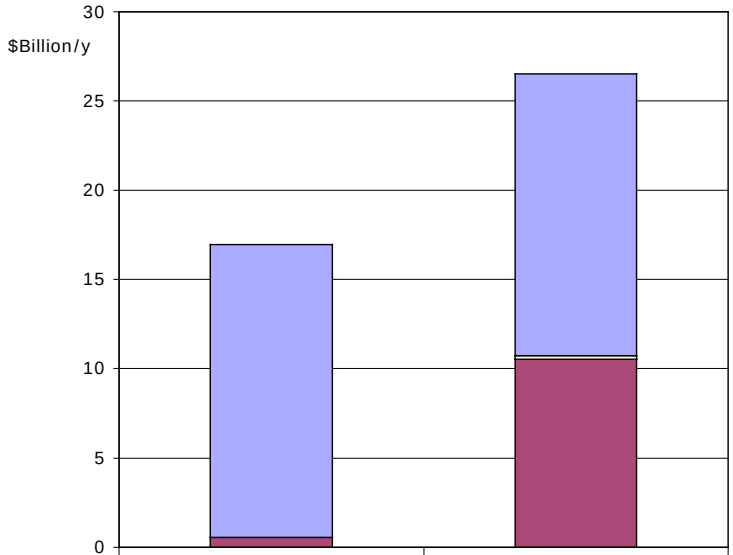
[30] South Korea has significant government-provided crop insurance with 59 percent of premiums paid by the state (Swiss Re 2003d).

Figure 10. Extreme-Weather Risks Are Spread in Five Directions



Note: Virtually all costs ultimately spread to indiv duals and firms

Figure 11. A Small Proportion of Weather-Related Disaster Costs Are Absorbed by Insurers in Lower-Income Countries



	Low Income Countries	High Income Countries
Domestic governments & Individuals	16.40	15.79
Internationnal Aid	0.00	0.20
Insurers & Reinsurers	0.55	10.53

Notes: Periods over which yearly averages are determined: Total: 1980-2003, Insurance: 1980-2003, AID: 1992-2003. Sources: http://www.reliefweb.org (disaster relief); Mun ch Re 2004 (insurance and total econom c costs; low-income defined as property/casualty premiums of $100/capita-year or less). Value for domestic governments & individuals is the residual. A d donors include those tabulated by OCHA: UN Agencies, donor governments, internat onal organizations, the Red Cross, and NGOs (excludes purely mil tary a d).

Factors that contribute to the differential vulnerability of emerging markets include a greater number of young children, disabilities, large families, low income, weak lifelines (transportation, communication, utilities, emergency response, and hospitals), poor quality of construction, absence of or deficiencies in building codes and other regulations, and occupations that tend to be located in harm's way and to depend on natural resources (e.g., the agricultural sector). Natural disasters (e.g., drought) often cause dislocation of large groups of people, which compounds their vulnerability to future events (UN 2002). These factors are also exacerbated by population growth, urbanization, intensive coastal development, and high geographical concentration of certain types of climate-sensitive physical and health-related hazards.

Models of future changes in extreme weather events predict particularly large impacts in the developing world from flooding and drought as well as likely increase in tropical cyclones. Associated models look at key issues such as the effects on agricultural productivity.[31] These impacts are intensified because developing countries and economies in transition are often closer to the margin of tolerance for temperature and precipitation changes (drought as well as flood). The economic and market structure of these countries is also intrinsically more vulnerable than those of established nations because emerging-market economies rely heavily on weather-sensitive sectors such as agriculture and tourism.[32] Coastal vulnerability is also high in emerging markets because of the concentration of coastal settlements, lack of early warning and evacuation system, and the relatively high costs of adaptation to disasters relative to the size of the GDP. Poor nutrition and health infrastructure also leave populations vulnerable to significant health impacts from extreme weather events. Projections indicate that by 2080 more than 50 million additional people may be at risk of hunger as a result of climate change (Rosenzweig et al. 2001).

Along with their significant vulnerability to the impacts of natural disasters, developing countries and economies in transition have a lower capacity to adapt and respond to disasters because of limited access to technology, know-how and education and well as limited institutional and financial capacity. The limits on financial resources are reflected in the current low penetration of insurance in emerging markets as well as the difficulty of access to capital for investments in disaster preparedness and recovery.

Although the vast majority of weather-related insurance losses are in wealthy nations, most of the human suffering occurs in poor countries. Death rates per million exposed people are vastly higher in poor countries (Figures 12 and 13). This is strikingly shown in a comparison of the top-40 natural catastrophes during the past three decades in terms of insured property losses and in terms of fatalities. Not one weather-related event appears on both lists (Appendices 2 and 3).

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[31] Recent work suggests that crop models are systematically underestimating the impacts of global change (Rosenzweig *et al*. 2002).

[32] For example, Tourism accounts for nearly half of Samoa's foreign exchange, 41 percent of Vanuatu's and 29 percent of Fiji's. Beaches, coral reefs, and coastal infrastructure are threatened by rising sea levels and storms as a result of climate change (IFRC/RCS 2002).

Figure 12. Emerging Markets High Physical Exposures and Relative Vulnerability to Natural Disasters: 1980-2000

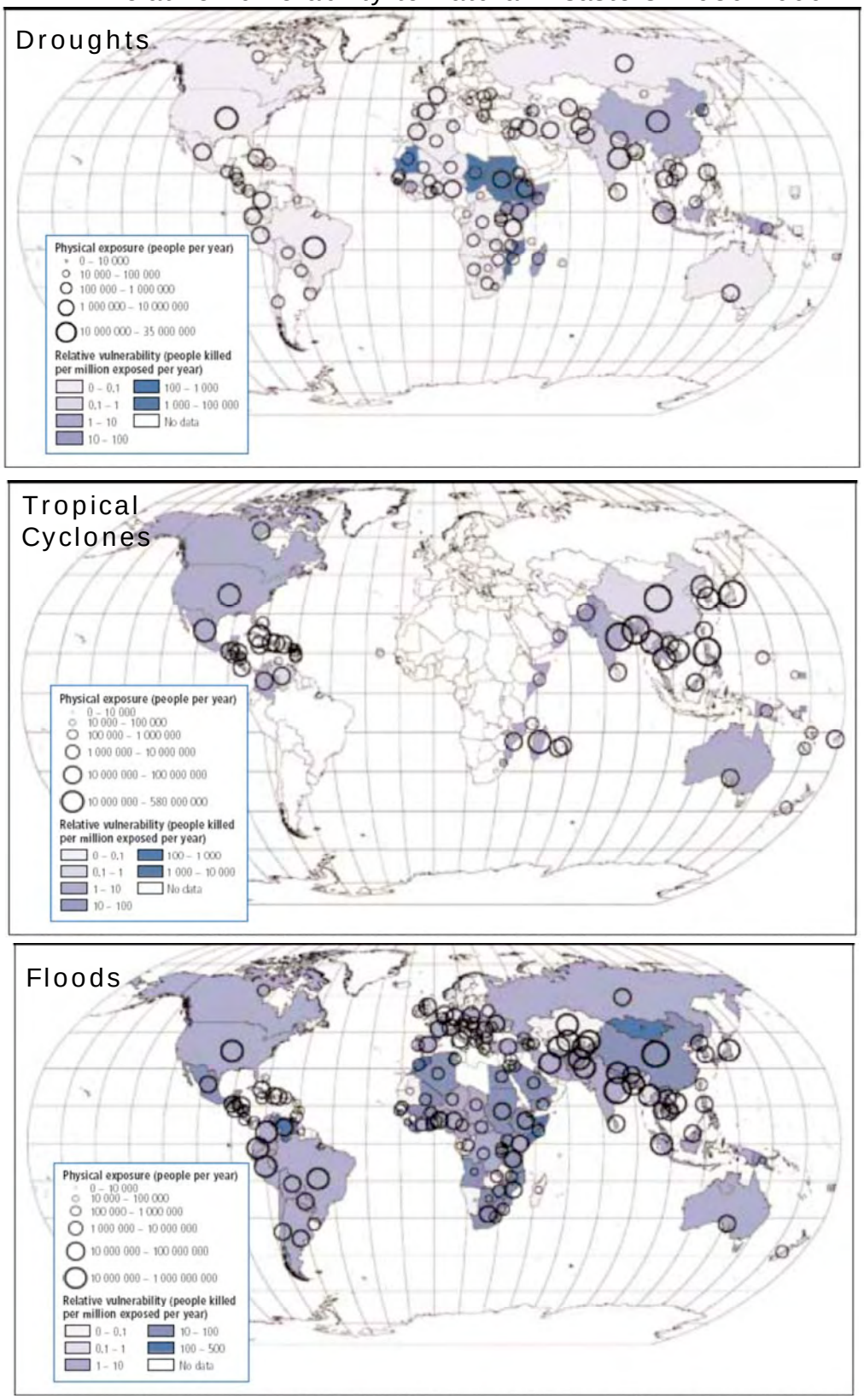
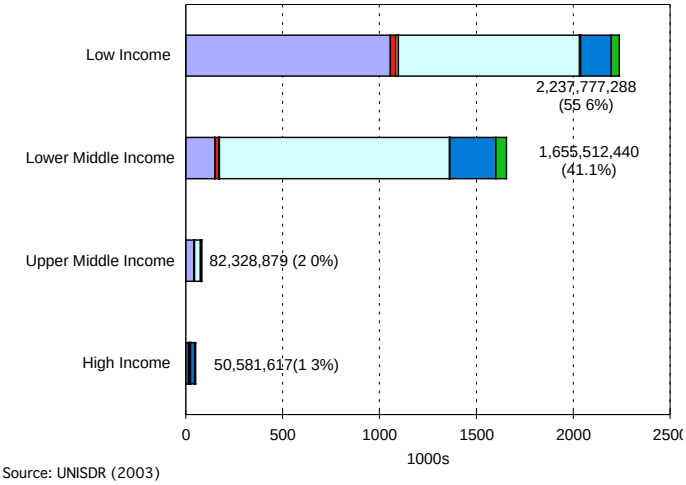
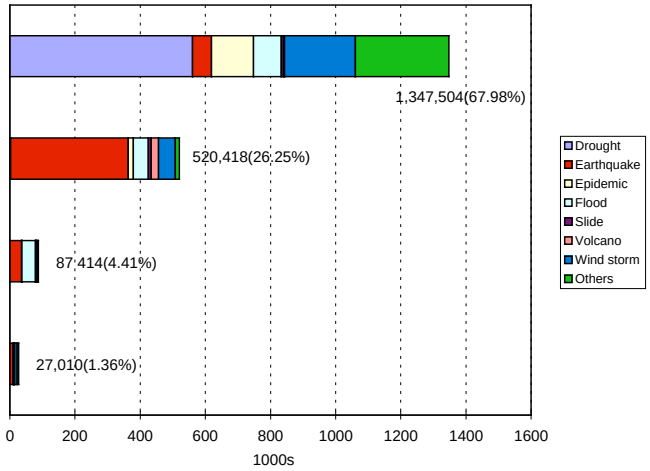


Figure 13. The Poor Are Most Vulnerable to Natural Disasters

a. Number of people affected, by income and disaste type

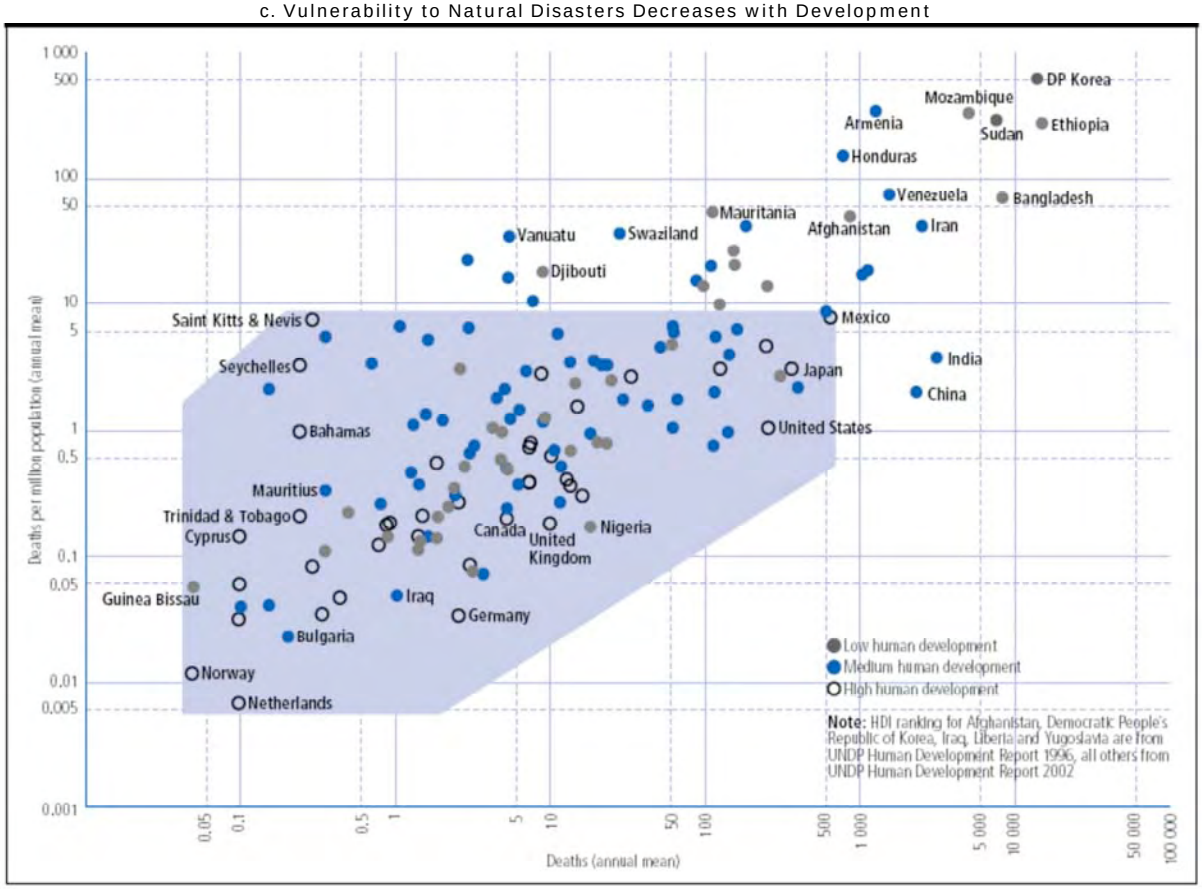


b. Number of people killed, by income and disaster type



Source: UNISDR (2003)

c. Vulnerability to Natural Disasters Decreases with Development



Source: EM-DAT OFDA/CRED International Disaster Database Source: UNISDR (2003). Note that scales are logarithmic.

THE ROLE OF INSURANCE IN ADAPTING TO EXTREME WEATHER EVENTS

> *The adaptive capacity of communities is determined by their socioeconomic characteristics. Enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties in climate, including variability and extremes. In this way, enhancement of adaptive capacity reduces vulnerabilities and promotes sustainable development.*
>
> – Intergovernmental Panel on Climate Change (Smit *et al.* 2001)

The Importance and Limitations of Insurance as a Method for Spreading Risk

Governments and individuals in less-developed countries often do not have the capacity to absorb the costs of natural disasters. It has been argued that insurance can play a substantial role in filling the gap between the actual cost and what others can provide, because of insurance's financial capacity and its ability to spread risks widely and encourage loss-reducing behaviors (World Bank 2002b).

Although they cannot be expected to solve all problems associated with natural disasters, increased availability of insurance combined with the loss-prevention techniques used and promoted by insurers could increase the capacity of emerging markets to adapt to extreme weather events. Insurers can play a role in nearly all aspects of adaptation including: early identification of risks, analyzing risks, loss prevention, research, education, and, ultimately, the spreading of risks among a large solidarity community via insurance (Burton 1996; Swiss Re 2002g). As an industry group, insurers have been at the forefront of analyzing weather-related risks and tracking trends.

Many socioeconomic systems can cope with gradually changing average conditions, but sudden and extreme events are more challenging. Insurers focus on increased frequency and extremes, which is where efforts to foster adaptation are most important (Smit *et al.* 2001). In fact, fostering adaptation to disasters is essentially a form of risk management, which is clearly within the technical and financial domain of insurance. Insurance is also an increasingly relevant means of increasing adaptive capacity because its penetration is increasing for other reasons (such as increased affluence, presence of multinational entities accustomed to using insurance).

Researchers struggle over how to define, measure, and forecast changes in adaptive capacity (Smit *et al.* 2001). Insurance "penetration" (premiums per GDP) and "density" (premiums per capita) are interesting metrics.

Insurance is arguably underutilized in the developing world and economies in transition. For example, $3 billion storm-surge losses hit Bangladesh in 1991 and the U.S. in 1995. In Bangladesh, three percent of the loss was insured; in the U.S. 68 percent was insured (Munich Re 2000a).

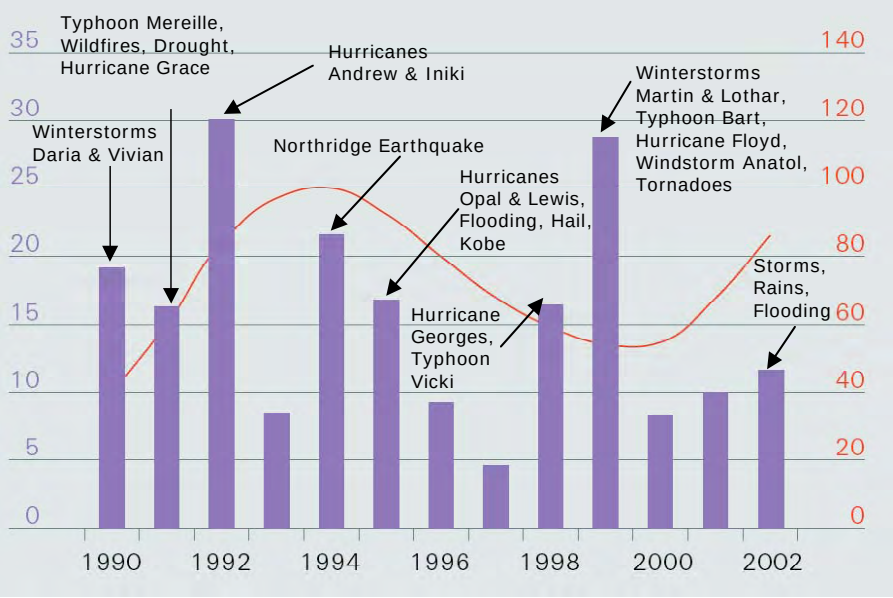
Important caveats apply when considering reliance on insurance and reinsurance, however. One is the short time frame of insurance contracts (typically renewed annually) and the ease with which insurers can withdraw from or increase prices in markets perceived as overly risky. Indeed, the insurance industry itself is vulnerable to extreme weather events, and its own capacity to absorb risks varies depending on recent losses and other market factors. However, insurers prefer not to withdraw from markets or otherwise reduce their market reach. Similarly, increasing premiums is acceptable to a degree, but at some point regulators may object and price elasticities can translate into reduced market share.

The solvency of insurers is clearly central to their ability to ultimately bear and spread losses. Insolvencies (bankruptcies) among US insurers triple from baseline levels in years of extreme natural disasters (Mills et al 2001). Significant challenges arise when there are either multiple weather- or non-weather-related losses in a given year, and/or erosion of reserves and assets in financial markets that coincide with catastrophe losses.

Implications for Insurance Pricing and Profitability

Catastrophe reinsurance pricing fluctuates dramatically in response to major losses (Figure 14). Industry experts cite the threat of natural disasters as one factor causing uncertainty and driving prices higher in world insurance markets (Hartwig 2002a). Examples from recent history include the doubling of reinsurance prices after Hurricane Andrew in 1992 and Winterstorms Lothar and Martin in 1999 (Swiss Re 2002h). The upward trend in pricing was compounded by the subsequent decline in securities markets and losses from the attack on the World Trade Center on September 11, 2001.

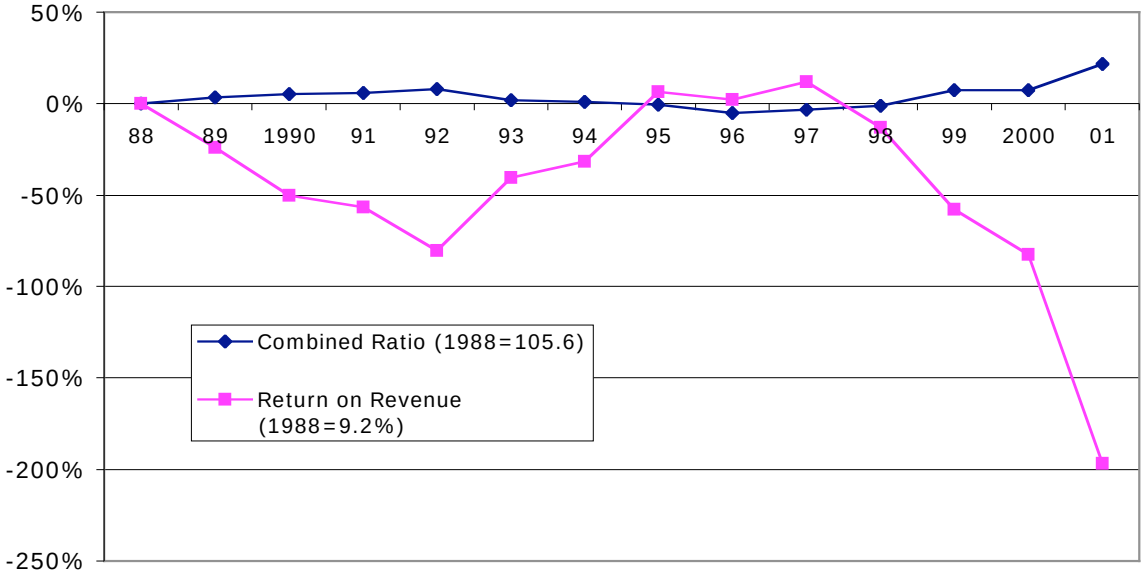
Figure 14. Reinsurance Prices are Highly Sensitive to Trends in Natural Disasters



Catastrophe loss, in $billion, shown on left-hand scale (blue bars) and reinsurance price index shown on right-hand scale (red curve). Source: Adapted from Swiss Re (2003e)

Presumably due to the perception of greater vulnerability, following Hurricane Andrew reinsurance prices rose significantly more in Latin America than in North America: doubling in Barbados and Trinidad and Tobago, tripling in Cayman, and quadrupling in Jamaica (Auffret). Reinsurer profitability has been adversely impacted by major catastrophes, notably Hurricane Andrew and the terrorist attacks of September 11, 2001 (Figure 15).

Figure 15. World Reinsurance Industry Profitability Declines in Periods of High Natural Disaster Losses: 1988=0



Note: Combined Ratio = (Losses +Underwriting Expenses)/Premiums, profitability =<100.
Source: Swiss Re, from Standard & Poor's, Global Reinsurance Highlights 2002

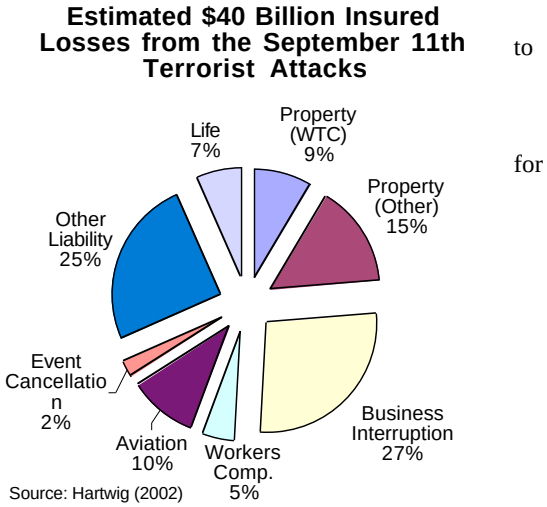
Contributing to insurer vulnerability has been a destructive tendency toward what is known as "cash-flow underwriting" or "market-share underwriting." damaging underwriting cycles in which insurers lower prices to capture market share at the expense of the underwriting profitability of their core business. The problem of over-reliance on investment income came home to roost following the decline of the equity markets in 2000 (Swiss Re 2002a; Howard 2003b).

Although the events of September 11th, 2001 appear unrelated to the question of extreme weather events, these events had effects the insurance community similar to those of a major natural disaster (Box 1). That is, in the wake of 9/11 insurance coverage was reduced or eliminated, prices increased in a variety of ways, and the industry perception of an entire area of risk was fundamentally altered. Catastrophic life reinsurance prices increased five to ten times (Prince 2002a), and many insurers withdrew entirely from the catastrophic life insurance market citing increased "volatility". Figures 16a and 16b illustrate the relative volatility of loss trends from natural hazards as compared to other hazards.

Box 1. Lessons from 9/11[33]

Various instructive parallels exist between the risk issues related to extreme weather events and those related to the terrorist attacks of September 11, 2001 (Challis 2002):

- 9/11 is a striking reminder that past experience is not necessarily a predictor of the future. Insurers have learned to "conceive the inconceivable" (Rasmussen 2004). The event dramatically surpassed the insurance community's conventional wisdom about maximum potential losses, redefining the imaginable and creating the "worst year in the history of the property-casualty insurance industry." according to the Insurance Information Institute.[34] Similarly, the modern-day incidence of extreme weather events has exhibited considerable divergence from historical trends (Goch 2002). This has material implications for regulatory rules concerning methods projecting losses in the future. In particular, current data and modeling methods used by insurers are inadequate for projecting losses under conditions where underlying climatic processes are changing.

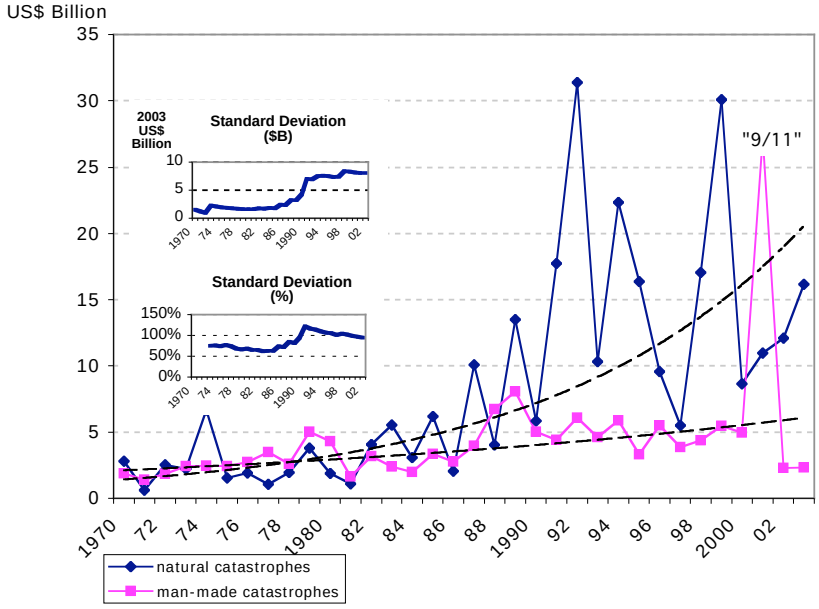


- 9/11 was a reminder of the global interconnectedness of the insurance industry. Remarkably, 60 percent of the losses will be paid by non-North-American insurers and reinsurers (Swiss Re 2002a). In a simulation study of the impact of two $7-billion hurricanes on the U.S., only 40 percent of the insurers involved were located within the U.S., and these firms absorbed only 58 percent of the losses (AIRAC 1986).
- 9/11 highlights the multi-dimensional insurance impacts that result from mega-catastrophes, spanning property, workers' compensation, life-health, business interruption, etc. Of added importance, many of these risks were previously assumed to be uncorrelated and thus more manageable. This experience is similar to the diversity of insurance lines affected by weather-related catastrophes and the surprisingly large losses that a single event can cause (Munich Re 2000b).
- Both 9/11 and extreme weather events raise key public policy questions about the fundamental insurability of catastrophic losses and the relative roles of private and public sectors, and increase emphasis on the government sector as "insurer of last resort." Some have stated that terrorism is uninsurable (Howard 2002b). After lengthy debate in congress, the U.S. government agreed to provide a reinsurance backstop for terrorism losses (as governments in many European countries have). Even given this support, the insurance industry has reduced its coverage in a variety of ways, including lower loss limits, higher deductibles, and increased exclusions (Howard 2002c).
- 9/11 has had clear and marked impacts on insurer financial performance, just as extreme weather events do. Worldwide property-casualty insurers lost 25 percent of their capacity by the end of 2002, equivalent to $230 billion, and saw their first after-tax net loss in history (Hartwig 2002a; Howard 2002d). Reinsurers will pay two-thirds of the costs of 9/11, and 25 percent of global reinsurance capacity was wiped out by the event (McDonald 2002; Howard 2002e). As a result, 9/11 has put considerable pressure on insurance and reinsurance prices, stimulating increased interest in self-insurance. As a result of 9/11 losses, U.S. rating agencies downgraded half of the companies with AAA ratings (Swiss Re 2002a).
- The events of 9/11 represent the first "life insurance catastrophe" in U.S. history, resulting in a sharp jump in prices, reduced availability, and 90 percent reductions in maximum losses payable (Hartwig 2002b; Prince 2002b). Similar surprises could be associated with increases in extreme weather events (e.g., urban heat catastrophes, flood-related fatalities, public health problems resulting from water service disruption or waterborne diseases) (Ross 2000).

[33] Excerpted from Mills et al. (2002).

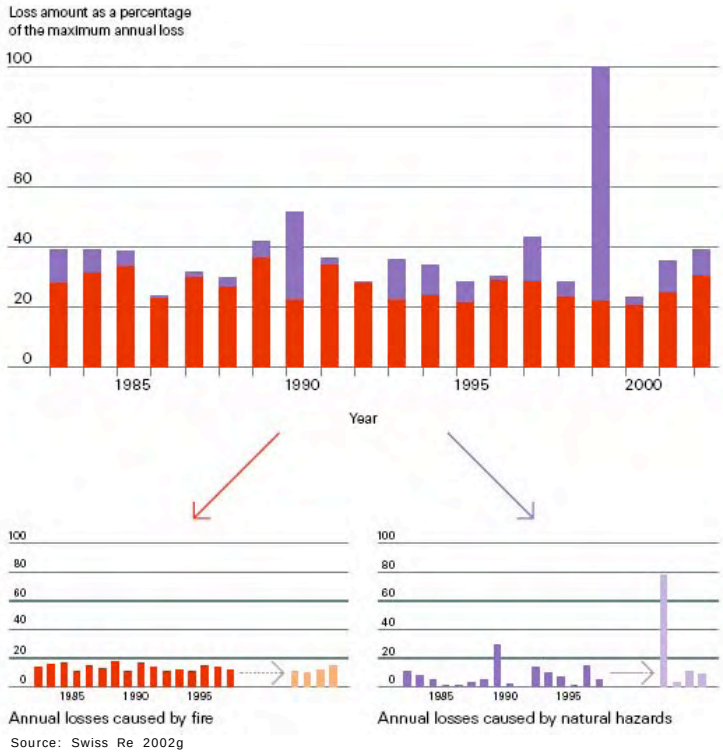
[34] As has been observed following major weather catastrophes, there were dramatic effects on profitability and challenges to insurer solvency.

Figure 16a. Global Inflation-corrected Insured Disaster Losses on The Rise: 1970-2003



Per Swiss Re's conventions, losses reported here are a subset of the total, including events with losses in excess of $35.1 million or total economic losses in excess of $70.2 million or 20 dead or missing, 50 injured, or 2000 homeless. Source: Swiss Re, Economic Research & Consulting, Sigma 1/2004 [Swiss Re (2004)]. Excludes life/health insurance impacts. Growth rate of weather-related natural catastrophes is greater than that of non-weather-related ones, e.g. earthquake and volcano. Trendlines added.

Figure 16b. Insured Losses from Natural Hazards Are Less Predictable Than Conventional Losses (Central Europe: 1983-2002)



In the U.S., the core insurance business has been unprofitable for 17 years. Especially in the wake of 9/11 and precipitous drops in world stock markets, insurers and reinsurers are "thinking the unthinkable." raising rates, and refusing to renew up to 40 percent of their contracts (Howard 2002a; Hilgen 2002; Howard 2003a). Still dealing with the legacy of Hurricane Andrew, U.S.-based State Farm has announced that it will discontinue new homeowners' policies in 15 states (Bowers 2002).

Empirical results for Hurricane Hugo indicate that the stock price of insurers with the greatest exposure to damage claims fell significantly while the stock price of insurers with low exposure to damage claims was unaffected. These results are consistent with the market anticipating that the damage claims resulting from Hurricane Hugo would not be fully offset by an increase in premiums (Julie 1996).

Insurers' Tools for Responding to Extreme Weather Events

Insurers have many traditional ways of responding to expected changes in extreme weather events, ranging from motivating or requiring their customers to implement physical loss reduction measures to a choosing a host of financial strategies including price or deductible increases, changes in terms of coverage (type and or limit), and withdrawal from particular types of insurance or geographical regions. It is important to keep in mind that insurers do not ultimately pay for losses, they spread these costs among the pool of those electing to use insurance.

Many "alternative risk transfer" systems have come into vogue in recent years, including catastrophe bonds and weather derivatives. These derivative mechanisms often become popular when the insurance market cycle is soft (premium revenue is low, and capacity is high) and reverse as markets harden and the industry's risk-aversion increases. The Intergovernmental Panel on Climate Change (IPCC) found that the current markets for these products are highly undeveloped and speculative, and the products' viability is as yet unproven (Vellinga et al. 2001). Weather derivatives became very popular during the late 1970s, primarily in response to cash-flow risks created by utility deregulation in the U.S. Widespread fraud has been another problem (McLeod 2003). Swiss Re (2002a) has observed that this market is "illiquid and not well diversified" and that several atypical winters caused many insurers to suffer losses and exit the market. The market was further troubled by the default of major industry players, including Enron. Other industry observers say that the weather derivative market is overcoming its problems, and finding an audience beyond its original target customers (utilities), with new buyers including farmers, resorts, the travel industry, manufacturers of seasonal products, and other business segments with weather-sensitive revenues (Ray 2003).

EMERGING INSURANCE MARKETS BY THE NUMBERS

> *Insurance density (premiums per capita) is markedly lower in most emerging markets than in the industrialized countries, being around USD44 on average … There are, nevertheless, great differences between the markets, with premiums per capita at between USD100 and USD400 in half of the countries. …[I]n the nineties the growth rate in [emerging markets] was twice as high as that in the industrialized countries. … High growth in these countries is attracting global insurers, who, given the deregulation process during the nineties, are now able to take over local companies or set up their own national subsidiaries."*
>
> – Swiss Re (2000a and 2001a)

The global insurance market amounted to $2.9 trillion premiums in the year 2003, or 8 percent of global GDP.[35] [36] The insurance industry's revenues make it equivalent to the third largest country in the world when compared with national GDPs. The insurance sector perhaps is the world's largest industry.[37] Approximately 40 percent of total premiums are for non-life (property-casualty) insurance, and the balance for life-health insurance (Appendix 4). Important trade allies, such as brokers, are not included in these numbers. The top ten brokers had $20 billion in revenues in the year 2002 (Business Insurance 2003).

Premiums in developing countries and economies in transition represented $314 billion in 2003 (up from $270 billion just a year earlier), or 11 percent of the world market as of 2002. Premium distributions among emerging markets are as follows: 62 percent of premiums originate from South and East Asia, 13 percent from Latin America and the Caribbean, 11 percent from Central/Eastern European, 10 percent from Africa, and four percent from the Middle East and Central Asia (Figures 17 and 18). The mix of life versus non-life insurance, premiums per capita, premiums as a share of GDP, and growth rates varies considerably from region to region.

Premiums per unit of gross domestic product ("penetration") or per capita ("density") also vary quite widely from country to country and tend to be considerably lower in developing countries and economies in transition than in industrialized countries (Figures 19; Appendix 5). Swiss Re's "S-curve" analyses suggest that non-life insurance saturation is at about five percent of GDP, and life insurance saturation is at about nine percent of GDP (Figure 20). During the past two decades, premium growth in emerging markets has consistently exceeded that in the more

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[35] Detailed country-by-country statistics (in U.S. dollars and local currencies) are published by Swiss Re in their annual "World Insurance" reports (e.g., Swiss Re 2004a).

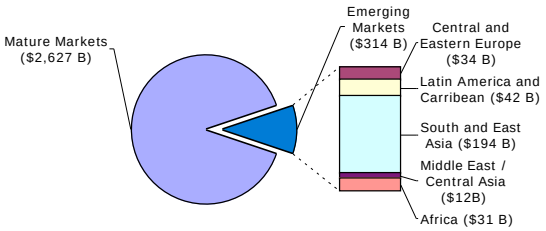
[36] Data presented in this report represent Western-style insurance and do not include the premium-equivalents that are collected from alternative systems, such as *Takaful* methods used in the Muslim world, or so-called "self-insurance." which is often formalized and represents considerable insurance-like capacity for responding to natural disasters not captured in statistics kept by western insurers.

[37] The world oil market, for example, is $970 billion/year at current production levels of 76Mbod and $35/bbl price; world electricity market in 1996 was $1.3 trillion at 13 trillion kWh generation assuming $0.10/kWh unit price; tourism receipts were $445 billion in 1998; world military expenditures were $800 billion in 1995 (Source: 1999 Statistical Abstracts of the United States).

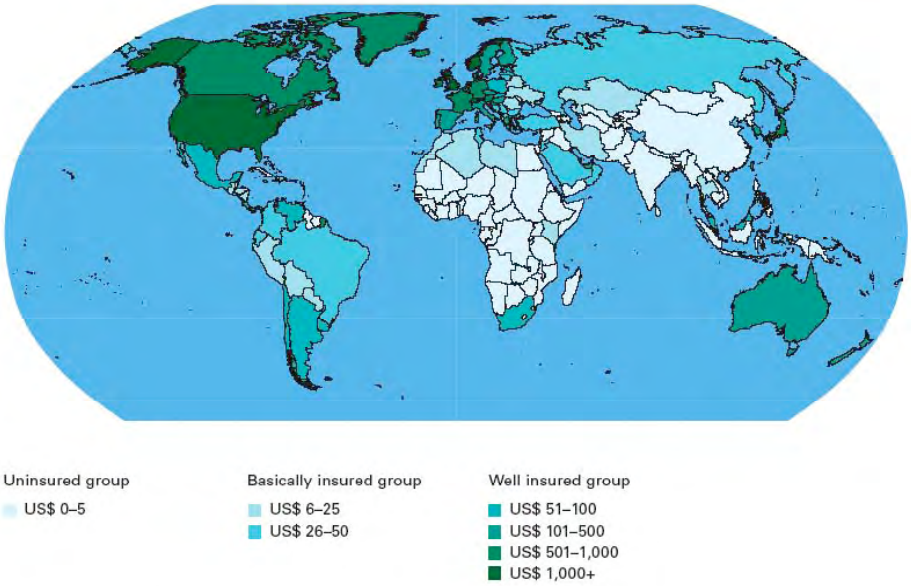
saturated industrialized economies, by a factor of two on average (Figure 21). Most emerging markets show premium growth rates in excess of GDP, especially for life insurance (Figure 22).[38]

Reinsurance (purchased by life and non-life primary ("direct") insurers who transfer part of their loss exposure to the reinsurer) is a far smaller market in absolute terms than is direct insurance (approximately $100 billion/year in premiums) but is essential to the functioning of the primary insurers.[39] Reinsurance will be discussed more fully below.

Figure 17. Eleven Percent of $2.9 Trillion/year Global Insurance Market is in Developing Countries and Economies in Transition: 2003



The Use of Insurance varies Widely Around the World (non-life premiums/capita)

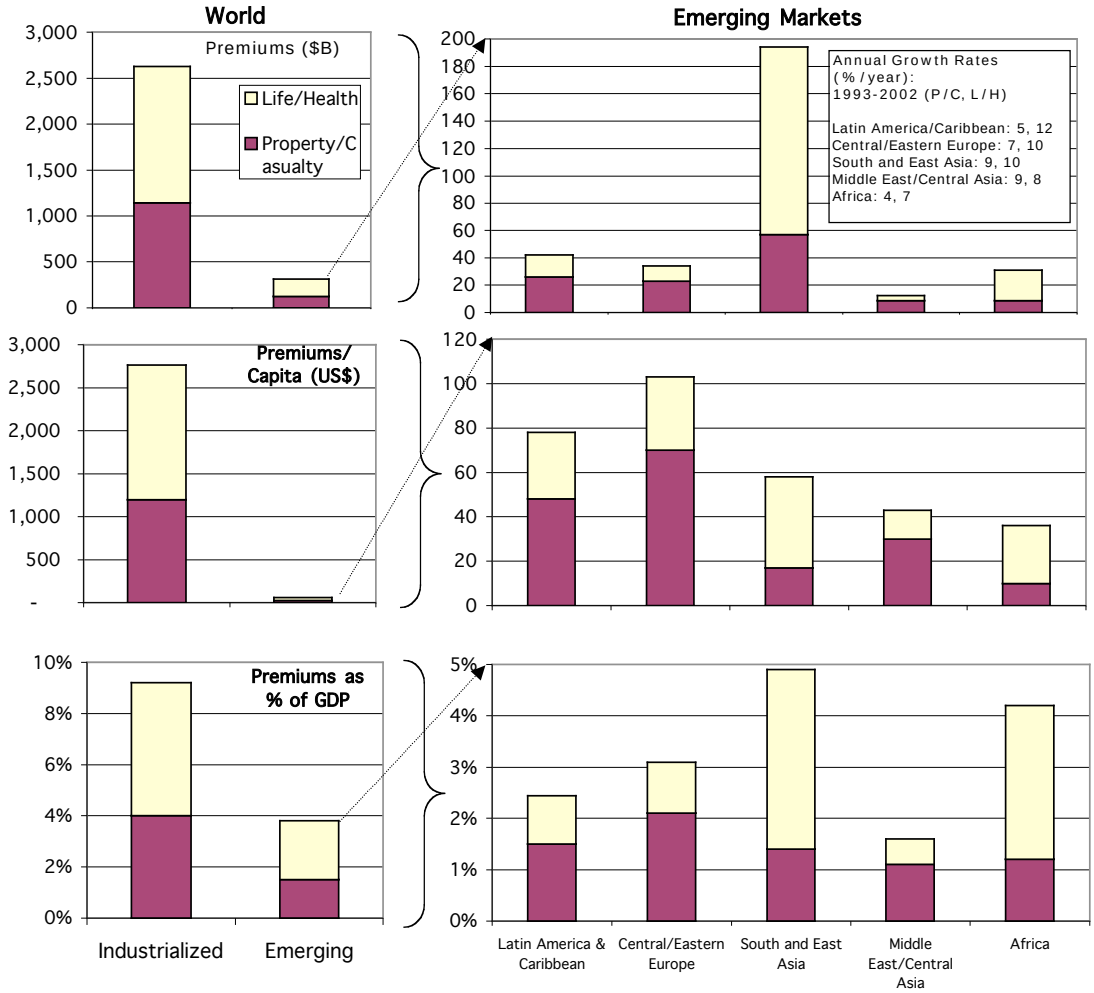


Property insurance premium (non-life including health) per capita per year in US$
Source: MR Economic Research/NatCat*SERVICE*®

[38] For the period 1980 to 1998, South and East Asia was the fastest growing region with 15-percent growth per year growth for non-life insurance and 25 percent for life insurance. In Latin America, growth was 10 percent and 15 percent, and in Africa five percent and 15 percent, respectively. Trends in Eastern Europe were highly erratic for the portions of the post-1992 period for which data are available (Swiss Re1999a).

[39] For example, reinsurers may absorb as much as 60 percent of the total insured loss from the U.S. attacks of September 11, 2001 (Swiss Re 2002c).

Figure 18. Global Insurance Market Summary: 2003



Source: Swiss Re (2004). Growth rates vary widely among nations, but life insurance tends to be more important than property insurance in both magnitude and growth rates.

Figure 19. Penetration (premiums as % of GDP) and Density (premiums per capita) Vary by Region: 2000

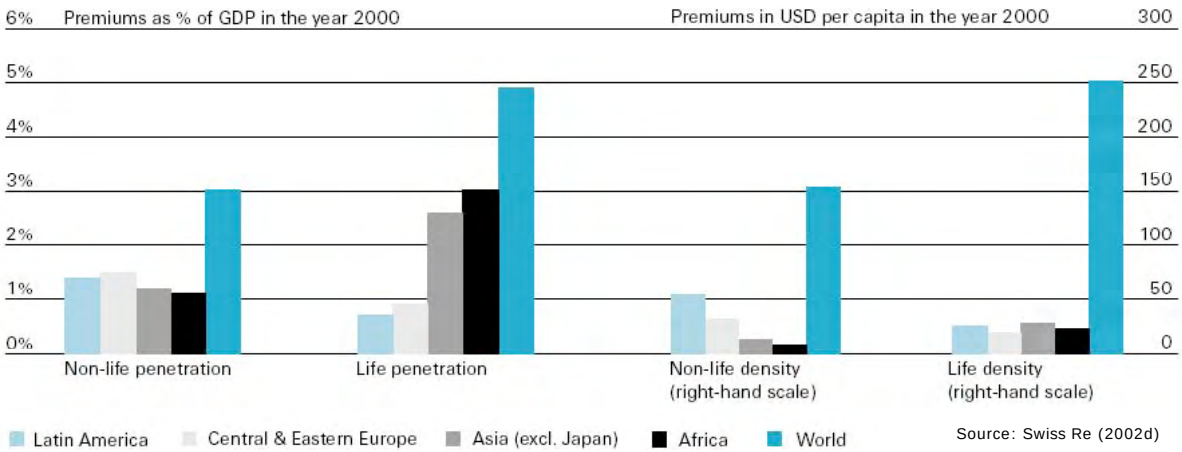
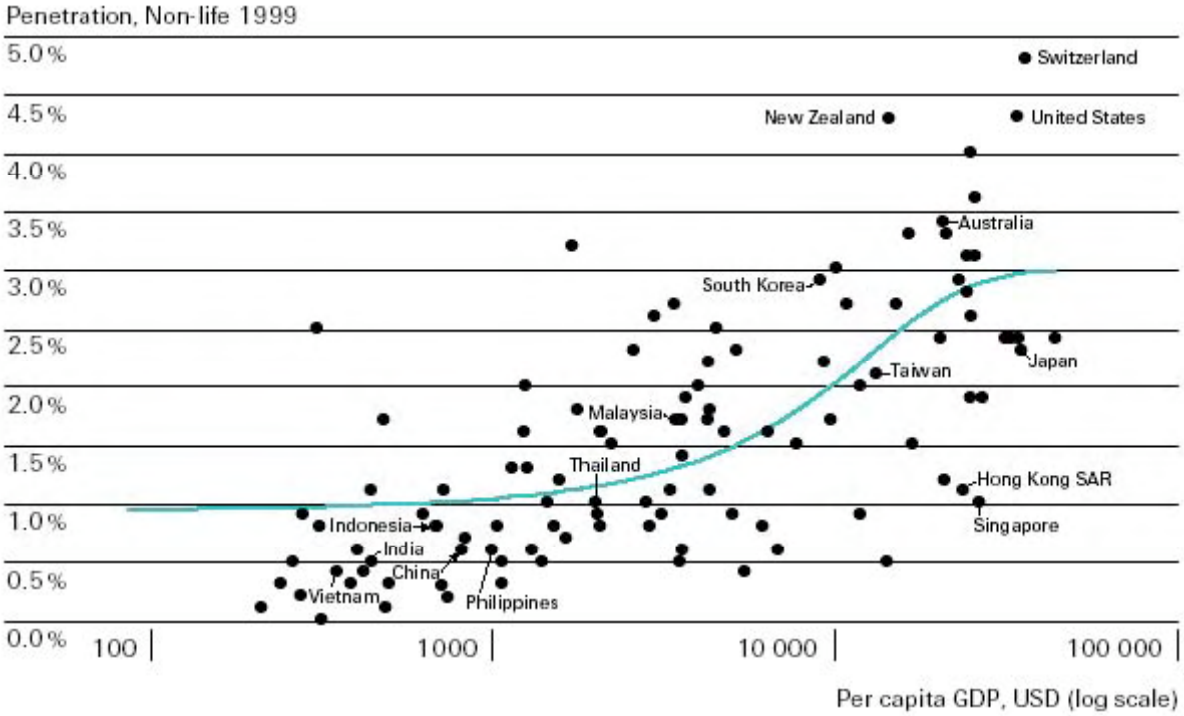
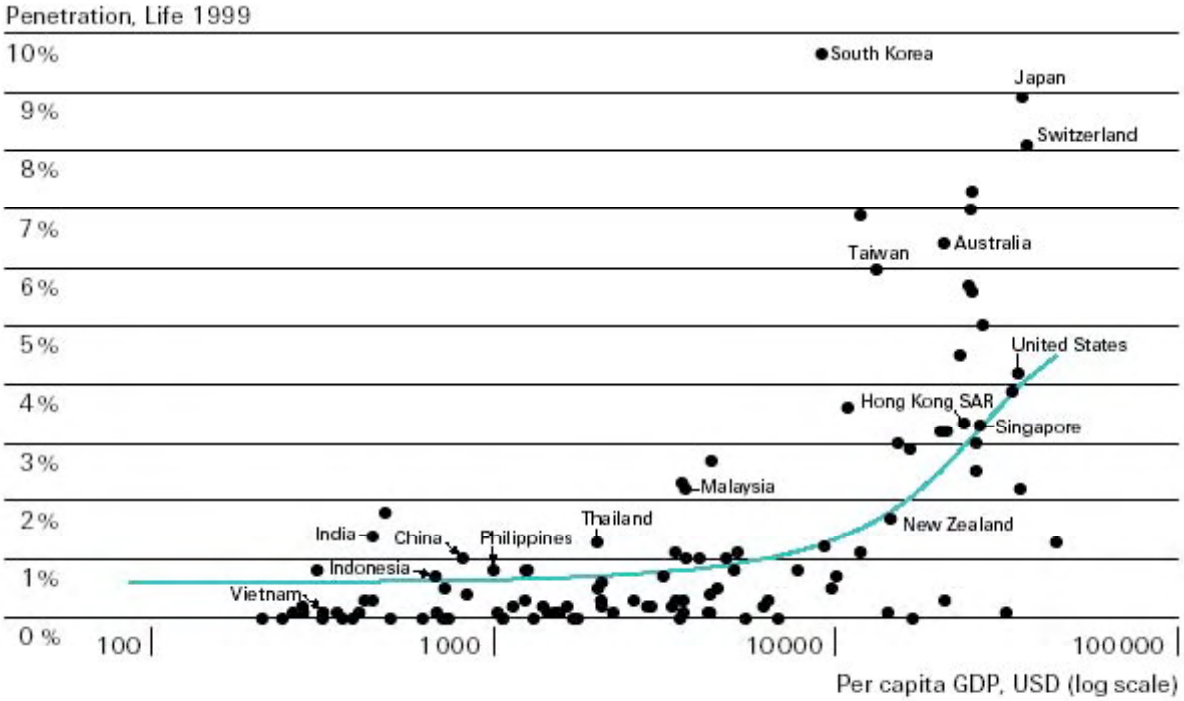


Figure 20. Insurance Penetration Rates Tend to Increase with Economic Growth (premiums as % of GDP, by Income)

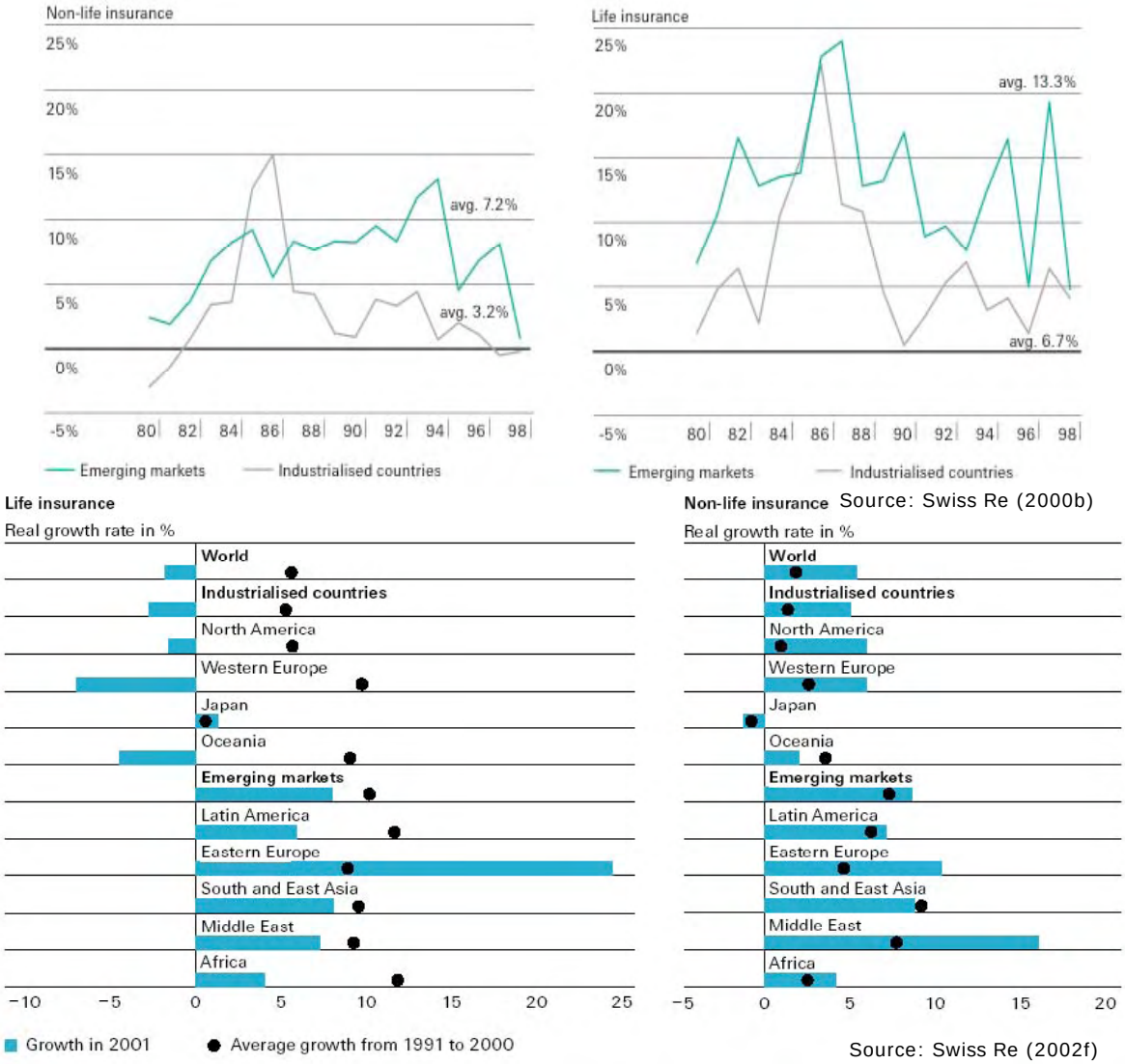




Note: The S-curve shows the statistical relationship between insurance penetration and economic development (represented by per capita GDP). The curve is estimated using panel data from more than 60 countries.

Source: Swiss Re (2001c)

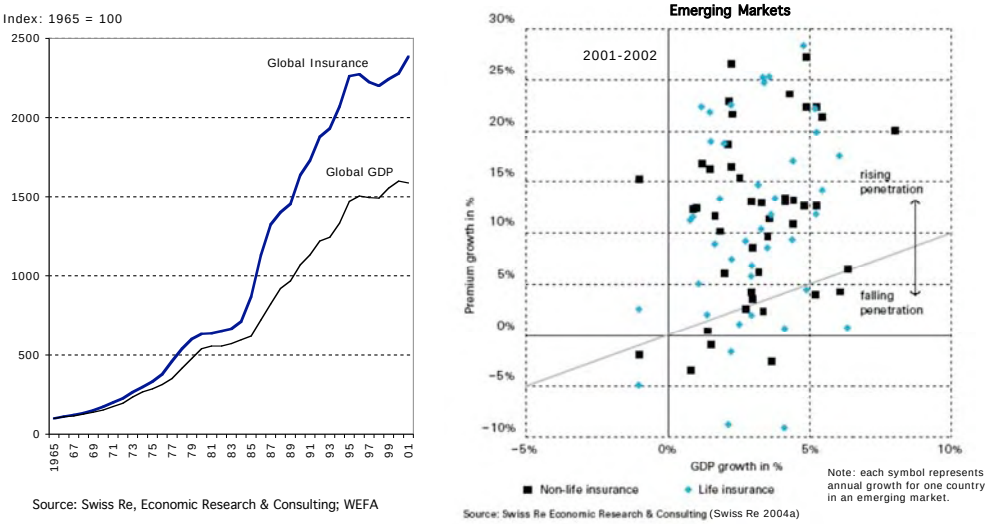
Figure 21. Premium Growth in Emerging Markets Is Consistently Higher Than in Industrialized Countries



Source: Swiss Re (2000b)

Source: Swiss Re (2002f)

Figure 22. Insurance Demand is Growing Faster than GDP, Particularly in Emerging Markets



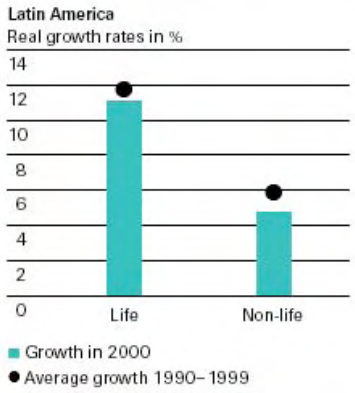
Source: Swiss Re, Economic Research & Consulting; WEFA

Source: Swiss Re Economic Research & Consulting (Swiss Re 2004a)

Available statistics do not shed light on the distribution of insurance by income level *within* developing countries and economies in transition. Companies and the relatively affluent individuals in these economies are the first to use insurance, however lower-income employees benefit indirectly (e.g., via employer-provided health insurance or continued employment where losses would otherwise cause the bankruptcy of firms) and eventually become direct insurance purchasers.[40] It has been noted that insurance in the Caribbean is primarily used by the tourism industry and larger agricultural operations (Auffret 2003).

Latin America & The Caribbean

In 2003, total premiums in Latin America and the Caribbean amounted to $42 billion or 2.5 percent of GDP (Figure 23).



Efforts to liberalize insurance markets throughout the region have contributed to considerable growth. Insurance premium growth has consistently exceeded that of the broader economy, e.g., six percent and one percent in 2001, respectively. Mexico exhibited the greatest annual average growth rates in the region (10 percent for non-life and 19 percent of life) during the period from 1995 to 2000 (Swiss Re 2002a). Perhaps the largest remaining barrier to private insurance in Latin America is the monopoly position of Brazil's state-owned reinsurer.

The newness of these markets along with various inefficiencies contribute to very high ratios of administration and marketing expenses to claims paid (as high as 50 percent in Argentina). The reinsurance market in the Caribbean has been recently said to be "high priced" and offer "low" transfer of risk, with catastrophe insurance premiums representing 1.5 percent of GDP versus average total economic losses of 0.5 percent over the past three decades (Auffret 2003).

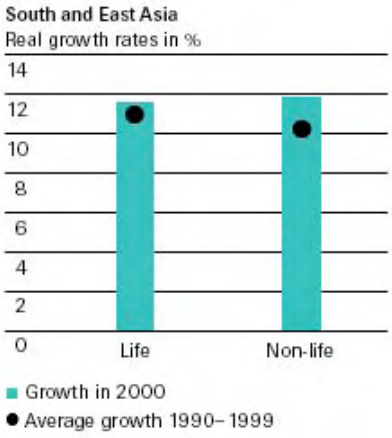
The premium density (expenditure per capita) for non-life insurance is higher in Latin America than in other emerging markets but similar in relationship to GDP. The premium density for life insurance is comparable to that in other emerging markets but lower in relationship to GDP.

[40] For example, in the Bangladesh flooding in 1998, approximately 70 percent of the modest $28 million in insurance payouts went to larger commercial interests, and none of the crop losses was insured (Vellinga et al. 2001).

Figure 23. Latin America Insurance Profile: 2000

Source: Swiss Re (2002d)

South and East Asia



In 2003, total premiums in South and East Asia (excluding Japan) amounted to nearly $194 billion or 4.9 percent of GDP.

Figure 24 shows a snapshot of Asia's insurance markets. Japan represents three-quarters of the non-life insurance market and even more of the life-insurance market, but growth rates are dramatically higher (around 20 percent/year) in many other countries in the region.

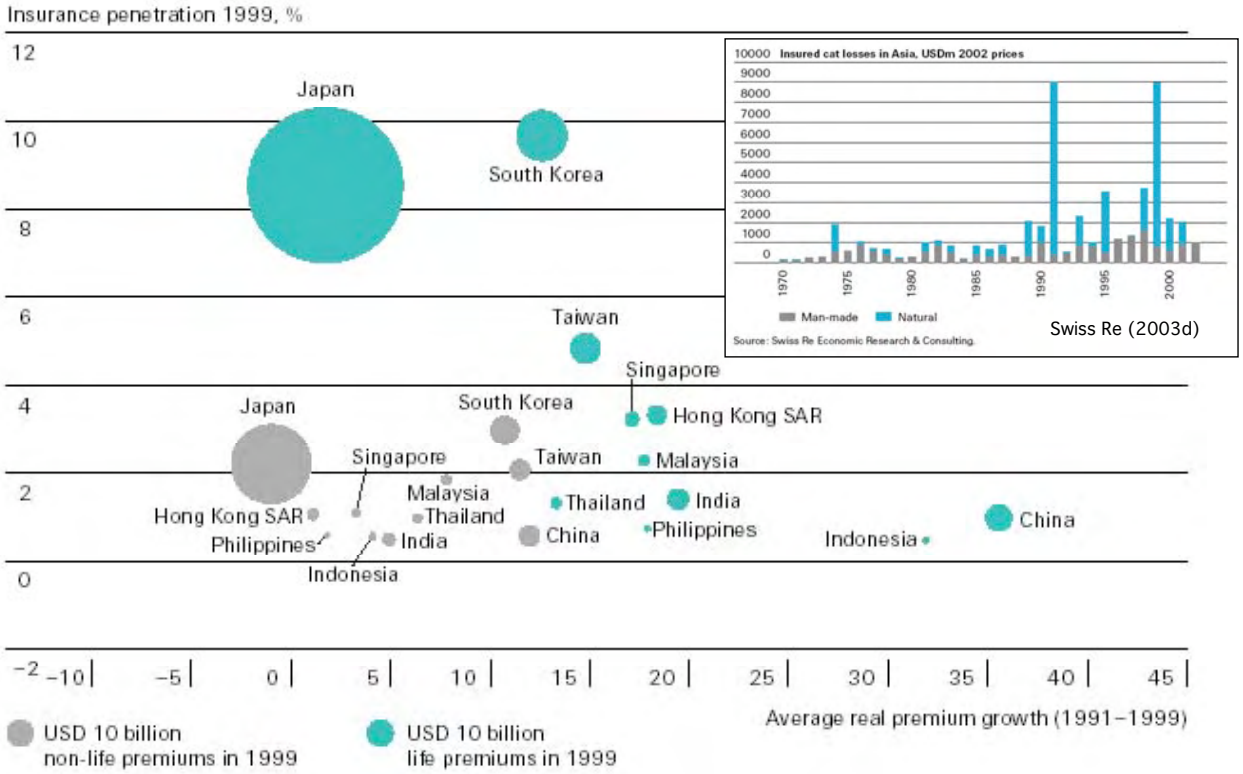
As shown in Figure 20, with the exception of Malaysia and South Korea, Asian countries were below the global average penetration for their levels of income for non-life insurance, but most are located above the average penetration curve for life insurance (because of extensive use of life insurance as a high-dividend savings mechanism).

In response to a concerted effort at liberalization (Box 2), premium growth in China is very strong (47 percent for life insurance and nearly 9 percent for non-life insurance in 2001) (Pilla 2003). Premiums in China amounted to $37 billion in 2002 and are projected to surpass $137 billion by 2011 (Roberts 2003).

Growing interest in life insurance in Asia is driven in part by rapidly aging populations. The number of pensioners per 100 in the labor force is projected to double in most Asian economies between 2000 and 2025 (Swiss Re 2001a), ranging between rates of 10 and 45 by 2025, depending on the country.

Asia will be among the fastest growing insurance markets, with projected annual growth rates during the period 2001 to 2005 of 7.9 percent for the non-life insurance sector and 8.9 percent for the life sector (Swiss Re 2001a).

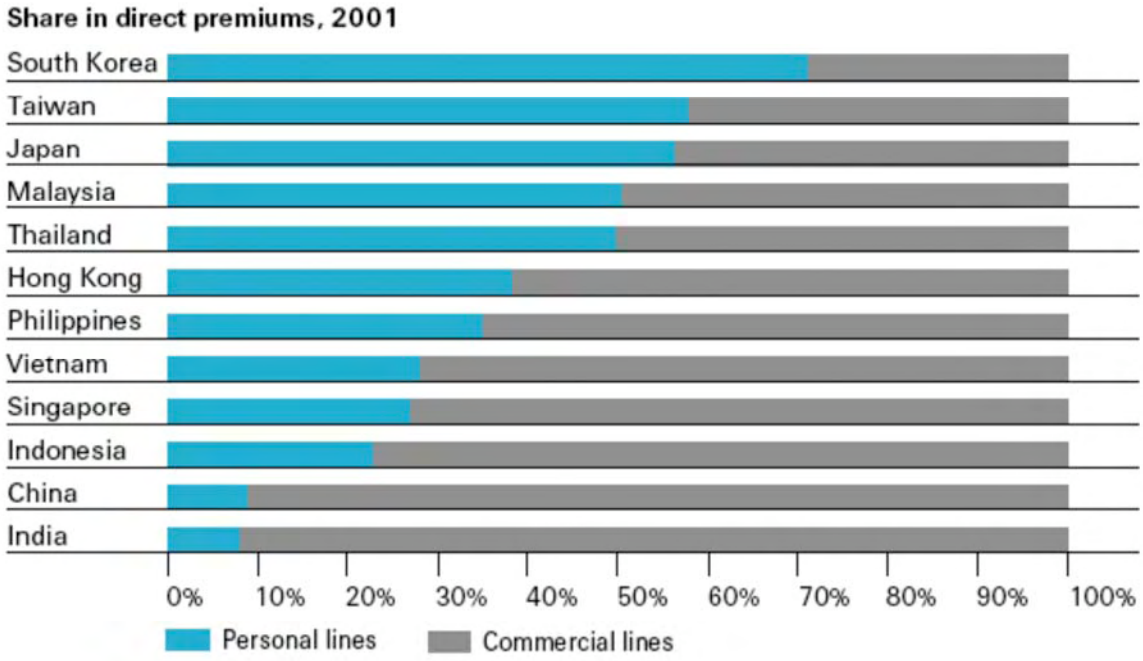
Figure 24. Asia Insurance Profile: 1999



Swiss Re (2003d)

Note: Markets with less than USD 1 billion in premiums are represented by asterisks.

Pentration defined as premiums/GDP. Source: Swiss Re (2001c)

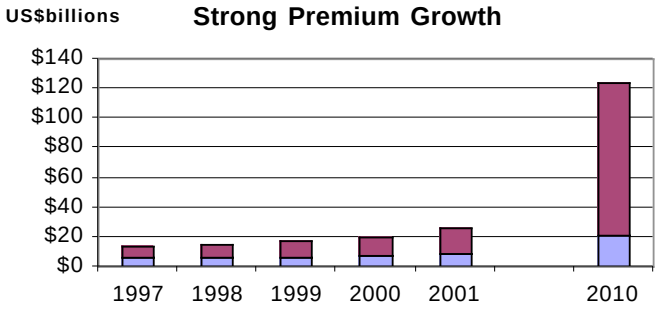


Note: Some estimates put commercial lines in South Korea at 10% of the total. This is due to the assumption that all motor business is non-commercial.

Sources: National insurance statistics; Swiss Re Economic Research & Consulting.

Swiss Re (2003d)

Box 2. China Awakes



	1997	1998	1999	2000	2001	2010
Property/Casualty Market						
real premium growth rate	0.7%	3.4%	5.8%	14.4%	14.2%	10.5%
penetration (premiums/GDP)	0.7%	0.6%	0.6%	0.7%	0.7%	0.9%
insurance density (premiums/capita, US$)	4.8	4.9	5.0	5.7	6.5	15.1
Life/Health Market						
real premium growth rate	85.9%	19.5%	18.3%	14.0%	41.8%	21.9%
penetration (premiums/GDP)	0.8%	1.0%	1.1%	1.1%	1.5%	4.5%
insurance density (premiums/capita, US$)	6.2	7.3	8.4	9.5	13.5	75.3

Source: Swiss Re (per Pilla 2003)

In 1949, all Chinese insurance companies were nationalized and transferred to the People's Insurance Company (PIIC) of China. In response to the notion that insurance was incompatible with communism, all of PIIC's business was suspended in 1959 but resumed in 1980, followed by an end to its monopoly when the first licenses were granted to domestic firms in 1989. The first foreign insurer [the U.S.-based American International Group (AIG)] entered the market in 1992 with its business limited to Shanghai. As of 1999, 172,000 people were still employed in China's public-sector insurance system (Jin and Query 2003).

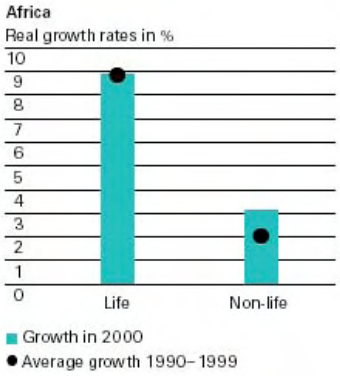
The barriers to foreign entry are many, including prohibitions on using foreign exchange to pay premiums (relaxed in November 2002), a requirement of $5 billion in assets and a minimum of 35 qualified brokers (both of which discriminate against small firms), a history of doing non-insurance business in China for at least two years, and prohibitions on placing investment capital outside of China (Pilla 2004). Some perceive laws and regulations as being "purposefully vague" (Pilla 2004). As of early 2003, offshore insurers were only allowed to operate in five cities, although Munich Re subsequently became the first international reinsurer to receive a nationwide operating license. Among the remaining barriers are ambiguity of licensing and other legal/regulatory requirements, prohibitions on selling group coverage to employers in China, and requirements that firms have $180 million in capital to operate in China. Legal and regulatory conventions vary by region (Pilla 2003). Currently, foreign insurers are required to cede reinsurance to the China Reinsurance Co. although this requirement will be phased out by 2006. Foreign non-life insurers will be allowed to form wholly owned subsidiaries, but life companies will be limited to a 50-percent stake. The changes are driven in part by conditions associated with China's membership in the World Trade Organization, and most barriers are to be lifted by 2006.

Example of Impacts of Extreme Weather Events in China
Flooding: 1998

223 million people affected
15.85 million people displaced; 3,000 dead
12.05 million houses damaged; 4.97 million houses destroyed
21 million hectares of land flooded
14 million people homeless; 2.9 million people living on dikes

Sources: Bradford (2003a,b); Ferguson & Ferguson (2003); Swiss Re (2001c); Sponberg (2000); Dasgupta (2003)

Africa



In 2003, total premiums in Africa amounted to $31 billion or 4.1 percent of GDP. One in five Africans has life insurance, and one in six has medical insurance (Chordas 2004).

Africa is a particularly small but fast-growing insurance market. Growth rates averaged nine percent per year during the 1990s for life insurance and a little more than three percent per year for non-life insurance.

Life and non-life insurance, respectively, represent two-thirds and one-third of the market in Africa (Swiss Re 2001a) (Table 1). The market is dominated by South Africa, which accounted for 93 percent of life and 53 percent of non-life premiums on the continent in 2003. South Africa has the distinction of having the world's highest insurance penetration, approximately 17 percent of GDP, largely because of the intensive use of life insurance.

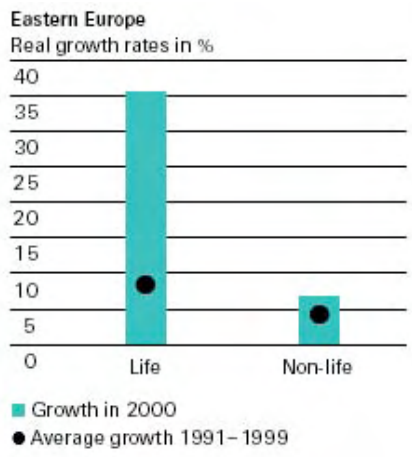
Table 1. Insurance premiums in Africa: 2003

	Total ($M)	Per Capita ($)	% of GDP	Non-Life ($M)	Life ($M)	2001-2003 per-capita change
South Africa	25,398	584	15.9%	4,670	20,728	24%
Morocco	1,288	43	2.9%	927	361	26%
Egypt	565	46	0.7%	386	179	411%
Tunisia	456	46	1.8%	416	40	31%
Algeria	399	13	0.6%	384	15	63%
Kenya	411	13	3.0%	304	107	44%
Nigeria	422	3	0.8%	345	77	50%
Zimbabwe	482	37	4.2%	205	277	61%
Mauritius	241	197	4.6%	95	146	37%
Other countries	1,307			1,053	254	
Total	30,969			8,785	22,184	

Source: Swiss Re (2004a *2001

The insurance literature contains scant information on insurance markets in the poorer African countries. Existing associations include the African Insurance Organization, the Association of African Insurance Brokers, and the Association of African Insurance Supervisory Authorities.

Central and Eastern Europe



In 2003, total premiums in Central and Eastern Europe amounted to nearly $34 billion or 3.1 percent of GDP (for comparison, the European Union average was eight percent of GDP in that year) (Figure 25).

Premiums have risen rapidly since markets opened in the early 1990s, by almost 10 percent per year for life insurance and seven percent for non-life, and similar rates of growth are projected to the year 2005 (Swiss Re 2001b).

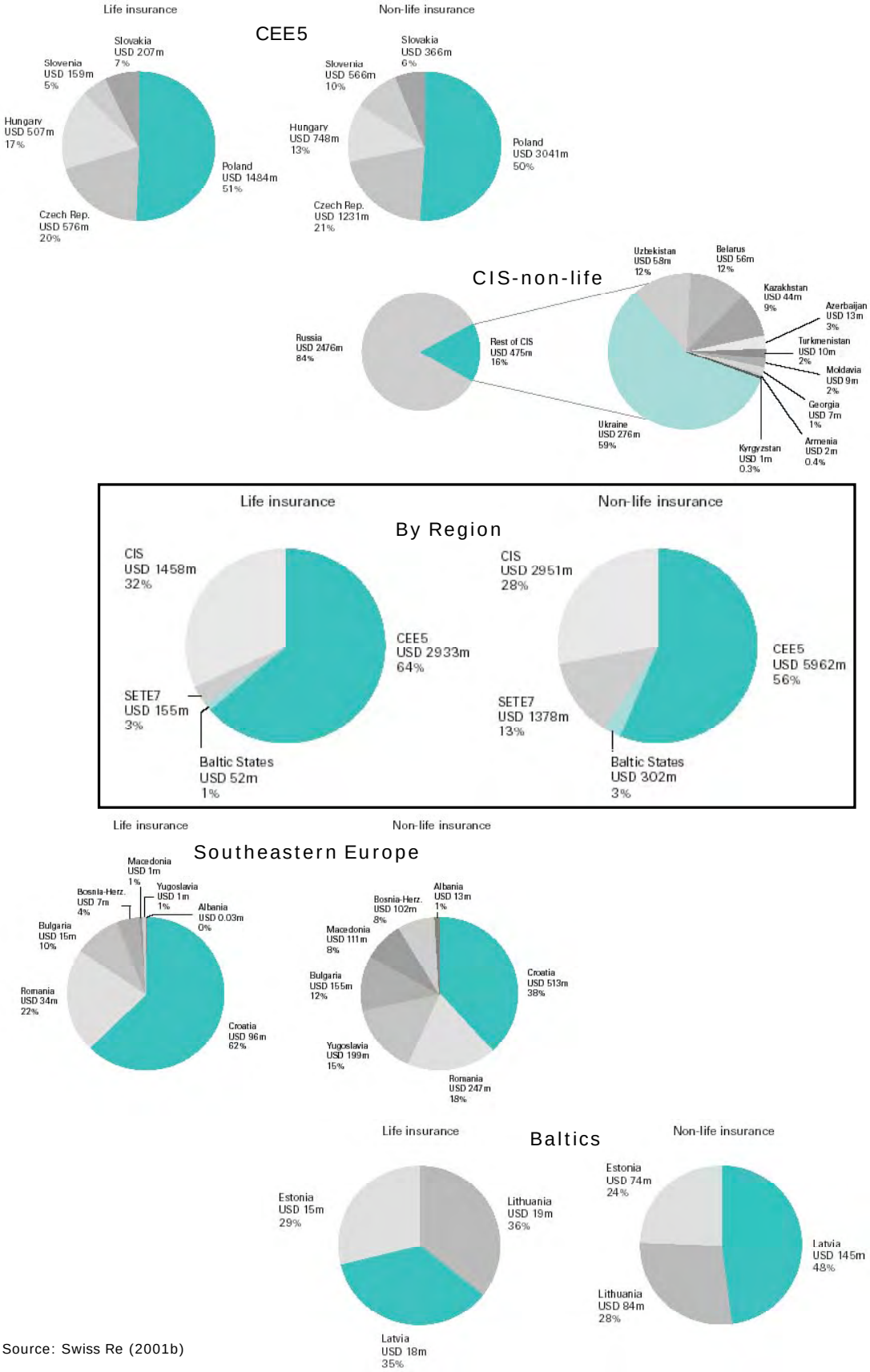
Like their counterparts in Latin America and Asia, the insurance industry in Central and Eastern Europe is significantly more concentrated (less competitive) than the industry in Western countries. Central government monopolies still command a large part of markets.

Pursuit of eligibility for entry into the European Union (EU) is a key driver towards reforms in the region. EU insurance directives require free-market access for foreign insurers, the right to sell policies without having an office in every country, and abolishment of government controls on products and prices.[41] Extensive regulatory changes were made in 1999 - 2000). The accession of eight former communist countries to the European Union in May of 2004 enables insurers from any part of the EU to do business there (Best's Review 2004).

Recent catastrophic weather-related losses in the region highlight the limited extent to which insurance currently contributes to risk spreading. Only 10 to 20 percent of the approximately $30 billion in economic losses from the extreme floods affecting Central and Eastern Europe in the summer of 2002 were insured; Western insurers say that in a mature market they could have covered 50 percent (Unsworth 2002).

[41] Swiss Re (2001b) discusses in depth the progress toward liberalization in each country.

Figure 25. Central & Eastern Europe Insurance Profile: 1999



Source: Swiss Re (2001b)

THE GLOBALIZATION OF EXTREME WEATHER RISKS

> *[I]ncreasing integration of economies around the world has significant implications for the nature of sensitivity to natural hazards. In particular, globalization has expanded opportunities for risk diversification and, for nations as a whole, it seems to be a positive trend. However, whether globalization ultimately exacerbates or reduces sensitivity, both of particular economies and individual households, is complicated and depends on specific country circumstances, including public action to reduce vulnerability. … From a natural hazards perspective, an important objective is to seek ways of using global markets to improve risk management further.*
>
> – Benson and Clay (2002)

Most discussion of extreme weather events focuses on the geo-spatial distribution of risk. However, *socio-economic* distributions of risk extend well beyond the physical footprint of a given loss event or the boundaries of a given country, increasingly as a result of global economic integration and the use of foreign aid and offshore insurance to absorb some costs of disasters.

Although there is much discussion about the positive versus negative linkages between environmental problems and globalization, it is clear that the rising risk of extreme weather events is increasingly distributed globally and that increased natural disasters will have an adverse impact on efforts to move towards an integrated global economy. Benson and Clay (2002) give an excellent of review of disaster issues related to international trade, foreign direct investment,[42] international financial markets, labor mobility, and economic growth itself.

The costs of natural disasters in emerging markets that are, today, partly transferred to wealthier nations, and will be increasingly so in the future through foreign primary insurers, reinsurance of locally domiciled insurance companies (most reinsurers are based in industrialized countries), and a variety of forms of international aid. Insurance of natural disasters is well established in industrialized countries and absorbs about a third of the total costs. In contrast, in the developing world and economies in transition, insurance plus international aid represents only a small percent of the costs (Figure 11). The balance falls in unknown proportions on local governments and the individuals impacted by disasters.

Development is a two-edged sword. On the one hand, it makes insurance more important, but, on the other hand, it increases risks. Reinsurers have pointed out, for example, that typhoon exposure in Taiwan is becoming increasingly worrisome as the nation develops its high-value semi-conductor industry (Bradford 2002). As we saw in the wake of the Kobe earthquake, natural disasters can have ramifications for economies a world away by disrupting supply chains and other aspects of increasingly global business activity. Natural disasters can also trigger increased interest rates charged on foreign loans because of the increased risk perceived by

[42] For example, the share of foreign direct investment (FDI) flowing to developing and transition economies increased from 21.8 percent to 39.8 percent between 1993 and 1997 (Benson and Clay 2002); thus, FDI is increasingly globalizing (i.e. spreading) the exposures of natural disasters.

lenders (Benson and Clay 2002). The degree to which this "surprise" was unanticipated, of the $100 billion in losses, only three percent was insured – undeveloped insurance coverage is not unique to emerging markets. Reinsurers have recognized the globalization of risks caused by "local" events (Munich Re 2002).

Corporate expansion also spreads risks globally. A recent study by Deloitte found that 30 percent of the world's largest 100 companies have offshore operations today, and that number is projected jump to 75 percent within just two years (Risk Management Magazine 2003a). New bases of operations are typically located in developing countries or economies in transition.

Many of the underlying hazards themselves are becoming increasingly global, e.g., disease transmission resulting from the increase in mobility, evidenced by the fact that migrant workers have been seen to spread the range of malaria.[43] The U.S. insurance trade press has recently noted the potential for insurance claims under workers' compensation, general liability, and even Directors and Officers liability policies for workers contracting infectious diseases while traveling abroad (Reitz 2003a).

Cross-border primary insurance markets

Insurance is an integral part of the trend toward globalization, and U.S.-based primary insurers are leading the way.[44,45] A statistical review by Swiss Re (2000b) found that foreign insurers' growth in emerging markets averaged more than 20 percent per year during the nineties.[46] During the late 1990s, the U.S. alone was collecting approximately $40 billion in premiums for policies placed overseas, with an average annual growth rate of 10 percent between 1990 and 1998 (III 2003). The rate of change in Asia was accelerated by the 1998 financial crisis, which expedited the process of financial reform (Swiss Re 2001c).

Between 1990 and 2000, the market share of insurers that are either partly or fully foreign owned tripled in Latin America and Central and Eastern Europe[47] to 47 percent and 41 percent, respectively, and to 12 percent in Asia (Swiss Re 2000b). As 10 new countries were admitted to the European Union in May of 2004, the EU became the world's largest developed insurance market—insurers from any EU member state are free to operate in any other (Best's Review

[43] Kristie Ebi, *Exponent*, Personal communication, June 2, 2004.

[44] Notably: Aetna, AIG, CGU, Chubb, Cigna, Metropolitan Life, New York Life, and Prudential (Swiss Re 2000).

[45] Although this point is not directly relevant to the current discussion, it is worth noting that wealthy nations also rely heavily on cross-border insurance. In a simulation study of the impact of two $7-billion hurricanes on the United States, only 40 percent of the involved insurers were located within the U.S., and these firms absorbed only 58 percent of the losses (AIRAC 1986). Similarly, as noted earlier, non-U.S. insurers will pay approximately 60 percent of the losses from the attacks of 9/11 (Swiss Re 2002a).

[46] Foreign insurers participate either by establishing local offices or purchasing an interest in local insurers. Examples of the latter include Liberty Mutual's acquisition of the Venezuelan insurer Seguros Caracas; ING's 49 percent acquisition of Sul America, Brazil's second-largest carrier; MetLife's $962 million acquisition of Mexico's largest life insurer; Aseguradora Hidalgo SA, and Citigroup's $1.24 stake in Mexican life insurer Seguros Banamex Aegon and Mexican pension-management company Afore Banamex Aegon (Ceniceros 2003; Pilla 2002).

[47] For additional Central and Eastern European data, see Munich Re (2000b) and Swiss Re (2001b).

2004). Foreign insurers operating in emerging markets typically have a higher market share in life and health insurance than in non-life insurance (property-casualty), driven at least in part by the privatization of social security systems and a vacuum created by the relative lack of domestic life insurance.

Growth is fueled initially by motivation among offshore insurers to follow existing customers,[48] the desire to find new sources of growth as mature markets become saturated, and the enhanced efficiency and risk spreading that accompanies geographical diversification. Meanwhile, host countries "pull" offshore insurers by the growth in demand for coverage that accompanies economic growth. Conditions set for entry to regional economic blocks such as the World Trade Organization (WTO) and EU are also key drivers. According to data gathered in 1998, U.S.-based Aetna and the American International Group led the list, deriving approximately 16 percent and 19 percent, respectively, of their 1998 premiums from emerging markets (Swiss Re 2000b).

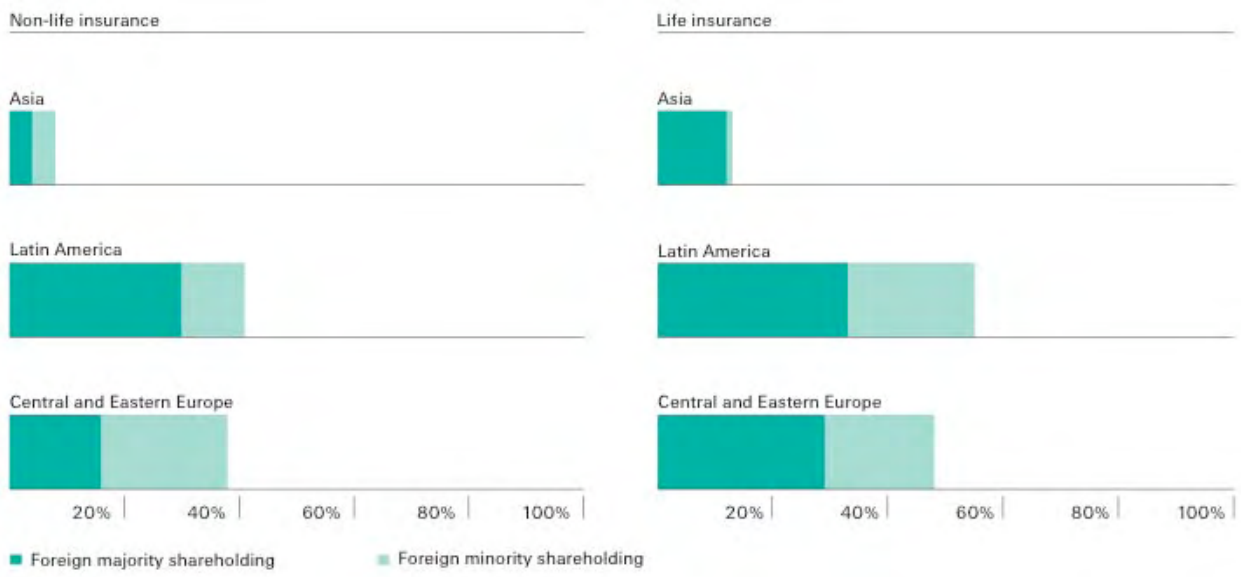
As of 1998, participation was highest in Latin America, with an approximately 40-percent market share for property-casualty insurance and nearly 60 percent for life-health insurance (Figure 26). The penetration of offshore insurance varies by country, exceeding 50 percent in many countries (Figure 27). The Latin American countries of Argentina, Chile, and Mexico have the highest penetrations. In Asia the greatest shares are found in Malaysia, the Philippines, Indonesia, and Singapore (Swiss Re 2000b), with a growth rate of five percent per year for foreign property-casualty insurers between 1997 and 2001 (Swiss Re 2003d). In Central and Eastern Europe, Hungary and Poland have the highest penetration of foreign insurers.

Insurers domiciled in industrialized countries face particular risks in emerging markets, including those arising from financial crises (Swiss Re 2003b). However, these insurers are less vulnerable to such events than local insurers, who are more embedded in and often singularly dependent on the local economy. Insurers domiciled in industrialized countries also tend to be better-managed and more solvent than local insurers in emerging markets (Swiss Re 2003d).

Although foreign insurers are enjoying the considerable business potential of emerging markets, these insurers are also exposed to the risks of extreme weather events in the countries in question. Foreign insurers are also indirectly vulnerable to weather-related events in less-developed countries through insurance of property or activities occurring in conjunction international trade or commerce. This includes various types of coverage, ranging from political risk insurance to weather-sensitive energy-sector vulnerabilities such as those related to the oil trade and other forms of "marine insurance" (SAI 2000).

[48] The largest companies are rapidly moving operations to offshore locations, typically in emerging markets (Risk Management 2003a).

Figure 26. Foreign Participation in Ownership is Important in the Insurance Market: 1998



Source: Swiss Re (2000b)

Foreign participation in Asia's insurance markets, 1999.

	Number of foreign non-life insurers			Number of foreign life insurers			Foreign share of total premiums[1]	
	Domestic (majority) foreign-owned companies	Joint ventures[2]	Foreign branches	Domestic (majority) foreign-owned companies	Joint ventures[2]	Foreign branches	Non-life	Life
China	0	0	5	0	4	1	0.7%	1.7%
India	0	0	0	0	0	0	0.0%	0.0%
Indonesia	0	24	0	0	22	0	28.9%	46.0%
Japan	4	0	27	11	0	3	3.8%	8.9%
Malaysia	8	0	2	4	0	1	14.2%	64.6%
Philippines	8	0	6	19	0	0	18.8%	58.3%
Singapore	11	0	19	4	0	3	56.7%	54.6%
South Korea	1	0	3	3	2	5	2.2%	6.7%
Taiwan	2	0	13	3	0	15	9.3%	29.9%
Thailand[3]	1	0	5	0	0	1	8.3%	48.6%
Vietnam	0	3	1	0	1	2	3.7%	n.a.

Notes: 1. Foreign shares are based on 1999 premiums. Hong Kong is not included due to data availability problems but it is believed that foreign companies dominate the local market.
2. Joint ventures with foreign shares of 49% or above are included. This is to cater for markets where a foreign equity majority is not allowed although the foreign partner typically takes over operational control.
3. For Thailand, a broader definition is sometimes attempted to capture also insurers with effective management control exercised by foreign shareholders. This approach would yield a foreign share of more than 15% in the non-life insurance sector.

(Swiss Re 2001c)

Figure 27. Foreign Insurers Have an Increasing Market Share in Emerging Markets: 1998

[1] Based on premium data in 1998, adjusted for mergers, acquisitions and changes in participating interests in emerging markets until end of March 2000.

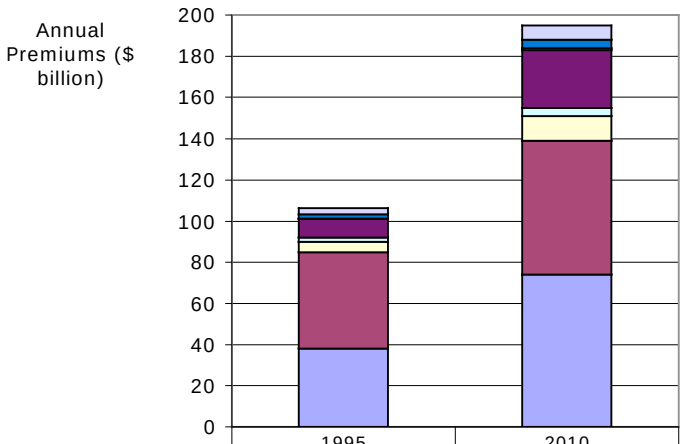
Source: Swiss Re (2000b)

Fearing excessive competition, Asian insurers are discussing a "Trade Block" to coordinate insurance and reinsurance across China, India, and other Asian countries to limit the market share of foreign (i.e. "Western") insurers (Kumari 2003).

Reinsurance: designed for global risk-spreading

Reinsurance is the means by which many insured risks (life and non-life) are ultimately distributed (Reitz 2003b). It is inherently a global segment of the industry; major reinsurers have a presence in virtually every country. The world reinsurance market is projected to nearly double from $106 billion to $194 billion between 1995 and 2010, with the greatest growth in developing countries followed by Central Europe and East Asia (Figure 28) (Duffy 2001). Although reinsurance premiums are small compared to those for primary insurance, reinsurers' influence on terms and policy formulation is high, and the availability of primary insurance is often contingent on the availability ("capacity") of the underlying reinsurance market. Reinsurance prices and profitability have been very volatile in response to large weather-related disasters (Figures 14 and 15).

Figure 28. Global Reinsurance Market Growth Projected to be Strong



	1995	2010
Middle East & Africa	3	7
Australia	2	4
South Asia	0.3	0.9
East Asia	9	28
Eastern Europe & Central Asia	2	4
Latin America	5	12
Western Europe	47	65
North America	38	74

Source (Duffy 2001)

The market segment known as "catastrophe reinsurance" provided approximately $103 billion in coverage in 2002, with associated premiums of just $6.2 billion (Swiss Re 2002c). Interestingly, approximately 50 percent of the premiums are collected and 40 percent of the exposure is assumed by U.S.-based reinsurers, followed by Europe at 22 percent/25 percent, and Japan at 16 percent/14 percent, respectively.

The entities that purchase reinsurance are referred to as "ceding companies." Although reinsurance is typically purchased by primary insurers, it may also be purchased by companies that "self-insure" but seek to limit their exposures and transfer any extraordinary losses to a reinsurer.

Reinsurance contracts can be defined in a number of ways. These include "underwriting risk" (insurance on the magnitude of losses), "investment risk" (insurance to protect a rate of return),

or “timing risk” (insurance to cover primary insurer losses resulting from the premature redemption of investments required to pay claims). A purchaser of reinsurance can thus protect against various combinations of catastrophic losses from a given event or from an overall increase in frequency of ordinary claims. They may also directly protect their net worth, as prescribed level of profitability (combined ratio). Reinsurance is typically purchased by a firm for its entire “book of business” (portfolio of policies) although reinsurance may also be applied to individual risks such as specific buildings or bridges (known as “facultative reinsurance”).

Loss may be defined on a per-risk, per-occurrence (event) or an aggregate basis over a contract term (typically one year). An alternative contract structure is known as “proportional” or “pro-rata” reinsurance in which the ceding company and the reinsurer share premiums and losses in equal proportions. Hybrid approaches also used. So-called “excess-of-loss” reinsurance may be purchased in “layers,” such that losses above the primary insurer’s maximum retention (analogous to a deductible) are purchased by multiple reinsurers, who thereby share and spread the risk and associated loss exposure. Although upper limits on coverage were not originally part of the design of reinsurance, growing uncertainty and increasing potential magnitudes of catastrophic losses [probable maximum losses (PMLs)], reinsurers today typically cap the maximum losses they will pay. As reinsurance layers are finite, extreme losses exceeding these limits revert to the primary insurer.

Reinsurance is particularly valuable to relatively small primary insurers, who do not have considerable “capacity” with which to absorb losses. When the reinsurance industry comes under stress, as was the case following 9/11, the smaller primary insurers tend to be the most affected.

As seen in the case of the 9/11 attack, governments can find themselves called upon to act as quasi-reinsurers, providing some form of backstop coverage to protect private industry from severe losses in catastrophic situations. Federal reinsurance now exists for terrorism risks in the U.S. and is being sought by private insurers for wildfire and other risks.

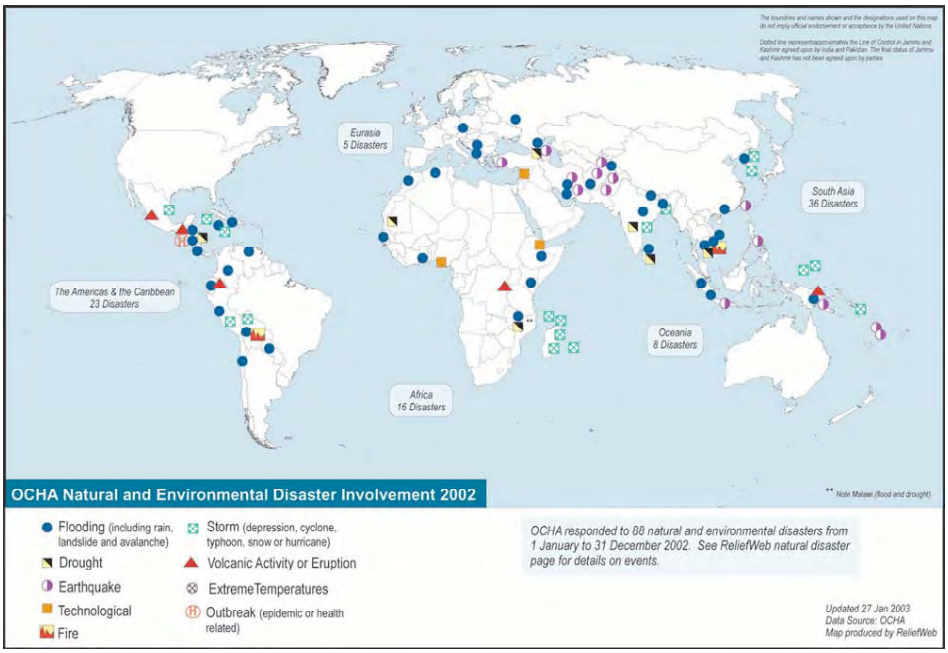
International Aid

> *Countries that have achieved sustainable development are less likely to require massive USG [U.S. Government] humanitarian assistance.*
>
> – USAID / Office of Foreign Disaster Assistance (OFDA)

Costs of weather-related events in developing countries and economies in transition are spread to industrialized countries not only through insurance companies but also through a complex mosaic of international aid (Figures 29a-i). International aid is a confluence of resources from national governments, non-governmental organizations, and private donations. The institutional setting of international disaster relief is complicated; sixteen UN agencies have a mandate in the area, under the UN Office for the Coordination of Humanitarian Affairs (UN-OCHA), which responded to 70 natural and environmental disasters in 2001 (Figure 29a). The vast majority of the aid passing through UN-OCHA is for civil strife or so-called “complex emergencies” rather than natural disasters (Figure 29d).

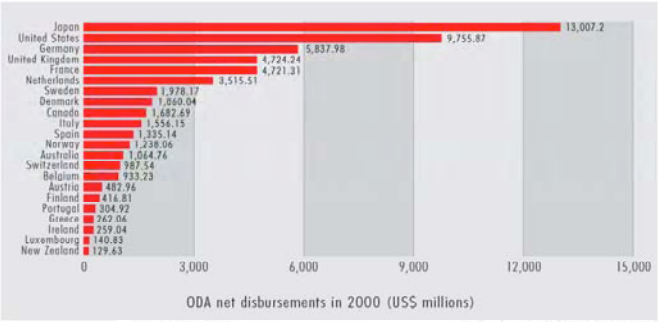
Figure 29. International Aid: Current Snapshot

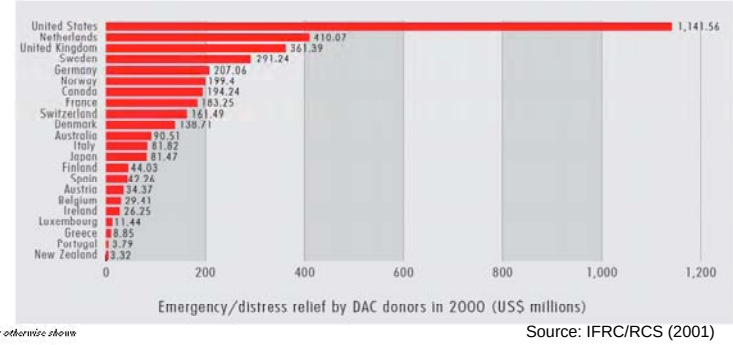
a. UN Involvement in Natural and Environmental Disasters: 2001



Source: UNOCHA http://www.reliefweb.int/w/map.nsf/home

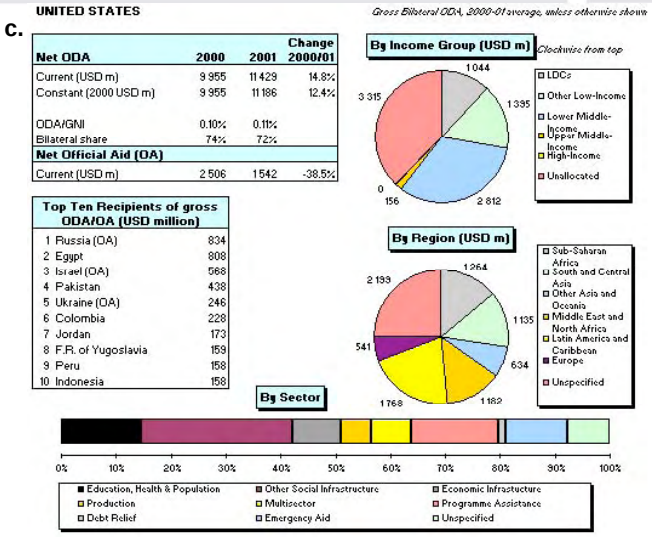
b. OECD Official Development Assistance & Emergency/Distress Relief: 2000





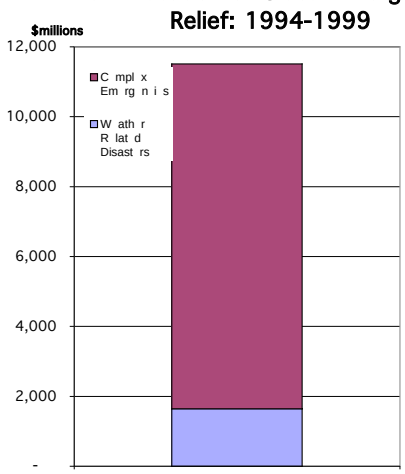
Source: IFRC/RCS (2001)

c.



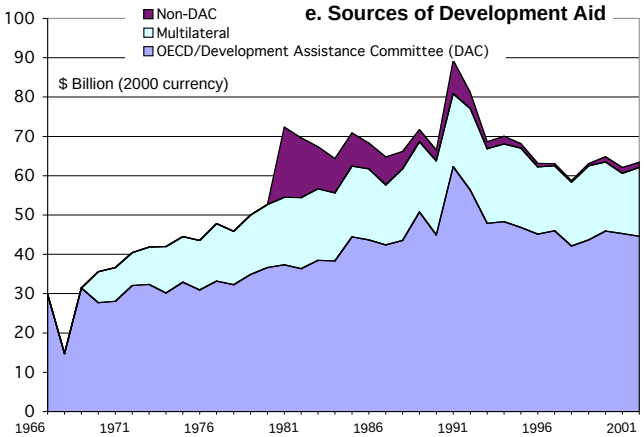
c. Source: Allocation of US bilateral ODA in 2000.
http://www.oecd.org/gif/M000000000/M00000299.gif

d. Allocation of Global Emergency Relief: 1994-1999



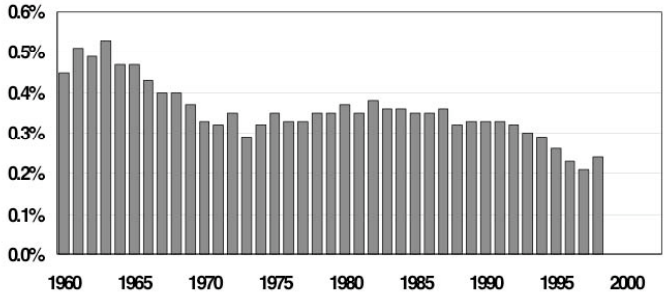
Source: http://www.reliefweb.int/arfts/.

Figure 29 (cont'd): Trends & The Need

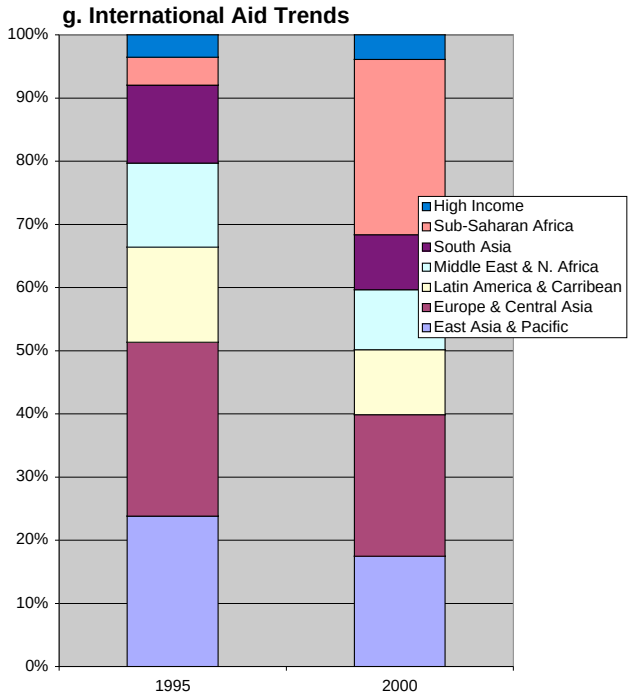


Source: OECD (http://www.oecd.org/dac htm/online.htm)

f. percent of OECD's DAC donors' GNP

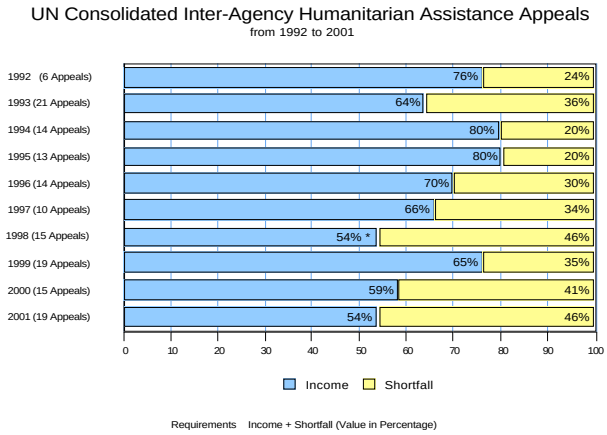


Source: Institute for Catastrophic Loss Reduction/OECD



Source: World Bank (2003). Includes Official Development Assistance and Official Aid. Excludes purely military aid.

h.



Source: Reliefweb (http://www.reliefweb.int fts/analysis/index.asp)

Source: OECD (http://www.oecd.org/dac htm/online.htm)

As shown in Figure 29b, worldwide Official Development Assistance totaled about $60 billion in the year 2000, and Emergency/Distress Relief totaled $3.6 billion (including natural and man-made disasters as well as complex emergencies). Total funding has remained roughly level (in real dollars) during the past two decades (Figure 29e).

According to UN-OCHA statistics, approximately $3 billion in international relief aid was provided for natural and environmental disasters between 1992 and 2002. The types of events precipitating these activities included flooding, drought, earthquake, extreme temperatures, volcanic activity, oil spills, and tropical storms (Figure 29a). Although considerable, this aid never matches the demand (Figure 29h) and represents only a small percentage of the total costs of natural disasters (Figure 11). Most countries receive only a fraction of the aid requested. International aid has been declining steadily as a percentage of donors' GDP, from around 0.5 percent in the 1960s to 0.2 percent today (Figure 29f).

Total U.S. government emergency relief has been approximately $1 billion annually in recent years (Figure 29c). The USAID Administrator is designated as the President's Special Coordinator for International Disaster Assistance and the OFDA assists in the coordination of this assistance. USAID's Bureau for Democracy, Conflict, and Humanitarian Assistance includes OFDA, as well as the Office of Food for Peace, the Office of Transition Initiatives, the Office of Private and Voluntary Cooperation, and the Office of American Schools and Hospitals Abroad. USAID's activities span disaster preparedness, response, and recovery, with significant funds distributed via non-governmental organizations as well as the UN.

In 2000-2001, approximately 12 percent of total U.S. aid was for emergency relief (Figure 29i). Three of the largest U.S. government providers of foreign humanitarian assistance are the U.S. Department of Agriculture (USDA), the U.S. Department of State's Bureau of Population, Refugees, and Migration (State/PRM), and the U.S.

Department of Defense's Office of Peacekeeping and Humanitarian Affairs (DOD/PK/HA). Additional assistance is provided by the U.S. Geologic Survey (USGS), the Centers for Disease Control and Prevention (CDC), the U.S. Forest Service (USFS), the National Oceanic and Atmospheric Administration (NOAA), the Department of Health and Human Services (HHS), and the Environmental Protection Agency (EPA).[49] Other parts of USAID, such as the regional bureaus, provide development aid, which often complements humanitarian relief programs or can be regarded as disaster rehabilitation or reconstruction assistance.

Importantly, international aid has been flat during the past two decades while the inflation-corrected economic costs of natural disasters have increased eightfold. Moreover, most (if not all) aid goes toward recovery, with little directed towards pre-event proactive and preventive measures. In a zero-sum game, non-weather-related world events such as civil conflict diminish the resources available for natural disaster recovery. Foreign policy considerations cause the majority of aid to flow for non-weather-related relief even though during the 1990s weather-related events were responsible for 98 percent of the people affected by disasters.

[49] OFDA Brochure.

Sometimes seemingly unrelated classes of events interact in devastating ways, for example the significant role that AIDS-related deaths are playing in famines in Africa (U.S. State Department 2003).[50] Such developments divert disaster relief funds, as suggested by the rising share of aid to sub-Saharan Africa indicated in Figure 29g.

[50] People weakened by AIDS are more susceptible to the complications of hunger, and AIDS has killed large numbers of agricultural workers. In some African countries, 30 percent of the population is infected; half a million workers died in Africa 2001 alone. Such circumstances increase vulnerabilities to weather-related disasters such as drought and floods.

CHALLENGES AND BARRIERS TO THE AVAILABILITY AND USE OF INSURANCE IN EMERGING MARKETS

> *As climate change imposes greater statistical uncertainty concerning maximum potential losses and weakens the connection between present and future climate regimes, P&C insurance companies will be deterred from relying wholly on past actuarial data to set future rates and control risk exposures. … [A]n 'underclass' of high-risk areas may be created within which coverage becomes more expensive or more difficult to obtain.*
>
> – UNEP & Innovest (2002)

The Limits of Insurability

Not all risks are commercially insurable. A variety of definitions of insurability are found in the literature that differ in detail but share the common theme of accepting or rejecting risks based on the nature of each risk and the adequacy of information available about it (Crichton 2002; Mills et al. 2001; Pearce 2002). The perceived insurability of natural disasters and extreme weather events may be affected by increases in the frequency or unpredictability of these events (Swiss Re 2004e). If the availability of insurance is consequently reduced, development may be constrained in the emerging markets.

In essence, private insurers set a series of conditions that must be met before they will assume a given risk or enter a given market; these conditions—sometimes referred to as "Standards of Insurability"—are intended to assure the insurers' financial survival in case of catastrophic losses (Table 2). This process involves technical and subjective judgments, and history shows that insurers will (sometimes recklessly) relax the standards when profits are high (Swiss Re 2002e).

When private insurers decline to cover a risk, the cost reverts to others. As a case in point, the risk of residential flooding in the U.S. is deemed uninsurable, which has given rise to a National Flood Insurance Program, which has more than 4.2 million policies are in force, representing nearly $560 billion worth of coverage (Bowers 2001).

Technical and Regulatory Complexities Facing Domestic and Foreign Insurers

Experience to date suggests that foreign insurers' participation will be important in the development of insurance markets in emerging insurance markets. Current trends toward deregulation and liberalization as well as increasing wealth are stimulating remarkable growth in insurance. Although insurance penetration in emerging markets increased considerably during the late 1990s, there remains considerable "pent up" potential given government monopolies, regulations, and other market factors that currently constrain the rate and nature of offshore insurer participation in many emerging markets (Boxes 2 and 3).[51]

[51] The World Bank held a workshop on this topic: see http://www.visualcommunications.com/wb/nbfi/home.htm#insurance

The ongoing shift toward free-market provision of insurance is expected to reduce consumer prices and expand choices of products and terms. Deregulation and liberalization are proceeding in many key countries and are nearly universal in Latin America (Table 3).[52] In Asia, for example, insurance pricing has been liberalized in Indonesia (1989), Philippines (2000), South Korea (2000), and Taiwan (1998) (Swiss Re 2001c).[53]

Box 3. India

With the establishment of the state-owned Life Insurance Corporation of India in 1956, all private life insurance companies were nationalized. An analogous change occurred in 1972 when all non-life firms were subsumed into the General Insurance Corporation of India. In the late 1990s the Insurance Regulatory Development Authority was formed, and, in keeping with general trends toward liberalization, decided in 1999 to license private insurers and brokers in India. The 1938 Insurance Act created special barriers to the entry of insurance brokers into India, but these have been remedied. Use of the British law system is seen as a plus by western insurers.

However, the government continues to impose restrictions on the market, such as allowing only 10 percent of a given policy coverage to be reinsured by non-Indian firms and requiring primary insurers to offer first right of refusal to a to-be-created government reinsurer and domestic private reinsurers (Kumari 2000). This policy pushes reinsurers to establish domestic subsidiaries, which, in turn, triggers a requirement that foreign insurers establish joint ventures with Indian partners and operate within an equity limit of 26 percent, plus a minimum capitalization of $43.5 million. India today is one of the engines of insurance industry expansion into emerging Asian markets. Total premiums reached $10 billion in the year 2000 (about two percent of GDP), with life insurance rising by 21.3 percent and non-life insurance by 3.8 percent.

Sources: Swiss Re (2001c); Kumari (2002, 2003); Fletcher (2003)

Notably, both China and India are opening their enormous markets to overseas companies, which will result in considerable expansion in the insurance sector. Central and Eastern Europe are also opening up to western insurers and reinsurers. Munich Re's acquisition of a majority stake in Al Europe, a management holding company with stakes in insurers across Central and Eastern Europe, represents $200 million in annual premiums (Aldred 2000b). In mid-2003, Munich Re became the first offshore reinsurer to be allowed access to the Chinese market.

[52] Smith (2001) reviews the status of Latin American markets country by country. Similar information for the Caribbean is provided by Auffret (2003).

[53] An extensive tabulation of regulatory conditions and reforms is provided in the appendix to Swiss Re (2001c).

Table 2. Defining "Insurability"

Conditions Contributing to Insurability	**Means of Achieving Insurability**
Assessable Risk: Insurers must understand the likelihood and estimated magnitude of future claims and be able to unambiguously measure the loss. This is essential for pricing, especially where regulators require that premiums be based strictly on historic experience (rather than projections). For example, some insurers and reinsurers currently avoid Asia and South America but have expressed interest in expanding into these regions if loss and exposure information become more available (Bradford 2002)	• Improved data (e.g., flood zone mapping) and climate/impact modeling for developing countries and economies in transition.
Randomness: If the timing, magnitude, or location of natural disasters were known precisely, the need for insurance would be reduced and the willingness of insurers to assume the risk would vanish. Intentional losses are not insurable. If losses can be predicted, only those who were going to make claims would purchase insurance, and insurance systems would not function.	• Statistical and monitoring systems. • Accountability and legal remedies for insurance fraud.
Mutuality: The insured community must sufficiently share and diversify the risk. The degree of diversification for one insurer is reflected in the number of insurance contracts (or the "book of business" in insurance parlance), geographical spread, etc. The larger the pool, the greater the reduction of loss volatility. Such risks must also be uncorrelated so that large numbers of pool members do not face simultaneous losses.	• Create sufficiently large and diversified pools of insureds.
Adverse Selection: Insurers need to understand the risk profile of the individuals in their market and be able to differentiate the exposures and vulnerabilities of the various customer subgroups. This can form the basis for differentiating premiums or coverage offered. Lack of this information or use of insurance only by the highest-risk constituencies creates elevated risk for insurers, thereby putting upward pressure on pricing and affordability/availability. A key example is the lack of attention to the geographical concentration of risks preceding the 9/11 disaster (Prince 2002a) and the ensuing public debate on the insurability of terrorism risks.	• Gather market data on vulnerabilities and associated demographic and geographic distribution of risks. • Differentiate premiums among different (risk) classes of insureds. • Rely on government insurance or co-insurance (e.g., U.S. flood insurance program)
Controllable Moral Hazard: The very presence of insurance can foster increased risk taking, which can be thought of as "mal-adaptation" to potential changes in weather-related events, which will, in turn, increase losses. This is an issue whether the insurance is provided by a public or private entity. The use of deductibles is the standard method of ensuring that the insured "retains" a portion of the risk. Moreover, the insured must not intentionally cause losses.	• Use of fixed deductibles (insured pays a fixed amount of any loss) • Use of proportional deductibles (insured pays a percentage of all losses) • Use of caps on claims paid • Education and required risk reduction
Managable Risks: The pool of potentially insurable properties, localities, etc. can be expanded if there are technical or procedural ways to physically manage risk.	• Building codes and enforcement • Early warning systems • Disaster preparedness/recovery systems
Affordability: "Affordability" implies that a market will be made, i.e., that the premiums required will attract buyers. If natural disaster losses or other weather-related losses are too great and/or too uncertain, an upward pressure is placed on prices. The greatest challenge is insuring poor households and rural businesses. This is evidenced by the ~50 percent increase in life insurance premiums in Africa in response to the AIDs epidemic (Chordas 2004).	• Micro-insurance or other schemes to facilitate small insurance for small coverages. Systems must maintain solvency following catastrophic events. • Government subsidy of insurance costs; provision of backstop reinsurance
Solvency: For an insurance market to be sustainable (and credible), insurance providers must remain solvent following severe loss events. Natural disasters have caused insolvencies (bankruptcies) among insurers in industrialized countries (Mills et al. 2001), and insurers in emerging markets are even more vulnerable. Solvency has been eroding for other reasons, particularly in the U.S. (Swiss Re 2002a)	• Solvency regulation (e.g., to ensure sufficient capital reserves and conservatism in how they are invested) (Swiss Re 2001b) • Risk pooling; Government insurance • Insurer rating systems
Enforceability: Trust and contractual commitments underpin the successful functioning of insurance markets. Insureds must be confident that claims will be paid, and insurers must receive premium payments. Recent large-scale fraud in the weather derivatives market underscores this issue (McLeod 2003). Many transitional economies, e.g., China, still have sufficiently unformed legal systems (Atkinson 2004).	• Contract law • Customer advocates • Regulatory oversight of insurance operations, pricing, claims processing

Table 3. Status of Insurance Market Liberalization in Selected Countries as of 2000

	Joint venture with foreign minority participation	Joint venture with foreign majority participation	100% participation/ subsidiary	Agencies/branch offices
PR China	(✔)[1]	✖	✖	(✔)[1]
Indonesia	✔	✔	(✔) 100% part. possible	✖
Malaysia	✔ (max 30%)	(✖) (51% for existing JVs)	✖	✖
Philippines	✔	✔ (max 51%)	✖	✖
South Korea	✔	✔	✔	✔
Taiwan	✔	✔	✔	✔
Thailand	✔ (max 25%) 2	✖	✖	✖
Argentina	✔	✔	✔	✔
Brazil	✔	✔	✔	✖
Chile	✔	✔	✔	✖
Colombia	✔	✔	✔	✖
Mexico	✔	(✔)[3]	(✔)[3]	✖
Peru	✔	✔	✔	✖
Venezuela	✔	✔	✔	✖
Croatia	✔	✔	✔	✖
Poland	✔	✔	✔	(✔)[4]
Russia	✔	✖	✖	✖
Slovakia	✔	✔	✔	✖
Slovenia	✔	✔	✔	✖
Czech Republic	✔	✔	✔	✔
Hungary	✔	✔	✔	✔
South Africa	✔	✔	✔	✖

✔ is permitted, (✔) with certain restrictions

✖ is not permitted, (✖) with exceptions

[1] Strictly controlled and restrictive licensing process. Branch offices limited to non-life insurance. Joint ventures required for life insurers.
[2] Licences issued at the invitation of the supervisory authorities.
[3] Only possible for countries originating from NAFTA. For other countries limited to a maximum of 49% participation.
[4] Finance ministry authorisation required.

Source: Swiss Re (2000b)

Although the opportunities for expanding insurance in emerging markets are clear, barriers and policy questions are also numerous and significant (Ferguson and Ferguson 2003). Issues include the lack of sufficient financial and business-operations transparency, the frequent absence of regulatory oversight and enforcement, and the general economic climate outside the insurance sector in many countries. Local traditions and expertise in risk assessment and management as well as insurance business practices must also be developed. New entrants to emerging markets must also cope with the intrinsic liabilities of “foreignness” as well as political and economic risks (including inflation and currency devaluation). The closure of many local and international insurance operations in Venezuela following recent strikes and civil unrest (Ceniceros 2003) provides an example of the impact of local political events on the insurance business. Among

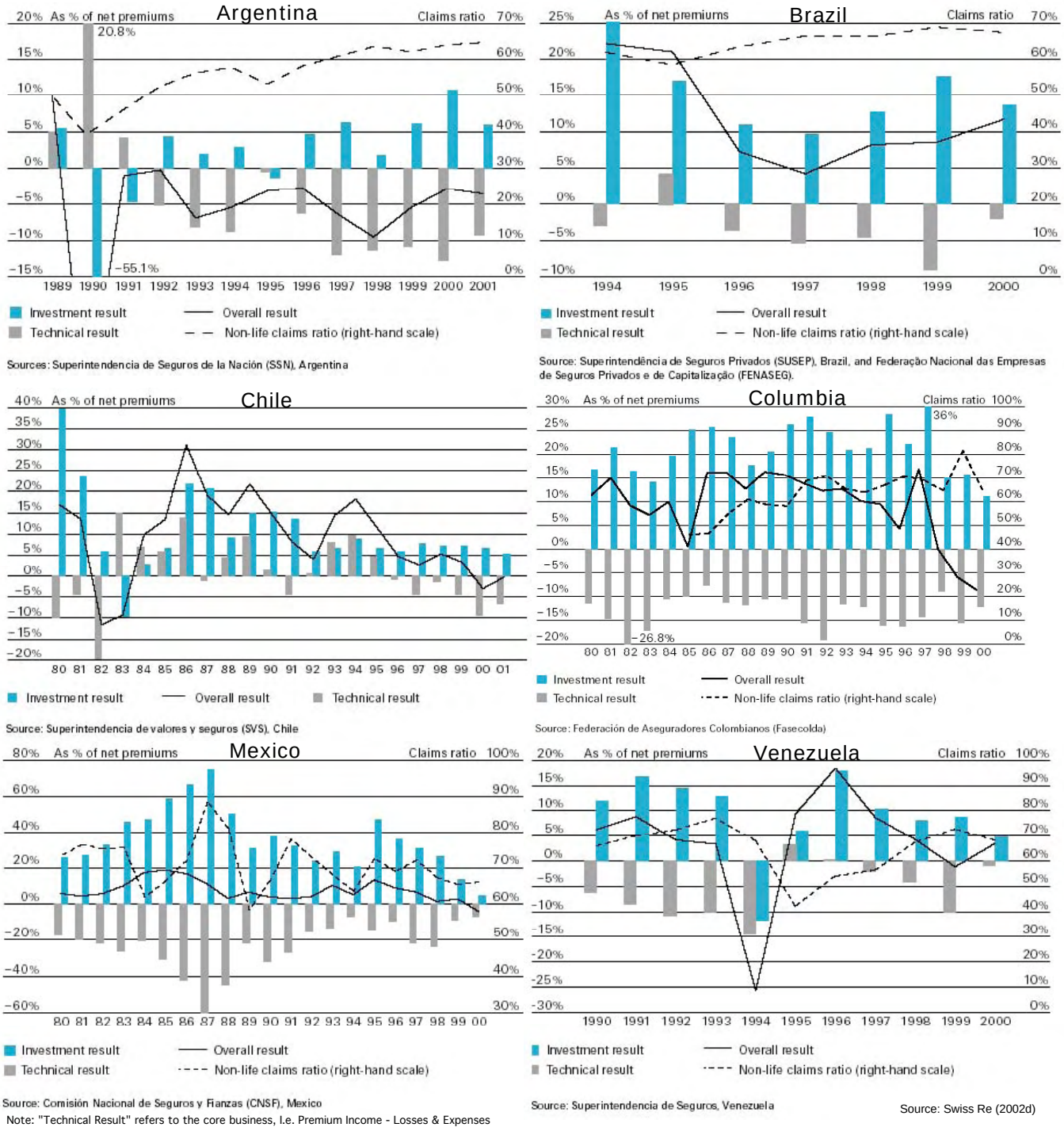
other problems, primary insurers have been faced with difficulties in renewing their reinsurance treaties. Competition in emerging markets, which has been described as “fierce” (Pilla 2003) and “predatory” (Swiss 2002d), can lead to insufficient revenues and thus reserves resulting in heightened risk of insolvency in response to catastrophic losses. Similar risks have been identified for insurers operating in Central and Eastern Europe (Swiss Re 2001b).

Instabilities in financial markets arising from problems with currencies, banking, or debt pose multiple concerns for insurers; increases in interest rates, devaluation of currency, drops in stock markets, inflation, decline in property values, and risks of political action/unrest (Swiss Re 2003b) can result in increased claims (e.g., from civil unrest, business interruptions, or increasing rates of theft). At worst, insurers’ solvency can be threatened or they may withdraw from the market although this is the exception rather than the rule in *today’s* climate and strategies exist for minimizing the potential impacts (Swiss Re 2003b). For example, following the Montserrat volcanic eruption, foreign insurers cancelled most insurance policies, leaving individuals and local governments to absorb future losses (Benson and Clay 2002). The insurance trade press has observed that “economic crises and political instability…have curbed development of [Latin American] insurance industry” (Pilla 2002). The same applies in Asia, where the economic crisis of the 1990s shifted double-digit insurance growth rates to double-digit contraction rates (Swiss Re 1999b; Swiss Re 2001c).

Like their counterparts in industrialized countries, insurers in emerging markets have, in recent years, become excessively dependent on investment returns for their profitability. As illustrated in the case of Latin American insurers, net profitability is only positive when the financial markets are doing well and when losses are average (Figure 30). These conditions, however, are particularly uncertain and volatile in emerging markets in emerging markets, coupled with uncertainties about natural catastrophe losses. When insurers invest in banks (which is common), they assume indirect risks associated with financial crises (including those triggered by natural catastrophes) (Howard 2003b).

When properly executed, numerous benefits can accrue from the entry of foreign insurers into emerging markets, including relieving overburdened government systems, facilitating trade and commerce, mobilizing savings, introducing of new technical and managerial practices, encouraging loss prevention, and remedying economic efficiencies, thanks to the scale and experience of market entrants (Skipper 2000).

Figure 30. Insurer Underwriting Profitability and Investment Returns are Volatile in Latin America



Note: "Technical Result" refers to the core business, I.e. Premium Income - Losses & Expenses

Source: Swiss Re (2002d)

Among the concerns for policy makers, however, is the need for regulation (market conduct, solvency and maintenance of reserves, licensing), impacts of foreign exchange, and the tendency toward "cherry picking" of particularly profitable products or markets by offshore insurers and the resulting flight of capital. Foreign insurers will be tempted to withdraw from markets perceived to be overly risky. For example, the growing threat of catastrophic losses has caused one of the largest U.S. insurers (CNA) to withdraw from all overseas reinsurance business (Howard 2002e). Climate change will precipitate increased rates of insurer withdrawls, or actions that otherwise limit insurance availability and coverage. Other insurers maintain that they have a long-run view, and near-term profitability will not affect their commitment to remaining in an emerging market.

An important "backdrop" issue is the recent global decline in insurance profitability (Swiss Re 2001d), to which the rising rate of natural catastrophe losses is widely recognized to be a contributor. Current conditions are causing various forms of contraction within the industry, including increased aversion to high-risk lines of business.

Cultural-Political Factors

Various cultural and political factors influence a community's receptivity to insurance. In some cases there are informal alternatives, e.g., those based on kinship networks, although such systems tend to be vulnerable to large-scale losses (Hoogeveen 2001).

In China, two important cultural-political factors have historically limited the use of insurance. Firstly, there is a wide-ranging superstition that buying life insurance will lead to premature death (Jin and Query 2003). Secondly, the communist doctrine was in many ways antithetical to the use of insurance. Given the rapid growth being witnessed since liberalization in 1999, however, it seems clear that these factors are having progressively less influence on the market.

About one-fifth of the world's population is Muslim, comprising 40 percent of the population in Africa and 20 percent of the population in Asia (Ahmad and Petrick 2003). In the orthodox Muslim world, the notion of commercial insurance (especially life insurance) is, for several reasons, heretical to traditionalists. According to Swiss Re (1999c), "Islamic law (Sharia) forbids its adherents from entering into agreements whose fulfillment is largely dependent on future, uncertain events. In addition, life policies cannot be marketed in these countries because of the ban on interest payments." Among the acts considered "reprehensible" under Islamic law are those involving unrestrained selfishness that leads to abuse and hoarding of wealth, including dealing in interest-based financial products, which are seen as synonymous with usury. It is argued that interest ("riba") leads to "manipulative, strained relationship between people; extracts another's property without counter-value; distracts and often prevents people from taking part in active professions for social well-being; and enables the rich to exploit those in financial need." Conservatives also argue that western-style insurance is unacceptable ("haram") because it is an implicit wagering contract, may rely on assets placed in interest-earning investments, is (because of uncertainties) prone to exploitation, and attempts to supersede the will of God. However, Islamic modernists argue that insurance approaches not utilizing riba are acceptable and consistent with Islamic Law because they ease anxiety and foster peace of mind.

As a reflection of the Muslim proscriptions against insurance, average expenditures on insurance in Saudi Arabia are small, about $50 per capita per year, despite the country's wealth (Swiss Re 2002f). In lieu of western-style insurance, a special culturally tuned system known as "Takaful"[54] is widely used in the Muslim world.[55] "Products" are available for a wide line of risks, e.g., "Motor Takaful." "Fire Takaful." "Liability Takaful." and "Family Takaful." Kamarudin (n/d) placed global Takaful premiums at $375 million in 1995.

The first Takaful company was founded in Sudan in 1979. Today, Takaful companies are found in countries including Bahrain, Malaysia, Indonesia, Saudi Arabia, Tunisia, Luxembourg, Sudan, Kuwait, Germany, The Netherlands, the U.K., and the U.S. Takaful is said to incorporate actuarial underwriting and pricing methods (Kamarudin n/d) and is reinsured by Asean Retakaful International.

Material published by Malaysia Takaful[56] describes practices that are very similar to what is called mutual insurance in the west; i.e., profits are returned to the policyholders and Takaful provider (typically on a 70/30 basis for a family business and 50/50 basis for general business (Ahmad and Petrick 2003). It is not known how Takaful systems perform in the wake of catastrophic losses; such losses could be a problem if the insured groups in a given "pool" are relatively small and/or geographically concentrated. (See also Table 2).

[54] Often spelled "Takafol."

[55] Takaful USA offers the following definition: "Takaful is a form of Islamic insurance which conforms to Shari'ah and ethics in business dealings. Takaful means 'mutual protection of assets and property based upon solidarity, peace of mind and joint risk sharing, which provides mutual financial and other aid to Takaful Members in case of need.' " See http://www.takafulusa.com/html/glossary html

[56] http://www.takaful-malaysia.com/

CLIMATE CHANGE AND THE INSURANCE SECTOR

> *Insurers and reinsurers … have every reason to stand on the side of those who regard it to be a fact that climate change is caused by mankind. And they have to witness that the classical loss prevention measures geared to individual risk objects can only make a limited contribution …. Calculating prices by looking at losses that have occurred in the past is a method that only works if the level of risk remains constant and any deviations in annual results are primarily caused by chance. Climate change goes hand in hand with systematically increasing burdens and ever-diminishing intervals between record losses.*
>
> – Munich Re (2001)

> *Despite advances in research, climate development is and will remain uncertain. Immediate action must be taken nevertheless…Man's influence on the climate system will aggravate [natural] risks still further.… As a company whose daily work involves dealing with risks, [Swiss Re] sees realistic possibilities of at least effectively reducing the risks of climate change.*
>
> -- Swiss Reinsurance Company

The insurance industry has become increasingly aware of the relevance of climate change to both the life-health and property-casualty sides of the insurance business, as evidenced by a growing number of articles in the trade press (Risk Management Magazine 2003b; Aldred 2002a; Goch 2002; Howard 2003b). Virtually all "lines" of insurance are vulnerable to climate risks (Swiss Re 2002g, Vellinga et al., 2001), whether direct property losses from natural hazards to business interruptions from the disruption of electricity grids to environmental liability claims caused by water contaminated by flood-related runoff. Adverse weather conditions affect business activities covered by specialized forms of insurance, including shipping, agriculture, power production, tourism, and construction. The severity and/or ranges of at least 18 diseases have been linked with climate factors (WHO 2004).

As noted by the Association of British Insurers, the advent of emissions "cap-and-trade" systems will create new liabilities for polluting companies related to their compliance with mandated targets (Aldred 2004a,b). This could also give rise to new forms of product liability and business interruption claims if polluting companies are forced to shut down. Even if litigation does not result in judgments against polluters, legal defense expenses will be borne by insurers and other parties.

Although a number of insurers (and other important market actors such as insurance brokers) have been vocal in their concerns about climate change (UNEP and Innovest 2002, Marsh 2003[57], Mills et al. 2001), others are either unaware of the issue or are standing on the sidelines. Despite uncertainties about definite attribution of climate change to human activities, insurers

[57] Marsh is the world's largest broker, with $8.3 billion in revenues in 2002.

have pointed out that the rise in the frequency and intensity/cost of extreme weather events is highly anomalous and is *consistent* with what is expected under climate change (Swiss Re 2004b). Many insurers also recognize no-regrets reasons to respond based on the current scientific understanding. (Insurers are more accustomed to decision making in the face of uncertainty than most other participants the economy.)

Insurers also recognize that, while their industry is increasingly reliant on risk modeling, climate change is not yet included in these models (Howard 2003b). The lack of good historic data or future-looking models is, in itself, a source of risk for insurers. Insurers have likened the situation to multiple throws of a pair of dice that are not only weighted, but whose weighting is changing in unknown ways over time (Swiss Re 2003e).

IPCC's Latest Findings on Insurance Industry Vulnerability and Adaptive Capacity

The use of insurance aggregates the costs of weather-related events across many sectors, from property to life and health. Statistical information compiled by insurers provides a rare quantitative and financial indicator of vulnerability and adaptive capacity (in the form of insurance coverage and reserves) to natural disasters. Insurers have already begun to play a role in climate science, mitigation, and adaptation efforts (Mills et al 2001).

Several chapters of the Intergovernmental Panel on Climate Change's Third Assessment Report deal with the impacts of climate change on the insurance sector and its potential role as an agent of adaptation. These include an entire chapter under Working Group II devoted to the subject on a global scale (Vellinga et al. 2001), a regional focus within the chapter on North America (Cohen et al. 2001), and brief discussion of the risk-management benefits of energy efficient and renewable technologies in a Working Group III chapter on emissions mitigation (Moomaw et al. 2001). The important geophysical vulnerabilities for insurers are summarized in Table 4. Among IPCC's key findings for the insurance sector (Vellinga et al. 2001) are:

- Most types of insurance providers are vulnerable (property, health/life, business interruption, event cancellation, motor vehicle, marine, environmental liability, etc.).
- Small weather-related events (e.g., lightning strikes, hail storms[58]) are as important as large ones, representing approximately 50 percent of total economic losses.
- Losses have been increasing steeply (Figure 7), doubling each decade, and the trends are consistent with what is expected as a result of climate change.

[58] Although often assumed to be unique to northern climates, hailstorms can be significant in the developing world, as evidenced by storms in 2003 that destroyed 2,000 hectares and injured or killed 68 people in Vietnam, caused 2,600 people to become homeless in Thailand, and resulted in 215 dead or injured in China (Swiss Re 2003c).

- Attribution is still an inexact science although a portion of the insured losses is ascribed to climate changes as distinct from demographic and economic factors. Losses have increased despite trends toward larger deductibles and a host of efforts at disaster preparedness (early warning systems, building codes, etc.).

- Increasing risk could lead to a greater volume of traditional business and the development of new financial risk-management products, but climate change – and associated changes in the timing, intensity, frequency, and/or spatial distribution of climate-related losses – will increase actuarial uncertainty, thereby affecting functioning of insurance markets, resulting in higher prices, depressed stock prices, elevated risk of insolvencies, and reduced insurance availability, among other effects.

- Insurers' options for adaptation include raising prices, refusing to renew policies, ceasing to write new policies, limiting maximum claims, and raising deductibles, all actions that can seriously affect investment in emerging insurance markets.

- The coincidence of climate change impacts with non-weather-related events (e.g., downturns in financial markets) decreases the industry's ability to absorb risk.[59]

- Increasing losses will elevate pressure on (reluctant) governments to assume more and more weather-related risks, especially flood losses, which, even today, are rarely commercially insured.

- There is an array of "no-regrets" options for insurers insofar as these options have value to the core business (i.e., help reduce known risks independent of those related to potential climate change).

[59] As an example, Munich Re's net assets fell from $47.2 billion to $17.2 billion between December 2000 and December 2002, entirely because of erosion of investment values (Howard 2003a). This coincided with a period of substantial disaster losses.

Table 4. Extreme climate-related phenomena and their effects on the insurance industry: observed and projected changes during the 21st century (Vellinga et al. 2001).

Type of event relevant to insurance sector	Relevant time scale	Changes in extreme climate phenomena	Observed changes	Projected changes	Sensitive sectors / Activities	Sensitive insurance branches (high confidence)**
			Likelihood			
Temperature extremes						
Heat wave	Daily-weekly maximum	Higher maximum temperatures, more hot days and heat waves*** over nearly all land areas	Likely, * (mixed trends for heat waves in several regions)	Very likely*	Electricity reliability, human settlements	Health, life, property, business interruption
Heat wave' droughts	Monthly-seasonal maximum				Forests (tree health), natural resources, agriculture, water resources, electricity demand and reliability, industry, health, tourism	Health, crop, business interruption
Frost, frost heave	Daily-monthly minimum	Higher [Increasing] minimum temperatures, fewer cold days, frost days and cold waves*** over nearly all land areas	Very likely,* (cold waves not treated by WG1)	Very likely*	Agriculture, energy demand, health, transport, human settlements	Health, crop, property, business interruption, vehicle
Rainfall/precipitation extremes						
Flash flood	Hourly-daily maximum	More intense precipitation events	Likely * over many Northern Hemisphere mid- to high-latitude land areas	Very likely,* over manyareas	Human settlements	Property, flood, vehicle, business interruption, life, health
Flood, inundation, mudslide	Weekly-monthly maximum				Agriculture, forests, transport, water quality, human settlements, tourism	Property, flood, crop, marine, business interruption
Summer drought, land subsidence, wildfire	Monthly-seasonal minimum	Increased summer drying and associated risk of drought	Likely*, in a few areas	Likely* over most mid-latitude continental interiors (lack of consistent projections in other areas)	Forests (tree health), natural resources, agriculture, water resources, (hydro) energy supply, human settlements	Crop, property, health

SNOWSTORM, ICE STORM, AVALANCHE	HOURLY-WEEKLY	INCREASED INTENSITY OF MID-LATITUDE STORMS***	MEDIUM LIKELIHOOD* OF INCREASE IN NORTHERN HEMISPHERE, DECREASE IN SOUTHERN HEMISPHERE	LITTLE AGREEMENT AMONG CURRENT MODELS	FORESTS, AGRICULTURE, ENERGY DISTRIBUTION AND RELIABILITY, HUMAN SETTLEMENTS, MORTALITY, TOURISM	PROPERTY, CROP, VEHICLE, AVIATION, LIFE, BUSINESS INTERRUPTION
HAILSTORM	HOURLY				AGRICULTURE, PROPERTY	CROP, VEHICLE, PROPERTY, AVIATION
DROUGHT AND FLOODS	VARIOUS	INTENSIFIED DROUGHTS AND FLOODS ASSOCIATED WITH EL NINO EVENTS IN MANY DIFFERENT REGIONS [SEE ALSO UNDER DROUGHTS AND EXTREME PRECIPITATION EVENTS]	INCONCLUSIVE INFORMATION	LIKELY*	FORESTS (TREE HEALTH), NATURAL RESOURCES, AGRICULTURE, WATER RESOURCES, (HYDRO) ENERGY SUPPLY, HUMAN SETTLEMENTS	PROPERTY, FLOOD, VEHICLE, CROP, MARINE, BUSINESS INTERRUPTION, LIFE, HEALTH
WIND EXTREMES						
MID-LATITUDE WINDSTORM	HOURLY-DAILY	INCREASED INTENSITY OF MID-LATITUDE STORMS***	NO COMPELLING EVIDENCE FOR CHANGE	LITTLE AGREEMENT BETWEEN CURRENT MODELS	FORESTS, ELECTRICITY DISTRIBUTION AND RELIABILITY, HUMAN SETTLEMENTS	PROPERTY, VEHICLE, AVIATION, MARINE, BUSINESS INTERRUPTION, LIFE
TORNADOES	HOURLY				FORESTS, ELECTRICITY DISTRIBUTION AND RELIABILITY, HUMAN SETTLEMENTS	PROPERTY, VEHICLE, AVIATION, MARINE, BUSINESS INTERRUPTION
TROPICAL STORMS, INCLUDING CYCLONES, HURRICANES AND TYPHOONS[8]	HOURLY-WEEKLY	INCREASE IN TROPICAL CYCLONE PEAK WIND INTENSITIES, MEAN AND PEAK PRECIPITATION INTENSITIES****	WIND EXTREMES NOT OBSERVED IN THE FEW ANALYSES AVAILABLE; INSUFFICIENT DATA FOR PRECIPITATION	LIKELY* OVER SOME AREAS	FORESTS, ELECTRICITY DISTRIBUTION AND RELIABILITY, HUMAN SETTLEMENTS, AGRICULTURE	PROPERTY, VEHICLE, AVIATION, MARINE, BUSINESS INTERRUPTION, LIFE

(CONT'D)

OTHER EXTREMES						
LIGHTNING[10]	INSTANTANEOUS	REFER TO ENTRIES ABOVE FOR HIGHER TEMPERATURES, INCREASED TROPICAL AND MID-LATITUDE STORMS	REFER TO RELEVANT ENTRIES ABOVE	REFER TO RELEVANT ENTRIES ABOVE	ELECTRICITY DISTRIBUTION AND RELIABILITY, HUMAN SETTLEMENTS, WILDFIRE	LIFE, PROPERTY, VEHICLE, AVIATION, MARINE, BUSINESS INTERRUPTION
TIDAL SURGE (IN ASSOCIATION WITH ONSHORE GALES), COASTAL INUNDATION	DAILY	REFER TO ENTRIES ABOVE FOR INCREASED TROPICAL CYCLONES, ASIAN SUMMER MONSOON, AND INTENSITY OF MID-LATITUDE STORMS	REFER TO RELEVANT ENTRIES ABOVE	REFER TO RELEVANT ENTRIES ABOVE	COASTAL ZONE INFRASTRUCTURE, AGRICULTURE AND INDUSTRY, TOURISM	LIFE, MARINE, PROPERTY, CROP
FLOOD AND DROUGHT	SEASONAL	INCREASED ASIAN SUMMER MONSOON PRECIPITATION VARIABILITY	NOT TREATED BY WG I	LIKELY*	AGRICULTURE, HUMAN SETTLEMENTS	CROP, PROPERTY, HEALTH, LIFE

* Likelihood refers to judgmental estimates of confidence used by Working Group I: *very likely* (90-99 percent chance); *likely* (66-90 percent chance). Unless otherwise stated, information on climate phenomena is taken from IPCC Working Group I, Summary for Policymakers and Technical Summary. These degrees of likelihood refer to the observed and projected changes in extreme climate phenomena and likelihood shown in shaded columns one to three of this table.
**High confidence refers to probabilities between 2-in-3 and 95 percent as described in Footnote 4 of the Summary for Policy Makers, Working Group II.
*** Information from IPCC Working Group I, Technical Summary, Section F.5
**** Changes in regional distribution of tropical cyclones are possible but have not been established

IPCC notes the particular need for and barriers to the use of insurance in developing countries:

> *In developing countries, the economic and social impacts of catastrophic weather events can pose a material impediment to development. Increased frequency or intensity of such events as a result of climate change could render these markets less attractive than they are at present for private insurers, in turn compounding the adverse impact on development.*
>
> – Vellinga et al. (2001)

IPCC focused only briefly on the issues of insurer vulnerabilities in developing countries and economies in transition, however.

Insurance Industry Sensitivity and Responses to Climate Change

The insurance industry first publicly noted its concern about climate change in the early 1970s, in a discussion of flood risks (Munich Re 1973). Its sophistication has since expanded to include more subtle implications of climate change, such as political unrest potentially caused by stressed water supplies (Munich Re 2001). As an illustration of the strategic importance of climate-change to reinsurers today, the five top corporate issues identified on Swiss Re's website are banking/insurance convergence, natural catastrophes, reducing mortality rates, sustainability, and terrorism.

Insurers are as concerned about small-scale events arising from subtle changes in weather patterns as they are of increases in catastrophic events (Swiss Re 2002g). Of concern even in the absence in changes in the magnitude of events is an increase in frequency (more commonly described by insurers as a decrease in return period).

In addition to being among the first to collect global data on the costs of natural disasters, insurers were among the first to observe changes in historic damage trends that may signal the effects of climate change. Examples are the nearly tenfold increase in soil subsidence losses (damages to buildings from shrinking soils during drought) during the last quarter of the 20th century (Crichton 2001) as well as increases in flooding (Zeng and Kelly 1997). The industry's technical studies of the causes of insurance losses show clearly that most types of physical damage increase exponentially in proportion to changes in the intensity of weather-related events (Figure 31). For example, wind damage increases with the third power of the wind speed (e.g., a 10-percent increase in wind speed will increase damage by 150 percent) and the force of hailstones is equivalent to the fourth power of their diameter (Dlugolecki 2001). A U.K. analysis of temperature change showed that a 1.6ºC increase in average temperatures (similar to that predicted by the IPCC) would increase in the likelihood of extreme-temperature events by 25 times (Crichton 2000).

Although many insurance companies do not appear to have considered the implications of climate change, approximately 90 insurers from 26 countries have signed an industry-driven commitment statement under the UNEP Insurance Industry Initiative for the Environment.[60] The underlying premise for the UNEP group's work is that a precautionary principle is needed when confronting climate risks, which means that risks must be evaluated and managed even in the absence of perfect information (UNEP and Innovest 2002). UNEP notes that insurers have yet to respond to the particular risks posed by climate change in emerging markets (UNEP and Innovest 2002).

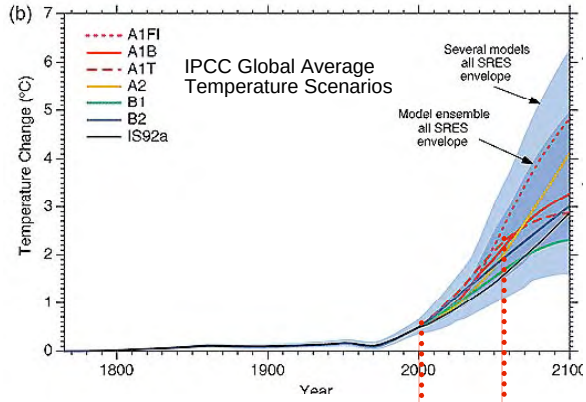
Insurers in the U.S. have been somewhat ambivalent on the climate-change issue although that stance appears to be shifting (Mills et al. 2001) as U.S. insurance trade literature increasingly covers the issue of climate change and reports on the work of IPCC, industry, and the UNEP group (Aldred 2000a and 2001a,b; Veysey 2002a; Goch 2002).

[60] See http://www.unepfi net

Figure 31. Rates of Changes in Climate are Magnified When Translated to Ultimate Damages & Insured Losses

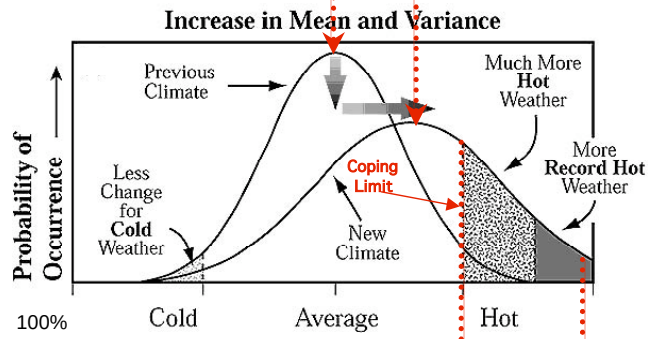
Natural Phenomenon (Hazard)

Previous Climate: E.g. 0.5 degree C over long-term average
New Climate: E.g. 2.0 degree C over long-term average



Variability (Risk & Uncertainty)

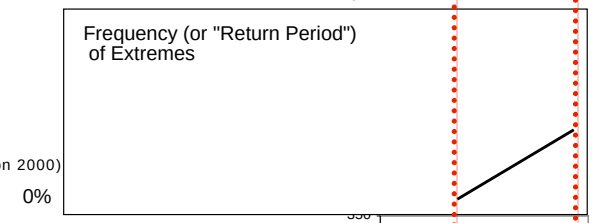
Previous Climate: Bell-curve distribution of annual temperatures
New Climate: Shift in average and stretched distribution due to increased variability (and uncertainty)



Change in Likelihood of Extreme Event (Peril)

Previous Climate: Extreme Temperature = Righthand 1% of tail
New Climate: Same temperature corresponds to 33% of area under curve

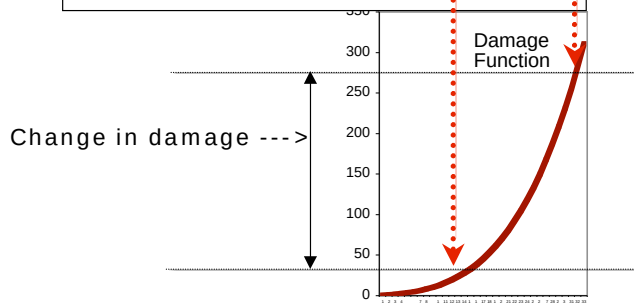
Examples:
For a 1.6C change in the UK, the incidence of hot summers increases 25-fold (Crichton 2000)
Lightning: 40% increase per degree of temperature increase (Reeve and Toumi 1999)



Impact (Loss)

Previous Climate: Baseline losses from phys cal events
New Climate: Increased losses from physical events (often exponential)

Examples:
Hailstones: Damage increases with diameter to the 4th power
Windstorm: Damage increases with diameter to the 3rd power of wind speed



Differences between U.S. and non-U.S. Insurers[61]

With important exceptions, U.S. insurers have devoted relatively less attention to the climate-change issue than their counterparts in Asia and Europe, and few have joined the aforementioned UNEP initiative. The primary differentiating factor is the greater interest of non-U.S. insurers in the precautionary principle, and their belief that *both* natural and human-induced climate changes are at play, i.e. non-U.S. insurers do not typically set up the either-or argument that only natural climate variability is at play.

It would be prudent for the property-casualty industry to act as if that theory [global warming] is correct. Failure to act would leave the industry and its policyholders vulnerable to truly disastrous consequences.

– H.R. Kaufmann, Swiss Re's General Manager in 1990 (Quirke 1994)

Risk management views the public discussion on climate change as a rabbit sitting paralyzed in front of a snake -- unaware that behind it a fox is poised to strike. There is not one problem but two: natural climate variability and the influence of human activity on the climate system.

– Swiss Reinsurance Company (1998)

The following points summarize some sources of the differences in attitude toward climate change between U.S. and non-U.S. insurers:

- Overseas insurers have been studying the question of climate change much longer than their U.S. counterparts have (Munich Re 1973). There is a stronger tradition of relying on science among European insurers and more staff climatologists providing analyses and corporate strategic counsel (although this work is concentrated in a few major companies). Munich Re has the largest climatology research effort in the insurance industry, with a staff of thirty-five people. Swiss Re has individuals within most major divisions of the company looking at the climate change question.

- The broader political discussion about the scientific validity of climate change is particularly polarized in the U.S., and most of the highly visible "climate skeptics" are based there.

- Non-U.S. reinsurers are heavily affected by U.S. natural-disaster insurance losses as illustrated by a simulation study of two $7-billion hurricanes in the U.S. The surprising result showed that five percent of participating European insurers became insolvent (bankrupt) versus 1.5 percent of participating U.S. insurers (AIRAC 1986).

- "Green" politics and ideals are far more established and influential in some overseas political systems. Accordingly, "green" marketing and product branding has a lower value in the U.S.

[61] Excerpted from Mills (2003a)

than in many other countries, especially Europe. Similarly, among European insurers, engagement with the issue of climate change is becoming synonymous with corporate responsibility and reputation (Swiss Re 2002i).

- There is less reliance on government insurance for flood and crop losses in many non-U.S. countries, so private insurers in those countries are more vulnerable to these events.

- There is a "cultural" and corporate tendency among U.S. insurers to focus somewhat exclusively on the *effects* of natural disasters whereas in some other countries there is an additional interest in focusing on and addressing *causes*. This is at times reflected in the very definition of terms, e.g., the Canadians include the reduction of greenhouse gases in their definition of "mitigation" whereas U.S. insurers would tend to limit the use of the term mitigation to be synonymous with “disaster preparedness.”

- There is less of an adversarial relationship between insurers and their regulators in most countries than is the case in the United States. Engagement of U.S. insurers with the climate-change issue would likely increase the need for regulator-insurer interaction, which U.S. insurers perceive as undesirable.

- Tax laws pertaining to establishing disaster reserves vary among countries. Some argue that the non-taxability of reserves in certain countries outside the U.S. gives an extra incentive for insurers there to anticipate global warming and build reserves against impacts without financial penalty. Conversely, some postulate that if U.S. insurers voice agreement with the global warming theory, they will then be forced by regulators to establish reserves for global warming disasters, which is viewed as undesirable because insurance industry reserves are heavily taxed in the U.S.

- Unique to the U.S. are considerable negative lingering associations between the enormous and long-lived liabilities created by the government’s Superfund clean-up program. Any new and potentially large-scale environmental proposition automatically invokes the specter of Superfund. Asbestos litigation and the more recent upsurge in mold-related claims—other present-day sources of large environmental claims—have also contributed to the industry’s aversion to anything labeled “environmental.” Recent discussions of potential litigation of polluters related to climate change may serve to further paralyze U.S. insurers on the issue (Houlder 2003).

- The UNEP Insurance Industry Initiative did not effectively solicit participation of U.S. insurers during its formation in the mid-1990s, and has not made a concerted effort to reach out to U.S. firms since that time. Nor has the initiative attempted to recast its message in terms that clarify its relevance and value to the U.S. insurance market and regulatory context.

One key difference between U.S. and non-U.S. insurer perspectives is the virtual absence of U.S. insurer perception that climate change mitigation could offer business *opportunities* and other financial co-benefits for insurers (Zwirner 2000). Overseas insurers, primarily in Europe have, in

contrast, actively identified opportunities and turned them into business realities, e.g., thoughtfully identifying emerging markets based on the "Flexible Mechanisms" proposed in the Kyoto Protocol (Hugenschmidt and Janssen 1999; Swiss Re 2000c; UNEP 1999).

In some cases, overseas insurers are developing green investment funds. Swiss Re has a "sustainability-based investment portfolio" approaching 100 million Swiss Francs (approximately $60 million) in the form of venture capital and other investments (Swiss Re 2000b; Swiss Re 2002i). U.K.'s Gerling Group, Swiss Re, Munich Re, CGU, Storebrand, and others are examples of European insurers that have adopted this perspective. Gerling has set up a $100-million Sustainable Investment Fund in which several other insurers have invested to date.

Insurer Climate-Change Initiatives

The UNEP group recently prepared the list of threats and opportunities presented by climate change, shown in Table 5.

Table 5. Climate-Change Threats and Opportunities for the Insurance Industry

Financial Sector Activity	Threat	Opportunity
General Financial Services	• New and existing markets become unviable as climate change increases regional exposure	• New markets/products related to mitigation projects/processes
	• Macroeconomic downturn due to actual impacts	• New markets/products related to adaptation projects/processes
	• Compounding of climate change risk across entire portfolio of converging activities (asset management, insurance, reinsurance).	• Public/private partnerships for commercially unviable markets
	• Unforseen changes in government policy	• Technology insurance and/or contingent capital solutions to guard against non-performance of clean energy technologies due to engineering failure.
Property/Casualty Insurance	• Physical damage to insured property from extreme/more frequent weather events, compounded by unmanaged development, resulting in volatile results and liquidity and credit rating problems	• Increases in demand for risk transfer and other services as weather risks increase
	• Increased risk in other lines of business (e.g. construction, agriculture, transport)	• Insurance of mitigation projects
	• Increases in population and infrastructure densities multiply the size of maximum potential losses from extreme weather events	• Innovative risk transfer solutions for high-risk sectors
Life/Health Insurance	• Increased risk to human health (thermal stress, vector-borne disease, natural disasters).	• Increase in demand for products as human health risk rises
Other	Business interruption risks becoming unpredictable and more financially relevant	• Collaboration with others in pooling capital
	• Disruptions to construction/transportation sectors	• Microinsurance
	• Increased losses in agro-insurance	• Weather Derivatives, CAT Bonds, etc.
	• Political/regulatory risks surrounding mitigation	
Asset Management	• Hidden GHG liabilities impair market values of securities	• Investment in climate leaders and best-in-sector securities
	• Real estate impaired by weather events and inceased energy costs	• Innovative climate-related theme funds
	• Potential absence of property insurance	• Consulting/advisory services.
		• Hedge funds investing in GHG credits

Source: Adapted from UNEP and Innovest (2002)

Some insurers have begun crafting products to provide credit guarantees for carbon trading, such as Aon's Carbon Risk Management (operated by the world's second-largest insurance broker) and Swiss Re's Greenhouse Gas Risk Solutions (operated by the world's second-largest reinsurer) (Sclafane 2001b; Aon n/d). Based on increased awareness of risks associated with corporate governance, Swiss Re requested that buyers of its Directors & Officers liability insurance disclose their carbon-related risks (Linden 2003), and there is the potential of exclusion of climate-change-related liabilities.

A number of insurers have also tried to lead by example, pursuing house energy management in their considerable real-estate holdings (Mills and Knoepfel 1996), and several now publish "Environmental Annual Reports" documenting their activities (Storebrand n/d; Swiss Re 2002b; Munich Re 2001). Storebrand and the Norwegian Red Cross have collaborated since 1995 and operate a mutual fund that directs some proceeds to Red Cross activities (Storebrand n/d). Storebrand and Swiss Re are also active with the World Business Council for Sustainable Development.

OPPORTUNITIES: THE CENTRAL ROLE OF PARTNERSHIPS

> *The insurance industry recognizes that economic development needs to be compatible with human welfare and a healthy environment. To ignore this is to risk increasing social, environmental and financial costs. Our Industry plays an important role in managing and reducing environmental risk, in conjunction with governments, individuals and organizations. We are committed to work together to address key issues such as pollution reduction, the efficient use of resources, and climate change. We endeavour to identify realistic, sustainable solutions.*
>
> – UNEP Insurance Industry Initiative
> Statement of Environmental Commitment[62]

> *Catastrophe insurance focuses foremost on spreading or distributing losses, rather than on reducing losses. It is in the industry's interest, however, to reduce the vulnerability of an area, and consequently the potential loss, as this would lead to lower premium rates (because the risk is lower) and [create] a larger overall market. The insurance industry can promote loss reduction through incentives to policyholders for taking loss reduction measures and by providing support for public sector and community-based disaster prevention. … International reinsurers could encourage [local] underwriters to take such initiatives, by providing lower reinsurance premiums for portfolios at lower risk to natural hazards.*
>
> – USAID & Organization of American States (2001)

Setting Priorities

One of the most daunting challenges in confronting issues related to weather-related catastrophes, climate change, and emerging insurance markets is identifying, prioritizing, and focusing proactive efforts. Based on the findings of this study, we offer the following 11 principles for screening and creating effective projects. (The items are numbered for convenience, but the numbering does not imply a particular ranking of importance.) Collaborations should include insurance brokers and other important trade allies. Much of the following is consistent with the conceptual framework put forward by USAID's Global Development Alliance, which seeks, among other things, to foster a higher degree of public-private collaboration in development assistance,[63] and gives considerable attention to energy and environmental issues (USAID 2002). As an illustration, Table 6 relates the principles below to priorities stated by the U.S. Agency for International Development.

[62] http://unepfi.net/iii/statemen htm
[63] http://www.usaid.gov/gda/gda_framework html

Table 6. Mapping Prospective Insurance Industry Activities on to USAID's Current Energy/Environment Objectives for Developing Alliances*

	Training & Capacity Building on Insurance & Risk Manageme nt	Innovative Insurance Products (e.g. Microinsurance , Energy Savings Insurance, Weather Derivatives)	Risk Mapping	Sustainable Forest Management	Sustainable Agriculture	Energy-Efficient, Disaster-Resilient Buildings & Farms	Energy-efficient Water Disinfectio n	Mitigating Urban Heat Islands	High-efficiency, Grid-Independen t Lighting Systems
Improved Protection and Sustainable Use of Natural Resources									
Providing biodiversity conservation through on-the-ground conservation initiatives and dissemination of best management practices				●					
Improving the design and implementation of policies that affect biodiversity use and conservation				●					
Providing technical assistance to field missions in strategic planning, program design, and monitoring of biodiversity programs	●								
Reducing damage to forests by inappropriate wood harvesting techniques				●					
Promoting rehabilitation of degraded land					●				
Increasing local participation in forest and tree system management				●					
Establishing integrated monitoring and assessment of forest resources to conserve biodiversity and improve forest health.			●						
Strengthening the individual and institutional capacity of non-governmental organizations (NGOs), community-based organizations, and government institutions involved in freshwater and coastal resources management		●							
Promoting new initiatives that help communities identify, value, and better manage freshwater and coastal resources under their control		●	●				●		
Increasing public awareness of and participation in freshwater and coastal resources management	●								
Improving the design and implementation of policies that affect water use	●				●				
Create low-cost/low-maintenance water treatment and disinfection systems							●		
Improved Management of Urbanization in Target Areas									
Improving living conditions and minimizing disaster risks, especially for urban slum settlements						●		●	●
Increasing equitable delivery of water, electricity, and waste disposal services							●		
Expanding the private sector's role in partnering with cities to provide services and shelter for the poor		●						●	
Incorporating people and community needs into urban management			●			●		●	
Increased Environmentally Sustainable Energy Production and Use									
Promoting energy efficiency and environmental management systems in cities, transport and industry						●		●	●
Expanding electrification activities to rural and economically disadvantaged urban areas							●		●
Fostering implementation of policy and regulatory changes that clarify or establish rights and incentives for the cost-effective utilization of renewable energy resources and technologies		●				●	●		●
Developing productive use of energy in applications such as irrigation pumping, drip irrigation and processing agricultural commodities, communications, and information technologies						●			
Improving public and private sector institutional ability to administer the energy sector, allow for more effective delivery of energy services to rural and urban populations, and expand improved urban environmental management systems		●				●	●	●	●
Reduced Threat to Sustainable Development from Global Climate Change									
Advancing approaches that promote climate-friendly technologies and carbon sequestration through innovative energy, forestry, and agricultural practices				●	●	●	●	●	●
Developing projects that reduce greenhouse gas emissions through cost-effective interventions				●	●	●	●	●	●
Mitigating impacts on food production, human health, the natural resource base and coastal areas caused by climate change, land use change, and long-term changes in precipitation patterns	●	●	●	●	●	●	●	●	●

* Energy/Environment Objectives from: USAID. 2002. "Public Private Alliances in Agriculture, Anti-Corruption/Governance/Civil Society Strengthening, Conflict/Relief and Humanitarian Assistance, Economic Growth and Trade Capacity Building, Education, Environment/Energy, Health, Information Technology." Annual Program Statement, APS No. GDA-03-001, U.S. Agency for International Development http://www usaid.gov/gda/aps2003.doc

1. ***Focus on Efforts that Enhance the Fundamental Insurability of Weather-Related Risks –*** A constructive starting point for enhancing market opportunities for insurance of natural disasters is to address ways in which current risks are perceived as uninsurable. Table 6 offers examples of strategies to address such concerns, including improving the modeling and data on disaster exposures and potential costs, establishing and enforcing improved building codes, establishing solvency regulation for insurers to obtain an appropriate balance between operating profitability and reserving for major losses, and providing for early warning systems and disaster-recovery assistance. The importance of improved data and modeling is central, as evidenced by a shift in the industry towards accepting flood risks where they previously had been viewed as uninsurable (Swiss Re 2002j). An example of a government initiative to enhance insurability is Puerto Rico's Reserve for Catastrophe Losses, under which a portion of which property insurance premiums is passed to a trust. According to Auffret (2003), "it is anticipated that this mechanism will improve the availability and affordability of catastrophe reinsurance and reduce the dependency of Puerto Rican insurers on foreign reinsurance."

2. ***Couple Efforts with Core Development Activities –*** There is virtual consensus in the development and relief communities that efforts at sustainable development will fail if not coupled with broader development objectives. Although correlation is not necessarily equivalent to causation, many observers note that relief costs have risen in recent decades as total development investments remained level (Figures 29e and 29i). In any case, reactive relief efforts are far less efficient and durable than those integrated with proactive pre-disaster efforts. Encouraging a culture of risk management is an element of development. Insurers will place more value on sustainability-driven initiatives if they are demonstrated to also enhance disaster resilience.

3. ***Foster Efficient Domestic Government and Private Insurance Risk Sharing –*** Certain risks will remain commercially uninsurable, despite efforts to the contrary, or may require some form of risk sharing (e.g., via disaster-relief funds) with public-sector entities. However, governments (especially in developing countries and economies in transition) are often financially unable to serve as "insurers of last resort" in absorbing the costs of disasters. Effective combinations of government and private insurance are essential; e.g., government "backstop" reinsurance of risks can enable private insurers to assume the initial risk "layers" of losses. In some cases, the converse is true, e.g., major insurers are now offering "excess" flood insurance to augment government-sponsored National Flood Insurance Program in the U.S.(McDonald 2003).

4. ***Utilize Public-Private Partnerships –*** As a corollary of the preceding point, sharing the cost of investment to reduce risk between the public and private sectors will be essential to the success of efforts to engage insurers in efforts to reduce vulnerabilities and increase adaptive capacity to extreme weather events under current and future climates (Kunreuther 2000).[64] As noted above, in one of only four major concluding recommendations to policy makers, the UNEP

[64] Possible partners include the UNEP Financial Services Initiative's insurance subgroup (note new African Taskforce), International Federation of Red Cross and Red Crescent Societies, The World Bank's ProVention Consortium (which already includes Swiss Re, Munich Re, and General Re).

Insurance Industry Initiative's latest major study emphasizes the importance of public-private partnerships on specific projects in emerging markets (UNEP and Innovest 2002). Governments can contribute to making risks insurable, e.g., by implementing land-use planning requirements and funding infrastructure to reduce flood risks. Insurers have stated their receptivity to such arrangements, particularly in view of the new imperatives presented by climate change (Munich Re 2004). Swiss Re (2002j) has stated that the "only" way to adequately insure flood risks is through such public-private partnerships. Even in wealthy countries there is an essential synergy between governments and insurers on weather-related risks such as flood insurance. Lack of government efforts to enhance flood defenses is currently jeopardizing the ability of insurers provide flood insurance (Veysey 2002b; Unsworth 2002). Swiss Re (2003c) has specifically called for public-private partnerships in the flood risk arena, stating that it is incumbent on the public sector to create and maintain conditions that make these risks insurable. No doubt in response to insurer questions about the continued insurability of major windstorm risks, the proposed National Windstorm Impact Reduction Act (H.R. 3980) calls for the creation of a new interagency program to reduce windstorm losses by developing a better understanding of the relevant phenomena, enhancing data collection and analysis, and implementing mitigation (adaptation) strategies. Another example is in the handling of soil subsidence risks in Texas and other states which result, in part, from groundwater depletion. Groundwater-removal permits are reviewed with respect to their potential impact on subsidence; government in turn provides a reinsurance mechanism and requires insurers to offer primary coverage (Cole et al. 2004).

5. ***Build Domestic Insurance and Risk-Management Capacity –*** In some cases where insurance does not exist at all, the initial goal will be to enable its introduction. Although foreign involvement in the development of insurance markets in emerging economies is an enormous opportunity, it is prudent to develop significant domestic capacity within these economies so that they are not vulnerable to the withdrawal of foreign companies. The ultimate financial integrity of the insurance system (or potential for withdrawal in the case of foreign insurers) is a core concern. Appropriate domestic regulatory systems must be in place to ensure the solvency of insurers.

6. ***Discourage complacency in response to insurance availability or government aid –*** Observers have noted that efforts to manage risk can inadvertently encourage complacency or even conscious risk taking. This is well known in the case of flood insurance where analysts have found that more people build homes in at-risk areas if flood insurance is available to cover their losses (Heinz Center 2000). The concern pertains to public aid as well as to private mechanisms such as insurance or micro-finance. Government-provided aid is seen to foster complacency and impede the ability of insurers to assume flood risks in the U.S. and Europe (Hodge and Zolkos 2003). Were insurance is used methods such as the use of deductibles can be employed to reduce risk taking.

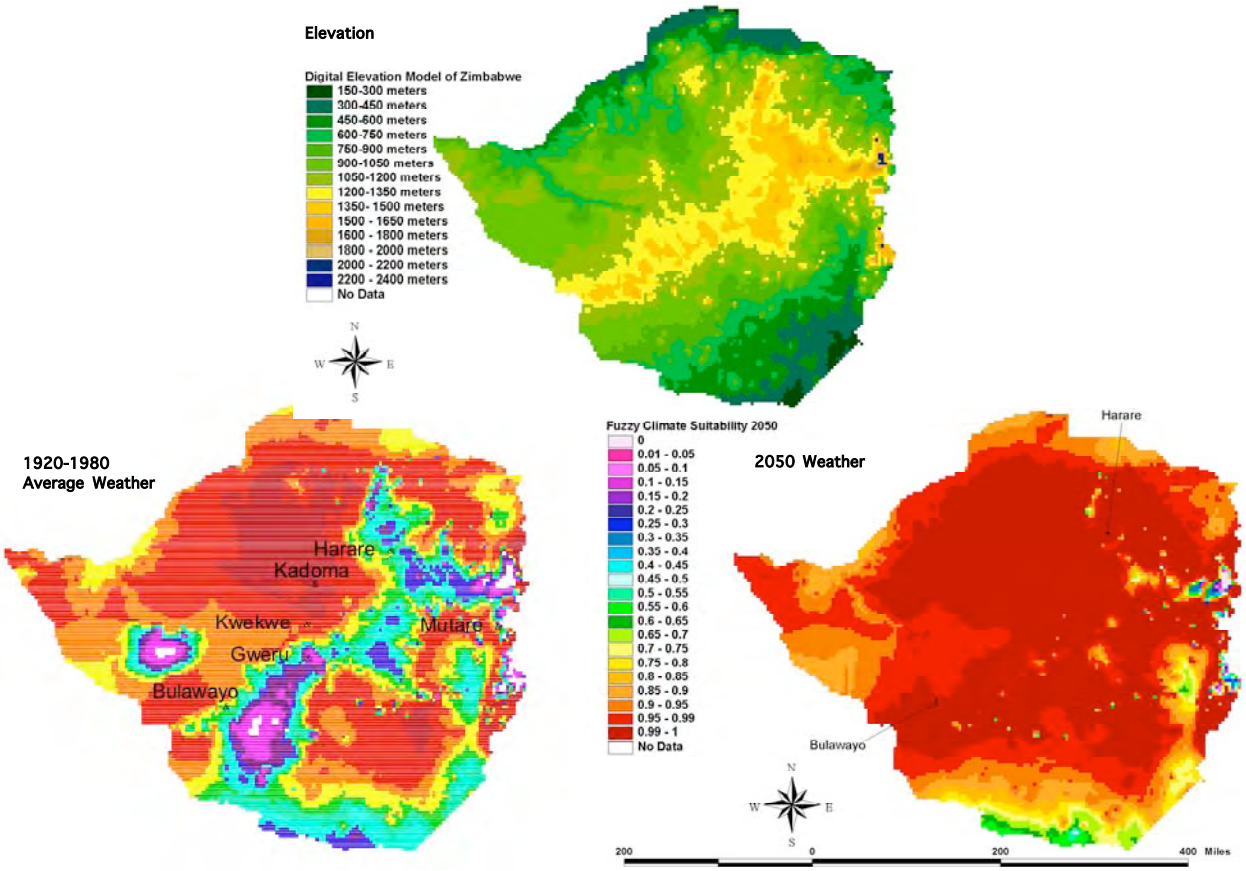
7. ***Respond to Insurers' Regional Priorities –*** Insurers, especially those who are likely to want to partner with public-sector entities, have considerable data and experience with risk assessment and loss control and are the ultimate judges of which potential projects will make a

material difference in creating or maintaining the insurability of risks in developing countries and economies in transition. Insurers have a good sense of the "hot spots" where natural hazards and human vulnerability coincide. Figures 2, 12, and 17 illustrate how insurance penetration and losses from natural disasters vary by region. Insurers will assign greatest importance to markets in which the potential for insurance is large, demand is growing rapidly, and weather-related disaster exposures and vulnerability are high. As an illustration, insurance premiums in Africa have reached $30 billion per year and growing at approximately four percent per annum, and there is a distinct concentration of impacts from flood, drought, famine, and epidemics. Those seeking to partner with insurers should identify and cultivate activities in the intersection of that industry's priorities and their own.

8. Address Life and Health along with Property Damage Insurance Issues –As indicated in Table 4, most ordinary and extreme events present risks to life and health, for people living in or visiting at-risk regions. The consequences for life and health arising from small-scale events and gradual climate changes are greater than those from large, abrupt events, but are more difficult to quantify. The vulnerabilities and adaptation issues facing life and health insurers are quite different than those facing property insurers (Campbell-Lendrum et al. 2003). [65] Examples include erosion of water quality due to temperature increases or drought, increases in the range of vector-borne diseases (e.g., Malaria, Figure 32). According to the World Health Organization, children are particularly vulnerable to and disproportionately impacted by climate-related health problems, especially diarrhoeal diseases and malaria (Gordon et al. 2004). In Africa, 10 to 15 percent annual increases in life insurance premiums exemplify the potential for epidemics to wreak havoc on insurance markets (Chordas 2004). Although life-health insurance is a faster-growing segment in emerging insurance markets than is property-casualty, the majority of information available on climate-change issues in the insurance industry focuses on the property-casualty side of the business. Also important are the mental health consequences of extreme weather events, which range from acute stresses caused natural disasters, to the cognitive implications for malnourished infants and children.

[65] Contributors to IPCC's Third Assessment Report synthesized a wide range of peer-reviewed studies to develop indicators of changes in the numbers of people at risk because of climate change. Their results for unmitigated emissions (from the benchmark scenario IS92a, known informally by IPCC as "business as usual") show roughly 3.25 billion people at risk of water shortage, three billion at risk from malaria, 900 million at risk of hunger, and nearly one billion at risk of coastal flooding by the year 2080 (Parry et al. 2001). The vast majority of these people live in developing countries.

Figure 32. Increase in Climate Conditions Suitable for Malaria Transmission in Zimbabwe: Today and 2050 (Index: 1.00 (red) = maximum suitability)



Source: Ebi et al (2004)

9. Raise Awareness within the Insurance Community **–** In their most significant, and recent study on the issue, the UNEP Insurance Industry Initiative's number-one recommendation for financial services companies and governments is that greater efforts be made to increase the awareness of extreme-weather and climate risks and associated issues within the financial services sector (UNEP and Innovest 2002). Their four recommendations for insurers and reinsurers are:

(1) **Recognize climate change explicitly in product development**, adopting a more collaborative stance with the public sector,
(2) **Support flexible mechanisms for emissions** reductions (e.g., the Clean Development Mechanism)
(3) **Support less-developed countries**, e.g., by participating in adaptation workshops with the countries as described in Articles 4.8 and 4.9 of the Kyoto Protocol and also by item (4) below,
(4) **Support innovative solutions** such as micro-insurance.

10. Harness Market-Pull Forces – As with other forms of market transformation, changes in the demand for insurance products can be as significant as proactive initiatives emanating from within the insurance companies. Insurance brokers are important intermediaries, and are able to work with consumer groups to aggregate demand for innovative insurance products and services. Micro-insurance is one such strategy, and deserves further investigation.

11. Understand Insurers' Relationship to the Security Implications of Climate Change –The linkages among environmental degradation, natural disasters, and security are increasingly recognized (Schwartz and Randall 2003). A key trigger is the potential reduction in carrying capacity as a result of abrupt or incremental changes in climate and weather. Insurers bear the risks of these exposures in many forms, including: political-risk insurance claims, which can be triggered by social disruptions arising from natural disasters and by international conflict over the control of water, energy, and other resources likely be effected by climate change.

* * *

Many of the preceding principles relate directly to USAID's climate-change program goals, which are:

> [T]o promote development that minimizes the associated growth in GHG [greenhouse gas] emissions, assists vulnerable populations and ecosystems to adapt to potential impacts from climate variability and change, and supports climate observation systems. To accomplish this goal, USAID works in developing and transition countries to implement "win-win" solutions that provide climate-related benefits while also meeting development objectives in the energy and water sectors, urban areas, forest conservation, agriculture, and disaster assistance. These solutions include activities that: (1) promote the transfer of clean energy technologies; (2) measure reductions in GHG emissions; (3) promote carbon management through improved land use; (4) support countries to participate more effectively in the U.S. Framework Convention on Climate Change; and (5) assess vulnerability to the impacts of climate change and increase adaptive capacity."[66]

Possible Initiatives

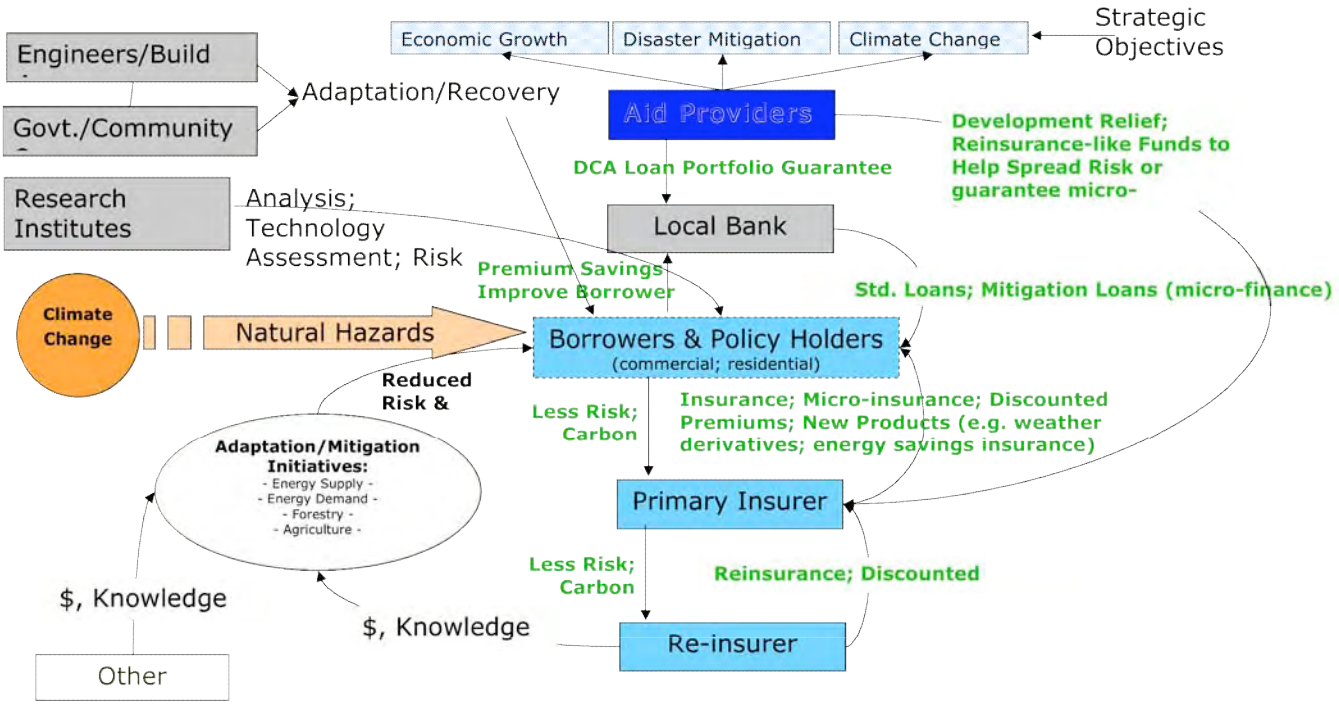
Listed below is a sample of possible initiatives that are consistent with one or more of the 11 principles outlined above. The activities are grouped into three categories: Information and Analysis, Innovative Insurance Products and Financing, and Sustainable Technologies that Enhance Disaster Resilience. An overarching theme is to help condition markets to manage risk so that insurance or insurance-like risk-spreading systems can be introduced successfully and in a sustainable fashion. The activities listed in each category are suggestive rather than comprehensive, and the categories and initiatives are not ranked. Cross linkages or combinations of the activities described can be readily imagined. Figure 33 is one conceptualization of the flow of knowledge and financial resources among the actors that could to foster attainment of these goals.

It is widely recognized that lack of information is one of the central barriers to improved adaptive capacity to natural disasters (Smit and Pilifosova 2001). Beyond the growing number of exemplary industry leaders, many members of the insurance industry have thought little, if at all,

[66] See http://www.usaid.gov/our_work/environment/climate/index.html

about issues related to extreme weather events, climate change, and emerging markets; these participant in the industry could benefit from focused communications efforts (UNEP and Innovest 2002). Increased collaboration between the insurance and climate-modeling communities could significantly improve the quality of data and risk analysis, facilitating increased availability of insurance in regions where a current lack of information is an obstacle to market development. The insurance industry can be an effective channel of information on disaster preparedness and recovery for their customers.

Figure 33. New Public-Private Systems Could be Created to Couple Climate Change Adaptation-Mitigation, Economic Development, and Risk Management



Extension of concept developed for USAID by Padco

I. Improve Information and Analysis

- Improve data and modeling. This report has identified numerous deficiencies and "blind spots" in the data needed to quantify risks and opportunities. Among these are information on small-scale events, historic impacts on life-health, and the distribution of insurance coverage within countries of interest (e.g., among residential/non-residential and by income).

  Better models and risk mapping can literally "make markets" by reducing uncertainties and helping pinpoint and thus manage risks faced by insurers entering emerging markets (Bowers 2000). For example, significant opportunities exist to couple insurer's actuarial risk models with climate models (e.g., linking wildfire impact models with climate models, Fried et al. 2004). In another example, the World Health Organization has proposed new initiatives to link climate monitoring with efforts to predict and establish early warning systems for disease outbreaks (WHO 2004).

- Increase awareness of issues and opportunities. Information can be made available through trade literature and meetings. Corresponding practical information could be published and disseminated to insurers' customers, e.g., in partnership with the UNEP Insurance Industry Initiative, which has many insurance-company members from developing countries and economies in transition. The in-country missions of aid-giving organizations are possible points of contact with insurers.

- Further explore issues and roles for life-health insurers. Most analyses of climate-change issues facing the insurance industry, including the work of IPCC, focus on the "non-life" (property-casualty) side of the business. An exemplary public-private effort to study the topic is a health-scenarios project that has been initiated by Swiss Re and UNDP, with the work being performed by the Harvard Medical School. The project is examining the insurance and broader economic implications of drought, flooding, heat waves, malaria, Nipah Virus, West Nile Virus, pollen and molds, agricultural pests and pathogens, coral and bivalve disease, wildlife diseases, and forest pests.

- Promote relevant scientific research that takes into account both indigenous/traditional knowledge and development and transfer of new knowledge and technologies. Vulnerability assessments or hazard mapping can forget or overlook the expertise of a local population. This resource, if harnessed and developed from the beginning of a project, can be a valuable asset (UN 2002). For example, a particularly effective approach to risk spreading has been observed in the marriage system of the Shona (the dominant ethnic group in Zimbabwe), in which large numbers of people become part of a network of individual claim-liability relations (Hoogeveen 2001).

- Interactions via the UNFCCC. The United Nations Framework Convention on Climate Change (Articles 4.8 and 4.9 of the Kyoto Protocol, per COP-7) has specifically called for workshops to explore opportunities for insurers to assist less-developed countries in responding to climate-change risks. However, according to UNEP and Innovest (2002), the industry has shown little interest. This issue should be explored and avenues identified to overcome the inertia.

II. Deploy Sustainable Technologies that Combine Adaptation and Mitigation

Considerable thought has been given to identifying disaster-management strategies that also support sustainable development. Examples include protection of mangroves, reefs, and beaches that buffer storm surge and wave risks; and forestry and agricultural practices on mountain slopes that reduce flood and landslide risk (Aalst and Burton 2002). Less effort has been devoted to identifying strategies that also reduce greenhouse-gas emissions (Mills 1996; Mills 2003a). Insurers can promote mitigation/adaptation technologies and practices in a variety of ways. The most direct way is through rewarding those who adopt these technologies and practices, using financial incentives in the form of lower premiums, higher deductibles, etc. There are other methods as well, such as channeling information to insurance customers and promoting improved building codes and land-use planning. There is considerable precedent for such activities among North American and European insurers (Mills 2003b).

Care must be taken to anticipate and avoid unintended consequences, e.g., strategies intended to support mitigation that unintentionally erode adaptive capacity. For example, small-scale hydroelectric systems may increase the habitat for malaria vectors.

Following are illustrative examples:

- *Embed sustainable technologies in disaster recovery activities.* USAID/OFDA's shelter specialist devised "Warm-Dry Rooms" for 22,000 families during the crisis in Kosovo between 1998 and 2000 (Figure 34) (OFDA 2002). Warm, dry rooms were created in existing structures as an alternative to creating displaced-persons camps, thereby maintaining the cohesion of communities while providing employment to those constructing the rooms. Augmenting such strategies with high-efficiency space-heating strategies would increase the number of families that could be served with finite heating-fuel supplies. Efficient lighting could also be integrated in this strategy (see second bullet below). USAID's Global Development Alliance (GDA) is one umbrella under which such initiatives could be developed. The GDA includes projects developed in public-private partnerships with industry.

Figure 34. USAID "Warm-Dry Rooms" Project

Warm-dry rooms in Kosovo helped residents remain in their homes throughout the winter (photo by Charles Setchell. USAID/OFTA).

- *Promote energy-efficient water disinfection for disaster recovery.* Approximately a decade ago, USAID provided seed funding to develop a new disinfection technology that would remove waterborne diseases using significantly less energy than traditional

methods. The result was "Ultraviolet (UV) Waterworks." a small-scale system that can operate on or off of the electricity grid (Figure 35). UV disinfection reduces pressure on fuel-wood resources, and thus is important to efforts to curb deforestation.[67]

Figure 35. Energy-Efficient UV Water Disinfection System

Source: http://www.waterhealth.com/emergency_relief.htm

- *Incorporate one-watt lighting systems in disaster relief, promoting independence from kerosene and batteries.* Nearly two billion people are dependent on liquid fossil fuels for lighting; supplies of these fuels can be easily disrupted during natural disasters. New light-emitting diode (LED) technologies make it possible to provide high-quality battery-driven (or even battery-independent) light supplies that are far more efficient and cost effective than versions currently in use (Figure 36) (Mills and Johnson 2002; Cool 2003). In extreme weather events, these systems would be valuable in disaster-recovery situations (both for aid workers and for impacted citizens, in homes or in camps for dislocated people). Typical solar/fluorescent lighting systems are deemed too expensive and have questionable durability in these contexts.

Figure ES-36. White LED Lighting System in Nepal (left) and Prototype Solar-PV Units (right)

Photo courtesy: Stewart Craine

- *Mitigate urban heat islands.* Lightening the coloration of roads and rooftops reduces ambient urban air temperatures, which reduces smog formation and lowers the risk of mortality during heat catastrophes. The need for mechanical air conditioning is thus reduced, to some degree.

- *Support afforestation using biomass energy plantations*. This would both support renewable energy production and soil/water conservation goals.

- *Deploy distributed renewable energy systems to enhance electricity-system reliability.* Utility grids are regularly disrupted, often for long periods, during natural disasters. For example, during the catastrophic European heat waves of 2003, electric power plant activity had to be curtailed because of elevated cooling-water temperatures (Munich Re 2004). Distributed renewable energy generation systems (e.g., micro-hydro, wind, solar

[67] See http://eande.lbl.gov/IEP/archive/uv/index.html

thermal, and solar electric power) are largely invulnerable to grid and fuel-supply disruptions. In the wake of the massive U.S. blackouts of summer 2003, insurers recognized the potential benefits of renewable energy (Sullivan 2003). This is particularly important in light of an increased awareness of the risks of wide-area power outages (Aldridge 2004) and a trend towards reductions in business interruption insurance availability (Lenckus 2004).

- Promote Sustainable Forestry Practices: Wildfire Management, Flood Risk Reduction and Enhanced Hydroelectric Power Production. Many studies have linked environmental degradation (including deforestation) with increased vulnerability to natural disasters (e.g., hurricanes and mudslides). For example, wildfires caused by slash-and-burn deforestation are both a source of net carbon emissions and a natural hazard for property and health. (See Portela and Aguirre 2000 for several examples specifically related to Cuba.) Indonesian wildfires were associated with the spread of Nipah virus (via dislocated fruit bats moving into human settlements and agricultural areas).

  In many places in Asia, Africa, and Latin America, deforestation has released silt that seriously impacts turbines and reduces hydroelectric reservoir capacity, among other problems. If effectively managed, future increases in runoff could mean more power generation. However, if runoff is a result of increased variability in climate (as expected under climate change), rather than increased average flows, more uncontrolled spills (floods) are expected. Effective forest management in certain watersheds would decrease the likelihood of flooding.

  A watershed with diverse vegetation will more effectively buffer a reservoir from rapid influxes of runoff than will a deforested watershed. If rapid influxes are prevented, the reservoir may be able to produce more power on an annual basis because operators can run more water through the turbines instead of spilling it during heavy flooding. An important collateral benefit is that reduced silting means overall storage capacity of the reservoir is maintained, preventing overflow flooding and extending the life of the facility.

  There exists some precedent within the insurance sector for the aforementioned types of projects. Storebrand—Norway's largest insurer— has invested in sustainable forestry projects (Storebrand n/d). In partnership with the Swiss Association for International Cooperation, Swiss Re contributed to the planting of 650,000 trees in Haiti,[68] to help counteract the detrimental effects of deforestation and erosion on drinking water.

- Promote Dry-land Farming Adaptation in Drought-prone Regions to Enhance Food Security, Preserve Water Quality, and Conserve Carbon in Soils.[69] Agricultural soil conservation measures reduce runoff, erosion, and vulnerability to drought. Insurers could support these

[68] http://www.swissre.com/INTERNET/pwswpspr.nsf/fmBookMarkFrameSet?ReadForm&BM=./alldocbyidkeylu/SBAR-59FLV7

[69] This idea suggested by Devesh Nirmul, Padco.

efforts by providing crop insurance if there is none or reducing premiums if crop insurance is already available. A similar approach could be explored for weather derivatives. USAID's Natural Resource Investment Fund Project (FIRENA) is reported to be conducting a successful pilot project in the Dominican Republic (Aalst and Burton 2002).

- Identify "Lessons Learned" and Enhance The Caribbean Disaster Mitigation Project (CDMP).[70] Initiated in 1993, CDMP is a project of USAID/OFDA, implemented in several countries by the Organization of American States, to promote sustainable public/private disaster mitigation mechanisms that lessen loss of life, reduce potential damage, and shorten disaster-recovery periods. Project activities included support for national insurance associations in organizing technical conferences, disseminating hazard and risk information, and producing hazard and risk maps and information to promote safer location of development (USAID-OAS 1996).[71] Beginning in 1998, Barbados-based United Insurance began a program in which homeowners and businesses can qualify for significant reductions in insurance premiums if they retrofit homes and buildings to better withstand hurricane wind forces.[72] The project operated in Dominica, Saint Lucia, Saint Kitts/Nevis and Antigua, and Barbuda and trained 145 homebuilders (UNDP 2004). In the Antigua-Barbuda Pilot Project, 100 homeowners and three of the country's major insurers participated. In the Hurricane Resistant Home Improvement program, a U.S. non-governmental organization built capacity of local builders to offer disaster-resilient homes using home improvement loans from local banks. In St. Lucia, a group insurance policy was obtained for participants. Possibilities for leveraging efforts to date include incorporating village-scale measures with joint adaptation/mitigation qualities.

III. Create Innovative Insurance Products & Financing

Insurers are, by definition, interested in preventing losses rather than paying to repair post-event damages. The availability, terms, and pricing of insurance can send signals that encourage practices that enhance disaster resilience; this is often the case in advanced insurance markets. Practices that can be encouraged include the use of early-warning systems, building codes (and their enforcement), land-use planning, sustainable forestry approaches, and a host of energy-efficient and renewable energy technologies that inherently improve disaster resilience, e.g., by reducing reliance on grid-based power. In addition, for the billions of people who have no insurance, new types of insurance products should be developed.

- Support Development and Utilization of Micro-insurance and Micro-finance. The idea of "micro-insurance" has been introduced to address low incomes and low insured values.[73] It has limited precedent (e.g., "funeral insurance") and can be applied to property, health, or crop insurance. Most current efforts are in life and disability insurance, for example "Delta Life" in Bangladesh, which saw $9 million in premiums during 2002 (see Micro-insurance Centre

[70] This information provided by Devesh Nirmul, Padco, unless otherwise noted.
[71] See http://www.oas.org/cdmp/bulletin/insur.htm
[72] See http://www.oas.org/cdmp/document/saferoof/hrhipwks htm#_Toc467666664
[73] Regionally based web sites devoted to the topic are located at http://www.microinsurancecentre.org and (for Central and Eastern Europe and the Newly Independent States) at http://www mfc.org.pl/ where nearly $560 million has been lent with an average loan size of $727.

2003). Delta Life's policies are simple and can be signed or thumb-printed; they require no medical checkup and a monthly income of $100 or less. Policyholders are also eligible for $100 loans if used for income-generating purposes, with the capital drawn from insurance premiums paid. The UNEP Insurance Industry Initiative encourages the use of micro-insurance (UNEP and Innovest 2002).

Micro-insurance can be coupled with efforts to support loss-prevention. For example, premium and/or deductible reductions could be offered where funds are used for loss prevention (or relocation efforts) that, as discussed above, simultaneously contribute to disaster resilience and sustainability.

The World Bank has studied micro-insurance extensively (World Bank 2000), and investigated the potential for small (easily verified) event-specific insurance policies, where, for example, $10 to $100 premiums could be paid to insure against rainfall below a predetermined level (Varanqis 2000).[74] Identical coverage would be given to all participants. The World Bank notes several efficiencies of such plans, including low administrative costs, low risk of moral hazard (complacency or fraud), and no need for on-site inspections.

The need to improve availability of financing for disaster-resilience in at-risk communities is well known (Pitt 2000). Micro-finance is a much-discussed means of providing appropriately small loans to poor families. Micro-finance can, and perhaps must, work in tandem with micro-insurance. However, concern has been appropriately raised that lenders do not have expertise in insurance and that unilaterally overextending into the realm of risk finance and management could be counterproductive. Instead, it is suggested that micro-finance entities work in collaboration with established insurers while partnering with micro-finance providers to take advantage of their existing networks and customer bases (McCord n/d). Interesting opportunities micro-finance providers include emergency relief loans.

One contingency that must be avoided is the collapse (insolvency) of local micro-finance/insurance networks in the event of catastrophic losses (World Bank 2000; Kahn 2003). The Grameen Bank in Bangladesh, the pioneer of micro-credit systems, is an example of the risk of micro-finance/insurance plans; half of Grameen's 2.3 million members were affected by floods in 1998, often losing the very possessions purchased with the funds borrowed from Grameen (IFRC/RCS 2003). There may be a particular role for public or private reinsurance in this regard, as a "backstop" for local micro-insurance systems.

Banks in the emerging markets have become common purveyors of low-price insurance products, often referred to as "bancassurance." Swiss Re (2002d; 2002e) describes these systems are in detail for Latin America and Asia. In Brazil, 25 percent of premiums are generated by bancassurance. Using the existing infrastructure of banks can help reduce the costs of providing insurance and increases confidence among customers. However, regulatory barriers impede bancassurance to varying degrees in many countries.

[74] The World Bank appears to have tried this approach in Nicaragua (World Bank 2000).

Under its Microenterprise Innovation Program, USAID has expressed interest in the potential for micro-insurance to small businesses.[75] A "Brainstorming Workshop" was hosted by the United Nations Development Program (UNDP) and the World Bank Disaster Management Facility, and a report is apparently still be in preparation.[76] USAID's Micro and Small Enterprise Development Program has catalyzed lending by financial institutions to small and micro businesses in more than 33 countries, leading to more than $150 million in new credit for micro and small enterprise borrowers.[77] Possibilities for expanding this work to the insurance sector should be investigated. Recent use of USAID "Enterprise Funds" to create a home mortgage system in Romania suggests other opportunities.[78]

- Link the Provision of Crop Insurance with Sustainable Agriculture for Enhanced Food Security and Carbon Sequestration. According to a UN presentation at the World Summit on Sustainable Development (UN2002) "in rural programmes and drought-prone areas, specific attention should be paid to food security and the promotion of agriculture techniques and inter-cropping that reduce hazard-related agriculture losses." Sustainable agriculture activities tend to increase carbon storage in soils, thus providing dual adaptation/mitigation benefits. New initiatives could foster such practices through linkages with either public- or private-sector-provided crop insurance.

- Identify Applications for Weather Derivatives and Other Hedging Tools. A panel of insurers convened by the UN noted that climate change could offer opportunities for the weather-derivatives market (Zolkos 2002). Other observers have stated that weather derivatives may be preferable to traditional insurance in some cases, given the linkage to a predetermined trigger regardless of the scale or nature of damage, rapidity of payouts, etc. (Box 4) (Benson and Clay 2002).

Box 4. Rabobank Helps Farmers Protect Against Coffee Price Drops

The Dutch Rabobank International is offering East African coffee farmers a tool to protect against the worst effects of low market prices. Rabobank uses a "commodity-hedging tool." which is effectively a form of insurance that widely used on Western commodity exchanges, to protect farmers against price falls.

One Ugandan business is the first to use this tool, purchasing small volume of price insurance for three groups of producers representing 450 small coffee farmers in Ishaka, Uganda.

In Tanzania, Rabobank is working with a large coffee cooperative that purchased price insurance to manage its risk for the 2002/03 Arabica coffee-selling season (October to December). In a recent project designed to protect producers who have no access to modern exchanges, Rabobank has been involved with several pilot transactions with the World Bank International Task Force in Commodity Price Risk Management.

Source: *The Monitor* (2003)

[75] See. http://www.usaid.gov/pubs/cbj2002/cent_prog/global/egad/933-001.htm
[76] See http://www.proventionconsortium.org/conferences/micro-finance htm
[77] See http://www.usaid.gov/economic_growth/egad/ci/msed2 htm.. Partnership opportunities may also apply in the case of AID's Global Development Alliance, http://www.usaid.gov/gda/
[78] See http://www.usaid.gov/regions/europe_eurasia/press/rom_mortgage_loan.html

Investors in renewable energy technologies will be particularly interested in these products, as weather is a key determinant of profitability (Aldred 2004a,b). However, serious concerns have been raised about the viability and credibility of the weather-derivative business model (Swiss Re 2002a), and a major case of fraud was recently uncovered spanning several countries (McLeod 2003). Care should be taken in evaluating potential applications.

- Assist Insurers in Developing Insurance for Renewable Energy Systems. Capital projects involving renewable energy are vulnerable to natural disasters and other types of risks. Major insurers and brokers, including Aon (Aldred 2000a), are becoming involved in providing coverage and perhaps other forms of risk management to projects established to achieve greenhouse-gas emissions reductions. Swiss Re has investigated providing professional liability insurance to firms that provide verification and measurement services for carbon-trading arrangements (Sclafane 2001b).

- Foster Development of Markets for Energy-Savings Insurance (ESI). Insurers in North America have begun to provide what is known as "Energy-Savings Insurance." which addresses performance risks in traditional energy-savings investments by warranting performance in exchange for a premium (Mills 2003c). There is a potentially large market for ESI in emerging markets (and analogous renewable energy and cogeneration performance insurance products), especially because performance risks could be particularly high there. One benefit of ESI is that it can operate essentially as a loan guaranty in cases where debt service is indexed to the anticipated energy savings. This can translate into favorable borrowing terms. By analogy, AID's Development Credit Authority has guaranteed loans for energy efficiency, which has been seen as beneficial by local banks.

SUMMARY, CONCLUSIONS, & POLICY CONSIDERATIONS

International emergency relief, domestic government assistance, and self-insurance are critical but woefully inadequate in meeting the challenge of present and future losses from extreme weather events. With the rate of weather-related losses increasing dramatically, rising natural disaster costs in aid-receiving countries, and growing need for other forms of aid, the outlook for relief aid absorbing a greater share of the costs is not good. However, the trend toward an integrated idea of development and disaster relief (UNDP 2002) stands to significantly leverage the resources that are directed to development but do not currently take into account disaster resilience and sustainability.

Insurance is a promising means of augmenting international aid and other risk spreading strategies and improving adaptive capacity for natural disaster impacts. Insurance is currently considerably underutilized (but rapidly growing) in developing countries and economies in transition.

Although insurance is not a panacea, it can help absorb risks not addressed by international aid and not affordable by local governments or citizens. Important caveats apply, including the short time frame of insurance contracts and the ease with which insurers can withdraw from or increase prices in markets perceived as overly risky. The insurance industry itself is vulnerable to extreme weather events, and its capacity to absorb risks varies depending on recent losses, prevailing loss-prevention initiatives, and other market factors.

The broader fiscal, political, and regulatory environment is crucial to the success or failure of insurance in emerging markets. As a recent illustration, the introduction of tax-deductible life insurance premiums boosted premium growth in Mexico and Brazil (Swiss Re 2003a). In contrast, the market in Argentina contracted following that country's economic crisis. The ability of foreign insurers to enter new markets depends on local political and regulatory protections. Domestic insurers also require enabling regulation. For example, restrictions on the types of investments insurers are allowed to make (or on their access to international markets) can place their assets at risk from natural catastrophes and cause prices to be set higher than would otherwise be the case (Auffet 2003). Effective insurance regulation also strikes a balance between allowing insurers an attractive return on their business activities and ensuring adequate solvency (and ability to pay) in the event of major claims. More fundamental needs include policies that support fiscal transparency, responsibility, and other measures that can garner the trust of the insurance-buying public. Last are important questions regarding the role of international aid, as suggested in Box 5; i.e., what is the proper balance between preparedness and recovery, and how can disaster resilience and sustainable development be woven into the overall fabric of aid rather than being an afterthought?

Opportunities for fostering insurer involvement in this process include (1) enhancing information, training, and analysis to help make emerging insurance markets more attractive (less risky) for insurers, (2) identifying and deploying sustainable technologies that help countries adapt to and mitigate natural disasters and their effects, and (3) developing innovative insurance products and financing mechanisms. A key challenge is in setting priorities and developing the public-private partnerships necessary for success.

Box 5. From Piecemeal Disaster Assistance to Holistic Sustainable Development Relief

More effective prevention strategies would save not only tens of billions of dollars, but save tens of thousands of lives. Funds currently spent on intervention and relief could be devoted to enhancing equitable and sustainable development instead, which would further reduce the risk for war and disaster.

– Kofi Annan, UN Secretary General (1999)

There is a close correlation between increased demographic pressure, especially in developing countries and economies in transition, growing environmental degradation, increased human vulnerability and the intensity of the impact of disasters. Development and inappropriate use of resources are contributory factors to natural disasters. They can accelerate or amplify recurrent phenomena such as droughts. Environmental degradation increases the intensity of natural hazards, and is often the factor that transforms the hazard, or a climatic condition such as heavy downpour, into a disaster. For example, river and lake floods are aggravated by deforestation, which, in turn, causes erosion and clogs rivers. Floods or droughts leading to famines dislocate families who become refugees as they are forced to migrate elsewhere. Poverty and hazard vulnerability are integrally linked and mutually reinforcing. The poor are forced to exploit environmental resources for survival, thereby increasing both the risk and exposure to disasters, in particular those triggered by floods, drought and landslides. Sustainable and integrated management of natural resources, including reforestation schemes, proper land use and good management of rivers and coastal areas, will increase the resilience of communities to disasters by reversing current trends of environmental degradation (UN 2002).

Following the severe African famines of the 1980s, efforts began to bridge the gap between emergency relief and long-term development (OFDA 2002). "Development Relief" can promote humanitarian and development goals and foster self-reliance while facilitating recovery from a current crisis and reducing the vulnerability to future events. Integral to this approach is avoidance of development activities that in themselves can cause increased vulnerability or exposure to natural disasters. Progress toward this new way of thinking has been considerable, but the gap has not been fully closed. A coalition of 165 U.S.-based non-profit organizations involved in relief defines "development relief" as the implementation of relief activities that also contribute to sustainable development. The World Bank's Disaster Management Facility also invokes this thinking at the top of its Mission Statement (World Bank 2003b) as does its ProVention Consortium. Aalst and Burton (2002) give several examples from the Caribbean and Ranganath (2000) offers a detailed, insightful, and practical perspective on the applications of this thinking in the wake of Hurricane Mitch in Central America.

In sum, coupling insurance for extreme weather events with strategies that contribute to public health and sustainable development would enhance disaster resilience, reduce the magnitude of losses, and thus help increase insurers' willingness to establish, maintain, and expand a constructive presence in emerging markets (developing countries and economies in transition). Based on the findings of this study, we offer the following principles for establishing priorities and creating effective projects in insurance and sustainable development:

- Focus on efforts that enhance the fundamental insurability of weather-related risks.
- Couple insurance efforts with core development activities.
- Foster efficient domestic government and private insurance risk sharing.
- Utilize public-private partnerships.
- Build domestic/local insurance and risk-management capacity.
- Discourage complacency in response to insurance availability or government aid
- Respond to insurers' regional priorities.
- Address life and health insurance issues along with those related to property damage.

• Raise awareness within the insurance sector.
• Harness market-pull forces (e.g., foster aggregated demand for insurance products)
• Understand insurers' relationship to the security implications of climate change.

Using these principles, we have outlined a sampling of specific initiatives that could be undertaken in the general areas of information and analysis, sustainable technologies to enhance resilience to disasters, and innovative insurance products and services. Specific criteria should be developed to help prioritize efforts to promote insurance penetration and sustainable development. As insurers have many "fires to fight," and environmental issues such as natural or human-induced climate change must compete for attention with other critical issues. Key target markets (economic, demographic, and geographic) should be identified, and proposed initiatives should clearly define their relevance to the insurers. It is incumbent on public entities seeking partnerships with insurers to establish and demonstrate the value of these partnerships. This report is a step toward that goal.

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APPENDICES

Appendix 1 (cont'd)

Country	Number 1950 - 59	1960 - 69	1970 - 79	1980 - 89	1990 - 2001	Population Affected 1950 - 59	1960 - 69	1970 - 79	1980 - 89	1990 - 2001
Lesotho		1	1	5	7		204,000	500	680,018	505,636
Liberia				3	8				2,599	1,007,614
Libyan Arab Jamah					1					
Macau					1					3,986
Madagascar		2	6	9	12		118,150	3,087,246	1,633,615	4,054,247
Malawi		2	1	5	16		3,500	20,000	2,530,759	19,738,658
Malaysia	1	4	3	4	17		450,084	246,111	102,627	75,420
Maldives			1	1	1			11,477	300	23,849
Mali		3	7	14	8		4,536	1,900,109	1,535,295	328,535
Marshall Is					2					6,224
Martinique		3	2	2	3		1,025	25,048		5,120
Mauritania		2	7	13	13		46,000	2,746,999	3,310,743	770,089
Mauritius		3	3	6	5		23,566	956,547	37,468	10,805
Mexico	8	9	11	16	34	9,050	370,168	944,494	594,082	2,586,176
Micronesia, Fed States				1	2				208	32,250
Mongolia		1		1	13		270,057			2,305,319
Montserrat*				1	1				12,051	
Morocco	2	5	5	6	10	161	86,285	459,773	12,248	375,326
Mozambique	1	2	7	16	18	107	50,000	1,320,899	18,689,547	9,613,967
Myanmar	1	6	8	3	7		749,201	1,775,293	85,417	670,491
Namibia				2	7				100	455,504
Nepal	1	6	8	16	26	60	7,467	1,023,629	4,135,375	1,044,876
Netherlands Antilles	1	1		1	1					40,002
New Caledonia	3	2	3	2	1	4		3	2,006	
Nicaragua		4	3	3	18		1,885	42,701	452,479	1,841,523
Niger		4	7	12	16		7	1,618,995	4,581,991	5,602,868
Nigeria		1	1	8	16		82,000	100	3,304,734	1,038,118
Oman			1	1				6,703	26	
Pakistan	9	7	7	13	34	249,840	936,021	13,639,350	1,306,658	26,390,892
Panama		3	4	4	9		4,339	10,374	96,765	34,589
Papua New Guinea			6	3	13			113	54,132	1,462,491
Paraguay		2	2	4	8		32,396	217,000	230,076	545,693
Peru	1	6	8	18	24	130	337,090	504,202	1,690,763	5,137,750
Philippines	6	12	24	26	40	62,183	2,303,978	15,243,549	21,242,074	73,752,677
Puerto Rico		1	3	4	4			4,589	2,626	115,922
Reunion		1		4	2				17,306	616
Rwanda			3	3	9			3,602,017	501,963	1,275,619
Samoa		3		3	3		95,264		2,000	283,021
Sao Tome et Principe				4					94,244	
Saudi Arabia		1		2	2		1,020		5,032	777
Senegal		4	8	13	8		2,210	5,115,301	2,171,400	444,840
Seychelles					1					1,242
Sierra Leone			1	2	8			10,001	3,412	205,124
Solomon Is		3	2	3	3		1,216	6,202	180,751	88,884
Somalia		3	4	9	14		730,250	291,671	678,616	4,266,722
South Africa	2	3	3	11	23	86	5,000	80	5,271,844	447,386
Sri Lanka	1	5	7	14	16	250,200	2,402,664	1,258,532	9,355,021	5,167,245
St Helena					1					300
St Kitts & Nevis	1			3	4				1,331	12,985
St Lucia		3		5	3		10		83,054	1,129
St Vincent & The Grenadines	1	1	1	4	2	122	2		21,860	303
Sudan		2	5	11	20		2,300	245,483	15,697,371	18,538,721
Suriname		1					4,600			
Swaziland				3	9				633,053	800,819
Syrian Arab Rep		1	2	1	3		40,000	209,253		658,199
Taiwan (China)	5	9	2	7	10	1,244	46,603	37,634	2,641	29,115
Tajikistan					19					3,472,638
Tanzania, Uni Rep		3	5	10	24		181,423	193,575	2,204,296	9,165,426
Thailand	2	2	4	8	24	500	205,975	4,631,778	3,803,951	25,465,240
Togo		1	1	3	9		15	150,000	401,667	290,957
Tonga*	3	3	5	1	4		8,002	10,908	146,521	26,125
Trinidad & Tobago		1	1		4		24	50,002		1,215
Tunisia		3	3	4	1		292,898	76,501	32,640	96,037
Turkey	2	6	5	10	16	237	120,200	100,130	62,726	41,659
Turkmenistan					1					420
Turks & Caicos Is				1	1				770	
Tuvalu			1	2	2			706		850
Uganda		1		5	20		25,000		1,446,745	1,306,713
Uruguay	1	1		1	11		38,071		18,500	29,509
Uzbekistan					5					1,100,613
Vanuatu	2		4	5	5	100		4	157,758	16,405
Venezuela		2	1	7	10		23,030	1	41,817	704,217
Viet Nam	3	4	6	14	32	3,356	914,779	4,484,523	33,883,094	28,990,702
Virgin Is (UK)				1	2				10,000	3
Virgin Is (US)					2					10,011
Yemen			7	4	8			2,072,974	855,545	313,579
Zaire/Congo, Dem Rep		1	3	3	14		922	500,507	300,646	177,102
Zambia			2	6	11			30,911	823,066	5,756,857
Zimbabwe		1	1	2	12			11	700,000	11,161,827
LDCs (Total)	**126**	**347**	**520**	**907**	**1602**	***LDCs (Median)***	**366**	**47,355**	**185,165**	**216,836**
						LDCs (Total)	**15,433,415**	**175,727,600**	**715,881,018**	**1,406,183,130**
						Cumulative 1950-2001	**Median:**	**455,504**	**Total:**	**2,304,321,792**

Notes:

Adapted from analysis completed by Padco's Climate Change Solutions Group for USA D's Global Climate Change Team.

Source: OFDA / Center for Research in the Epidemiology of Disasters (CRED) "Natural.xls" Intl database of Disasters (http://www.cred.be/emdat intro.html) and (for population data) U.S. Census Bureau's International Database (http://www.census.gov ipc/www/idbagg.html)

All disasters reported here are classified as natural. Disasters included in this query include floods, droughts, slides, famines, insect infestations, epidemics, wind storms, extreme temperatures, and wild fires.

Impacted Populations include those persons that have either been killed, injured, left homeless, or otherwise adversely affected.

* There seems to be an error in the reported number of disaster impacted persons for a particular disaster that took place in 1985 in Tonga, as this number exceeded the total population for that year. There seems to be as similar problem with The Island of Monserrat in 1989. Therefore these countries have been excluded from the Total calculation and accompanying charts for all tables.

Appendix 2 The 40 worst catastrophes in terms of fatalities 1970-2001

Victims[1]	Insured loss[2] (in USD m, at 2001 price levels)	Date	Event	Country
300 000	–	11/15/74	Storm and flood catastrophe	Bangladesh
250 000	–	7/29/80	Earthquake in Tangshan (8.2 Richter scale)	China
138 000	3	4/30/95	Tropical cyclone Gorky	Bangladesh
60 000	–	6/1/74	Earthquake (7.7 Richter scale)	Peru
50 000	156	6/22/94	Earthquake in Gilan	Iran
25 000	–	12/8/92	Earthquake in Armenia	Armenia, ex-USSR
25 000	–	9/17/82	Earthquake in Tabas	Iran
23 000	–	11/14/89	Volcanic eruption on Nevado del Ruiz	Colombia
22 000	233	2/5/80	Earthquake (7.4 Richter scale)	Guatemala
19 118	1063	8/18/03	Earthquake in Izmit	Turkey
15 000	100	1/27/05	Earthquake (moment magnitude 7.7) in Gujarat	India, Pakistan
15 000	106	10/30/03	Cyclone 05B devastates Orissa state	India, Bangladesh
15 000	–	9/2/82	Flooding following monsoon rains in northern parts	India
15 000	530	9/20/89	Earthquake (8.1 Richter scale)	Mexico
15 000	–	8/12/83	Dyke burst in Morvi	India
10 800	–	11/1/75	Flooding in Bay of Bengal and Orissa state	India
10 000	234	12/16/03	Flooding, mudslides, landslides	Venezuela, Colombia
10 000	–	5/26/89	Tropical cyclone in Bay of Bengal	Bangladesh
10 000	–	11/21/81	Tropical cyclone in Andrah Pradesh and Bay of Bengal	India
9 500	–	10/1/97	Earthquake (6.4 Richter scale) in Maharashtra	India
9 000	543	10/23/02	Hurricane Mitch in Central America	Honduras, Nicaragua, et al.
8 000	–	8/17/80	Earthquake on Mindanao	Philippines
6 425	2 872	1/18/99	Great Hanshin earthquake in Kobe	Japan
6 304	–	11/6/95	Typhoons Thelma and Uring	Philippines
5 300	–	12/29/78	Earthquake (6.3 Richter scale)	Pakistan
5 000	1 044	3/6/91	Earthquake	Ecuador
5 000	426	12/24/76	Earthquake in Managua	Nicaragua
5 000	–	7/1/80	Earthquake in West-Irian	Indonesia
5 000	–	4/11/76	Earthquake in Fars	Iran
4 500	–	10/11/84	Earthquake in El Asnam	Algeria
4 375	–	12/22/91	Ferry Dona Paz collides with oil tanker Victor	Philippines
4 000	–	5/31/02	Earthquake in Takhar	Afghanistan
4 000	–	2/16/76	Storms and snow in Ardekan	Iran
4 000	–	11/25/80	Earthquake in Van	Turkey
4 000	–	12/3/88	Accident in chemical plant in Bhopal	India
3 840	6	11/2/01	Typhoon Linda	Vietnam et al.
3 800	–	9/9/96	Flooding in Punjab	India, Pakistan
3 656	327	7/2/02	Flooding along Yangtze River	China
3 400	1063	9/22/03	Earthquake in Nantou	Taiwan
3 200	–	4/17/82	Tropical cyclone	Réunion

[1] Dead or missing
[2] Excluding liability losses

Source: Swiss Re, Economic Research & Consulting, *sigma* 1/2002

Appendix 3 The 40 most costly insurance losses 1970–2003

Insured loss[18] (In USD m, indexed to 2003)	Victims[19]	Date (start)	Event	Country
21 062	3 025	11.09.2001	Terrorist attack on WTC, Pentagon and other	US
20 900	43	23.08.1992	Hurricane Andrew	US, Bahamas
17 312	60	17.01.1994	Northridge earthquake	US
7 598	51	27.09.1991	Typhoon Mireille	Japan
6 441	95	25.01.1990	Winterstorm Daria	France, UK et al
6 382	110	25.12.1999	Winterstorm Lothar over Western Europe	France, CH et al
6 203	71	15.09.1989	Hurricane Hugo	Puerto Rico, US et al
4 839	22	15.10.1987	Storm and floods in Europe	France, UK et al
4 476	64	25.02.1990	Winterstorm Vivian	Western / Central Europe
4 445	26	22.09.1999	Typhoon Bart hits south of the country	Japan
3 969	600	20.09.1998	Hurricane Georges	US, Caribbean
3 261	33	05.06.2001	Tropical Storm Allison; torrential rains; heavy flooding	US
3 205	45	02.05.2003	Thunderstorms, tornadoes, hail	US
3 100	167	06.07.1988	Explosion on platform Piper Alpha	UK, North Sea
2 973	6 425	17.01.1995	Great Hanshin earthquake in Kobe	Japan
2 641	45	27.12.1999	Winterstorm Martin	France, Spain, CH
2 597	70	10.09.1999	Hurricane Floyd; heavy downpours, flooding	US, Bahamas
2 548	38	06.08.2002	Severe floods across Europe	Europe
2 526	59	01.10.1995	Hurricane Opal	US, Mexico
2 288	26	20.10.1991	Forest fires which spread to urban areas, drought	US
2 277	–	06.04.2001	Hail, floods and tornadoes	US
2 220	246	10.03.1993	Blizzard, tornadoes	US, Mexico, Canada
2 090	4	11.09.1992	Hurricane Iniki	US, North Pacific Ocean
1 959	23	23.10.1989	Explosion in a petrochemical plant	US
1 899	–	29.08.1979	Hurricane Frederic	US
1 870	39	05.09.1996	Hurricane Fran	US
1 859	2 000	18.09.1974	Tropical Cyclone Fifi	Honduras
1 827	100	04.07.1997	Floods after heavy rain in Central Europe	Poland, Czech Rep., D et al
1 804	116	03.09.1995	Hurricane Luis	Caribbean Sea
1 707	6	27.04.2002	Spring storm with several tornadoes	US
1 694	350	10.09.1988	Hurricane Gilbert	Jamaica et al
1 685	30	18.09.2003	Hurricane Isabel with winds of up to 170 km/h	US, Canada
1 651	20	03.12.1999	Winterstorm Anatol	West / Northern Europe
1 634	54	03.05.1999	Series of more than 70 tornadoes in the Midwest	US
1 619	500	17.12.1983	Blizzards, cold wave	US, Canada, Mexico
1 605	–	04.04.2003	Thunderstorms with large hailstones	US
1 600	350	02.04.1974	Tornadoes in 14 states	US
1 527	–	25.04.1973	Flooding on the Mississippi	US
1 512	–	15.05.1998	Wind, hail and tornadoes (MN, IA)	US
1 479	63	17.10.1989	Loma Prieta earthquake	US

[18] Property and business interruption losses, excluding life and liability insurance losses
[19] Dead and missing

Source: Swiss Re (2004)

Appendix 4. Premium volume 2003 by continents and organisations

Total Business (property/casualty and life/health)

Total business	Premium volume (in millions of USD) 2003	2002	Change (in %) inflation-adjusted 2003	2002	Share of world market (in %) 2003	Premiums[1] in % of GDP 2003	Premiums[1] per capita (in USD) 2003
America	**1 156 512**	**1 094 583**	**2.7**	**8.5**	**39.33**	**8.52**	**1 349.9**
North America	1 114 642	1 054 415	2.7	8.7	37.90	9.40	3 464.3
Latin America and Caribbean	41 871	40 168	1.4	4.4	1.42	2.45	78.3
Europe	**1 022 158**	**846 697**	**1.1**	**3.7**	**34.76**	**7.98**	**1 251.8**
Western Europe	987 755	821 352	0.6	3.7	33.59	8.46	2 084.9
Central/Eastern Europe	34 402	25 345	18.4	2.5	1.17	3.10	103.1
Asia	**685 753**	**628 918**	**2.6**	**2.5**	**23.32**	**7.51**	**183.4**
Japan	478 865	445 940	−0.1	−1.4	16.28	10.81	3 770.9
South and East Asia	194 462	171 348	9.8	13.9	6.61	4.91	58.0
Middle East/Central Asia	12 426	11 631	1.1	9.0	0.42	1.65	43.8
Africa	**30 968**	**24 805**	**−10.1**	**7.7**	**1.05**	**4.09**	**36.4**
Oceania	**45 280**	**37 469**	**−1.9**	**−0.8**	**1.54**	**7.70**	**1 449.3**
World[2]	**2 940 670**	**2 632 473**	**2.0**	**5.4**	**100.00**	**8.06**	**469.6**
Industrialised countries[3]	2 626 542	2 359 175	1.4	4.8	89.32	9.21	2 763.5
Emerging markets[4]	314 128	273 297	7.2	10.3	10.68	3.78	58.7
OECD[5]	2 709 757	2 439 058	1.3	4.8	92.15	8.99	2 339.9
G7[6]	2 286 491	2 082 165	1.5	4.9	77.75	9.58	3 213.9
EU, 15 countries	931 012	773 039	0.6	3.7	31.66	8.58	2 385.1
EU, 25 countries	947 509	786 343	0.7	3.7	32.22	8.35	2 030.0
NAFTA[7]	1 125 562	1 067 351	2.6	8.8	38.28	9.03	2 653.0
ASEAN[8]	24 287	22 368	3.9	0.5	0.83	3.35	47.7

Property/Casualty Business

America	**636 683**	**578 045**	**7.0**	**10.7**	**50.21**	**4.69**	**743.2**
North America	610 882	553 280	7.2	11.0	48.17	5.15	1 898.6
Latin America and Caribbean	25 801	24 765	2.6	4.1	2.03	1.51	48.2
Europe	**437 452**	**346 207**	**5.7**	**7.3**	**34.50**	**3.35**	**524.9**
Western Europe	414 044	329 002	5.0	7.0	32.65	3.47	854.7
Central/Eastern Europe	23 408	17 205	18.8	13.4	1.85	2.11	70.1
Asia	**163 413**	**150 813**	**2.3**	**6.4**	**12.89**	**1.77**	**43.3**
Japan	97 530	92 031	−1.5	2.9	7.69	2.20	768.0
South and East Asia	57 255	50 863	8.8	11.8	4.51	1.41	16.7
Middle East/Central Asia	8 629	7 920	3.7	15.9	0.68	1.14	30.4
Africa	**8 784**	**6 718**	**6.8**	**10.1**	**0.69**	**1.16**	**10.3**
Oceania	**21 824**	**16 628**	**6.3**	**12.5**	**1.72**	**3.71**	**698.5**
World[2]	**1 268 157**	**1 098 412**	**6.0**	**9.0**	**100.00**	**3.48**	**202.5**
Industrialised countries[3]	1 144 280	990 940	5.7	8.9	90.23	3.98	1 195.1
Emerging markets[4]	123 877	107 472	8.5	10.0	9.77	1.48	22.9
OECD[5]	1 176 574	1 020 912	5.6	8.9	92.78	3.88	1 008.6
G7[6]	992 687	873 750	5.7	8.9	78.28	4.13	1 385.8
EU, 15 countries	389 077	308 716	5.0	7.2	30.68	3.50	974.8
EU, 25 countries	399 514	317 234	5.1	7.2	31.50	3.45	837.8
NAFTA[7]	617 572	560 221	7.2	11.1	48.70	4.96	1 455.6
ASEAN[8]	9 643	8 563	8.3	19.1	0.76	1.15	16.4

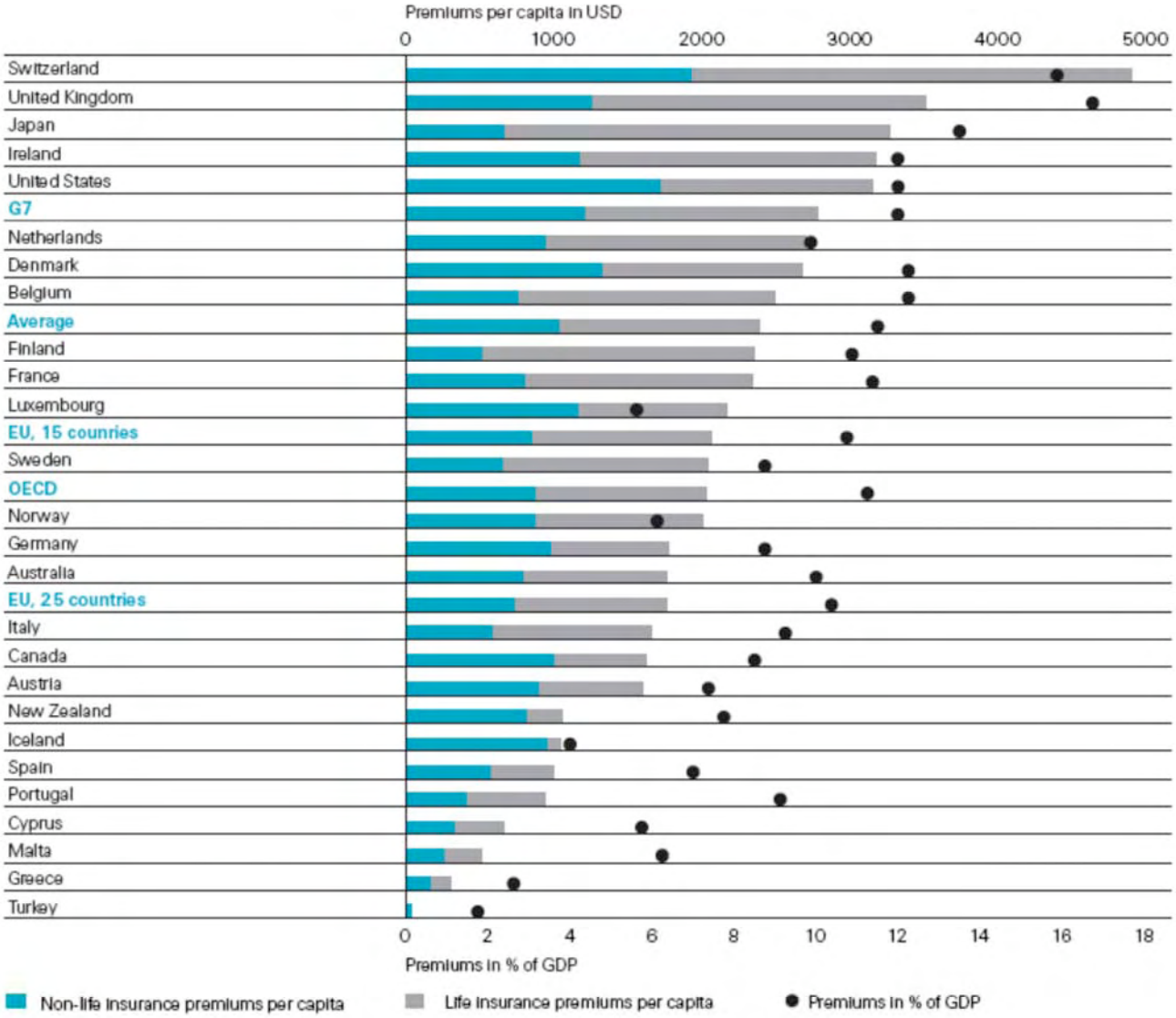
Life/Health Business

America	**519 829**	**516 538**	**−2.2**	**6.2**	**31.08**	**3.83**	**606.8**
North America	503 759	501 135	−2.2	6.2	30.12	4.25	1 565.7
Latin America and Caribbean	16 070	15 403	−0.4	5.2	0.96	0.94	30.0
Europe	**584 705**	**500 489**	**−2.0**	**1.3**	**34.96**	**4.64**	**726.9**
Western Europe	573 712	492 350	−2.3	1.6	34.30	4.99	1 230.1
Central/Eastern Europe	10 994	8 140	17.5	−14.9	0.66	0.99	32.9
Asia	**522 340**	**478 105**	**2.7**	**1.3**	**31.23**	**5.74**	**140.1**
Japan	381 335	353 909	0.2	−2.5	22.80	8.61	3 002.9
South and East Asia	137 207	120 485	10.2	14.8	8.20	3.50	41.3
Middle East/Central Asia	3 797	3 711	−3.0	−2.1	0.23	0.50	13.4
Africa	**22 184**	**18 087**	**−14.8**	**7.0**	**1.33**	**2.93**	**26.1**
Oceania	**23 456**	**20 841**	**−8.4**	**−9.3**	**1.40**	**3.99**	**750.7**
World[2]	**1 672 514**	**1 534 061**	**−0.8**	**2.9**	**100.00**	**4.59**	**267.1**
Industrialised countries[3]	1 482 262	1 368 235	−1.7	2.0	88.62	5.23	1 568.5
Emerging markets[4]	190 251	165 826	6.6	10.6	11.38	2.31	35.7
OECD[5]	1 533 183	1 418 146	−1.8	2.0	91.67	5.12	1 331.3
G7[6]	1 293 804	1 208 415	−1.5	2.2	77.36	5.45	1 828.1
EU, 15 countries	541 935	464 323	−2.3	1.4	32.40	5.07	1 410.3
EU, 25 countries	547 995	469 109	−2.2	1.5	32.76	4.90	1 192.2
NAFTA[7]	507 990	507 130	−2.5	6.3	30.37	4.08	1 197.3
ASEAN[8]	14 643	13 804	1.5	−8.3	0.88	2.20	31.3

Source: Swiss Re (2004)

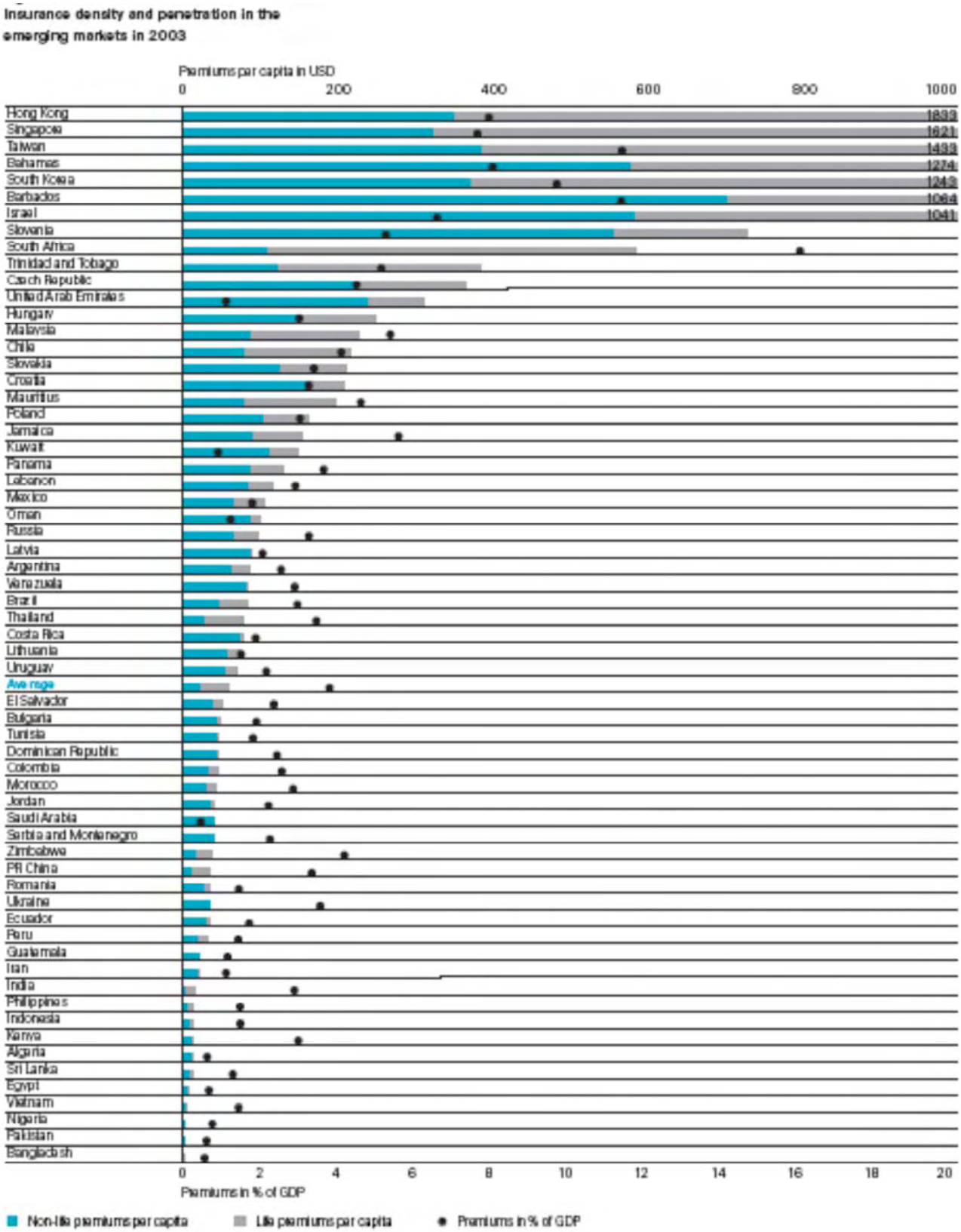
Appendix 5. Insurance Premiums Per Capita, By Type, and as a Percentage of GDP; by Country: 2003

Insurance density and penetration in the industrialised countries, 2003



Source: Swiss Re Economic Research & Consulting

Appendix 5 (cont'd). Insurance Premiums Per Capita, By Type, and as a Percentage of GDP; by Country: 2003



Source: Swiss Re Economic Research & Consulting

INTERNET RESOURCES

Disaster Statistics

OECD: International Aid and Debt Statistics
The Development Assistance Committee (DAC) publishes statistics and reports on aid and other resource flows to developing countries and countries in transition and related matters, based principally on reporting by DAC Members. Database for making custom reports from 1966.
http://www.oecd.org/dac/stats/

Munich Re
Statistics on total economic as well as insured costs, fatalities, and number of events
http://www.munichre.com

Swiss Re
Regional Reports and Market Data; Natural Disaster Loss Reports
http://www.swissre.com

CRED: The Center for Research on the Epidemiology of Disasters
Extensive repository of data on natural disasters; searchable database
http://www.cred.be/

CRID: Regional Disaster Information Center: Latin America & The Caribbean
http://www.crid.or.cr/crid/Indexen.htm

Reliefweb
UN appeals for relief, information on natural disasters, detailed mapping, financial tracking
http://www.reliefweb.int/w/rwb.nsf

UN/OCHA: UN Office of Coordination of Human Affairs
Current and historical emergency relief information, by country.
http://www.reliefweb.int/ocha_ol/

Natural Hazards Center, University of Colorado, Boulder
Data, research, and extensive on-line library
http://www.colorado.edu/hazards/

Policy & Deployment

International Federation of Red Cross and Red Crescent Societies
http://www.ifrc.org/

ISDR: International Strategy for Disaster Reduction
Policy papers, including World Summit on Sustainable Paper, Various other resources
http://www.unisdr.org/unisdr/WSSD.htm

ProVention Consortium
http://www.proventionconsortium.org/partners.htm

World Bank Disaster Management Facility
http://www.worldbank.org/dmf/

World Bank Forum on Insurance
http://www.visualcommunications.com/wb/nbfi/home.htm#insurance

International Federation of the Red Cross and Red Crescent Societies
http://www.ifrc.org/WHAT/disasters/

Integrated Adaptation/Mitigation Strategies

LBNL's Insurance Site
Analyses of the loss-reduction characteristics of sustainable energy technologies
http://eetd.lbl.gov/insurance

Other Lists of Links

World Bank Disaster Management Facility's Links
http://www.worldbank.org/dmf/links.htm

UN Links
http://www.unisdr.org/unisdr/WSSD.htm

CRED's Links
http://www.cred.be/centre/links.htm

ACRONYMS

AIG	American International Group
bbl	Barrel (of oil equivalent)
CDC	Center for Disease Control and Prevention
CDMP	Caribbean Disaster Mitigation Project
CRED	Centre for the Epidemiology of Disasters
DOD/PK/HA	U.S. Department of Defense's Office of Peacekeeping and Humanitarian Affairs
EPA	U.S. Environmental Protection Agency
ESI	Energy-savings insurance
EU	European Union
FDI	Foreign Direct Investment
FIRENA	USAID Natural Resource Investment Fund Project
GDA	USAID Global Development Alliance
GDP	Gross Domestic Product
HHS	U.S. Department of Health and Human Services
IFRC/RCS	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change
Mbod	Million barrels of oil per day
NOAA	National Oceanic and Atmospheric Administration
OCHA	UN Office for the Coordination of Humanitarian Affairs
OECD	Organization for Economic Cooperation and Development
OFDA	USAID Office of Foreign Disaster Assistance
PIIC	People's Insurance Company of China
PML	Probable maximum loss
State/PRM	U.S. Dep't of State Bureau of Population, Refugees, and Migration
TkWh	Trillion kilowatt hours (of electricity)
UN	United Nations
UNDP	UN Development Program
UNEP	UN Environment Program
UNFCCC	UN Framework on Convention on Climate Change
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geologic Survey
UV	Ultraviolet