



Insurers as Partners in Inclusive Green Growth

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Preface

The Group of 20 (G20) nations increasingly recognize the importance of green growth, and many countries are demonstrating strong leadership through effective and progressive policies. However, governments do not act alone—the private sector is an important partner, providing new technologies, business models and investment opportunities across a variety of sectors to help scale up transformation. In 2012 the G20 Development Working Group commissioned the International Finance Corporation, as the largest development finance institution dedicated to private sector development with a strong emphasis on sustainability, to take stock of mechanisms to mobilize private capital, including from institutional investors, for inclusive green growth investments in developing countries. This work is intended to inform the creation of a public-private G20 Dialogue Platform on Inclusive Green Investment.

As part of this effort IFC commissioned a series of supporting documents and materials, including this publication, specifically created as underpinning material to inform the final synthesis report produced by IFC for consideration at the G20 meeting in St. Petersburg in 2013.

These publications can all be found at www.ifc.org/Report-MobilizingGreenInvestment.

Intrinsic to the concept of inclusive green growth is limiting damages due to natural disasters, including those stemming from global climate change. Insurance is at an earlier stage of evolution in the developing world and takes a different form there. As the incidence of weather-related catastrophes has tripled in the past three decades, the underdevelopment of insurance markets renders a high proportion of losses uninsured, and thus a rising stake in new loss-resilient infrastructure. In many developing countries, insurance has been historically dominated by public entities.

Insurers can materially engage in green growth in several ways: by helping spread the costs of everyday as well as catastrophic losses (their core business) that so often represent a setback to development efforts; accurately evaluating and communicating risks to inform public and private decision making; offering innovative risk management products and services; providing influential input to the public policy processes; and directly investing some of their substantial assets (more than \$20 trillion under management) in inclusive green growth projects and providing risk management tools for other investors.

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Executive Summary

Attaining durable economic growth in the developing world while stemming rising environmental impacts that otherwise perversely impede that very growth requires widespread deployment of green technologies and practices. Green growth becomes socially equitable and inclusive when access to the accompanying efficiencies and benefits to environment, health, and food security extend to those at the bottom of the economic pyramid. Intrinsic to the concept of inclusive green growth is the mitigation of and adaptation to otherwise unavoidable natural disasters, including those stemming from the systemic risks of climate change.

Navigating an increasingly challenging risk landscape is a key to successful inclusive green growth, and the insurance sector stands as a natural partner in that process. Conversely, if increasing environmental degradation and other risks go unmanaged, a crisis of insurability (availability and affordability of insurance provided by the private market) could ensue, further hampering growth and shifting a greater share of risk to an already over-taxed public sector.

Climate change adaptation and mitigation are thus central to the insurance-and-Inclusive-Green-Growth narrative. By spreading risk, the availability of insurance substantially diffuses the near- and long-term economic disruption from natural disasters, while reducing the burden on individuals as well as in-country and foreign governmental aid. Today, a quarter of the direct costs of global catastrophes are financed through insurance.

In 2012, insurance represented 7 percent of the global economy—the world’s largest industry—manifesting as \$4.6 trillion in premium revenues, \$22 trillion in assets under management, and a large workforce. Insurance premium volume in the developing world represents about 15 percent of the global total, and growth rates are far higher than in mature markets given that demand is far from saturated. This underscores a further role for insurance in economic development.

Insurers can materially engage in green growth in several ways: by helping spread the costs of everyday as well as catastrophic losses (their core business) that otherwise represent a setback to development efforts; offering innovative risk management products and services; providing influential input to the public policy processes; and directly investing some of their substantial assets in inclusive green growth projects and providing risk management tools for other investors.

As an industry involved in every economic sector (i.e., real estate, industry, water, agriculture, transportation, energy, and health), insurers can support cross-linkages among a wide diversity of green growth project areas. There are many precedents, largely from the industrialized world. In particular, as of late 2012, nearly 400 insurers from 51 countries had employed a versatile set of techniques to promote green technologies and practices and proactive responses to climate change risks.

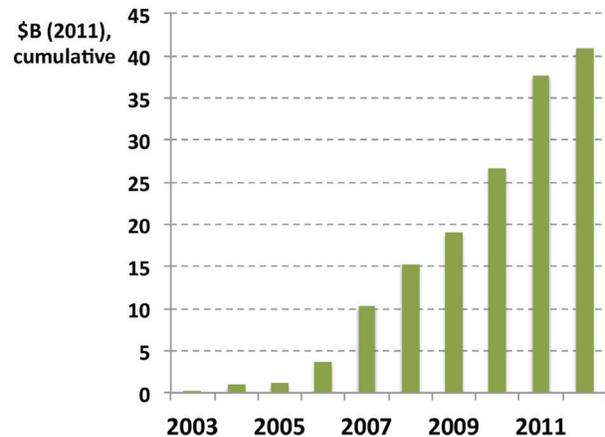
Of particular relevance, insurers provide about one-third of the total \$71 trillion institutional investment currently in place globally.

In the past decade, 25 insurers have collectively made over \$40 billion in finance and direct investments relevant to climate and environmental concerns, spanning venture capital, private equity, public equity, and credit. Of the total, \$23 billion was invested in climate change mitigation projects. In addition, between 2004 and 2011, insurance companies provided asset financing in the form of corporate finance and loans in at least 29 transactions, valued at approximately \$11 billion. This is accompanied by \$7 billion in broader social-screened investments that include but are not limited to environmental criteria. Additional investment by at least 155 insurers in greening their own infrastructure is not included in these numbers, but is substantial, with 28 of these companies reporting attainment of carbon neutrality.

Existing green initiatives involve a diversity of insurance industry actors, including direct insurers, reinsurers, brokers, agents, actuaries, modelers, and industry associations, often in partnership with regulators, academic institutions, consumer groups, governments, and non-governmental organizations.

The breadth of potential insurer engagement is consistent with an imperative to approach inclusive green growth in an integrated manner rather than a piecemeal project-by-project basis. Key opportunities for accomplishing this by extending best practices from the industrialized world to a developing country context include:

Green finance and investment by global insurers: as of Q3 2012



- Extending the availability of insurance to manage risks in the developing world.
- Facilitating resilience and adaptation to changing weather and climate extremes.
- Introducing innovative products and services that support green growth.
- Engaging in public policy and land-use planning processes.
- Investing in and financing green growth, resilience, and adaptation projects.

Success depends in no small part on factors out of insurers' direct control. These include a host of political risks, regulatory factors such as pricing and public sector involvement in disaster management, and conditions determining whether buyers will exercise demand for green insurance products and services.

2

Context

Development paradigms have often sacrificed environmental considerations for near-term economic gains, with the added consequence of amplifying inequities in social welfare. Indeed, the inefficiencies embedded in traditional development and associated investment decisions can ultimately serve to constrain human wellbeing and economic prosperity. These tensions, however, are not pre-ordained.

The real-world limits to traditional development approaches are startlingly evident. Today, nearly two centuries after the industrial revolution and untold investments in infrastructure for the developing world, poverty remains pervasive: 1.3 billion people lack access to electricity, 2.6 billion have no access to sanitation, and 900 million lack safe drinking water. There are more people on earth today without electricity than the entire human population in Edison's day. In addition to humanitarian considerations, these underserved markets represent large uncaptured business opportunities.

Moreover, thanks to the inefficiencies of historical development efforts, all populations—irrespective of their economic wealth—have emitted sufficient greenhouse gas (GHG) pollution to trigger dangerous changes to the climate and extreme weather events, and are heading toward far more destructive, yet still avoidable levels of impact (World Bank 2012a). With countries at all levels of wealth vulnerable to the impacts climate change, environmental degradation is eroding the resilience of human systems, magnifying inequities, and impeding prosperity.

Inclusive Green Growth

The vast investment needed to overcome these challenges must, by definition, be framed by the notion of inclusive green growth, which is *the* pathway to sustainable development (World Bank 2012b). For the poor, traditional development has offered unaffordable, and thus often unobtainable, options. Green growth, in contrast, emphasizes affordable solutions, such as energy-efficient and renewable energy systems with lower lifecycle costs than traditional solutions (Mills 2005a). Green growth can simultaneously reduce environmental degradation that adversely impacts health and wellbeing, particularly for lower income populations.

As articulated by the Af Development Bank (AfDB 2012):

By choosing certain activities, economic growth can be decoupled from environmental harms. In some cases, environmentally superior choices may also enhance economic productivity (e.g., through efficiency gains) or human welfare (e.g., through goods and services provided by natural environments). Green growth is the selection of economic activities that, at best, promote environmental and social development and, at a minimum, do not harm the environment or human welfare. This is achieved through rigorous analysis of economic alternatives and their related environmental

and social impacts. ... [G]reen growth will mean pursuing inclusive economic growth through policies, programs and projects that invest in sustainable infrastructure, better manage natural resources, build resilience to natural disasters, and enhance food security.

As a case in point, a major global chemical company (Dow), oil company (Shell), consumer products company (Unilever), reinsurance company (Swiss Re), and NGO (The Nature Conservancy) looked in some detail at emerging examples of green infrastructure such as water treatment, coastal and floodplain protection, and fortifying the built environment (Dow et al. 2013). The group found that by harnessing ecosystem services, such systems increase resilience of industrial business operations, often demonstrate financial advantages (both due to reduced capital and operating expenses), reduce energy and other resource use, and manage socio-economic risks.

Developing nations possess a particular opportunity to “leapfrog” industrialized economies whose historically suboptimal long-term infrastructure investment decisions have locked them into less efficient and more polluting practices.

While the notion of risk management has become embedded in the worlds of public policy and business, it has come late to the environmental sphere where relatively simplistic cost-benefit analysis retains a dominant role in decision making. In reality, the environmental risks associated with development projects—even those associated with well-intended improved practices—are not well known, and are in a dynamic state. This is particularly evident in the face of global climate change, which is arguably the ultimate systemic risk facing society today.

The insurance sector is key to understanding and managing risk within the private

sector, and to a lesser but still important degree in the public sector.

Insurance and (Inclusive Green) Growth

Analyses by the World Bank (Arenal 2006) and others (Lloyds of London 2012) have established that the presence of insurance (both life and non-life) stimulates economic growth. The same is said for the presence of institutional investors, of which insurers are among the top three globally (Grant 2013). This makes intuitive sense, in that an environment where physical and health-related risks are professionally spread and managed, coupled with higher levels of investment throughout an economy and reduced burden of loss costs on governments, fosters economic activity. Further synergisms with banking can be imagined, e.g., reducing risks for lenders where the underlying (climate-sensitive) asset is insured.

Insurance is an element of the financial services sector not traditionally associated with “green” initiatives. However, the industry has undertaken extensive activity regarding green technologies and practices (Mills 2012a). This stands as a strong exemplar of the often-asserted false choice between economic growth and environmental or sustainability considerations. Insurers’ rationale for engagement in inclusive green growth should follow from the fact that emerging markets are the industry’s future as an underwriter, and they represent the largest arena for associated investment. This is borne out in a recent survey where 70 percent of insurance CEOs identified Asia and nearly 50 percent Latin America as “very important” to their company’s overall near-term growth prospects (Geneva Association 2012). From a policymaker’s vantage point, insurance represents a key private-sector modality of risk spreading, while green growth (by virtue of

reducing risks) can ultimately improve the affordability of insurance.

The global insurance sector is well positioned to enhance inclusive green growth in developing countries. Insurance markets have grown steadily in the developing world, with 16 percent of the \$4.6 trillion insurance revenues in what insurers deem “emerging markets” as of 2012, with the share projected to roughly double by 2023. Over \$720 billion in annual premiums already come from emerging markets¹ (Figure 1; Appendix I). Moreover, insurance can help offset the high proportion of GDP otherwise lost due to natural disasters in the developing world. Most long-run economic costs of natural disasters occur where insurance is not in use (von Peter et al., 2012).

Insurance is a strongly crosscutting industry, reaching into virtually every segment of the economy. As a result, insurers stand to offer a systemic perspective on green growth topics. For example, we have seen the Chief Underwriter for the Asia Catastrophe Pool/Asia Agriculture Pool express concern about the challenges that climate change poses for food security on the one hand and competition between water resources for hydroelectric power and agricultural irrigation on the other (Corona 2013). They further couple this technical point with recognition of socioeconomic and demographic structural considerations such as the potential value of increased insurance (risk-spreading) in reducing the need for rural populations to move to urban areas, and the need for responses to take the form of public-private partnerships. It is notable that the U.S. President Obama’s 2013 climate change platform calls for public-private collaborations with insurers (Executive Office of the President 2013).

Insurers can materially support green growth in a variety of ways: by helping spread the costs of everyday as well as catastrophic losses (their core business); offering innovative

risk management products and services; providing constructive and influential input in public policy processes; and directly financing or investing some of their substantial assets in inclusive green growth projects. As an industry almost uniquely involved in every economic sector (i.e., real estate, industry, water, agriculture, transportation, energy, and health), insurers and their products can support cross-linkages among disparate risks and green growth project areas. Through appropriate engagements, the insurance industry can also help enhance project quality and significantly leverage development funding.

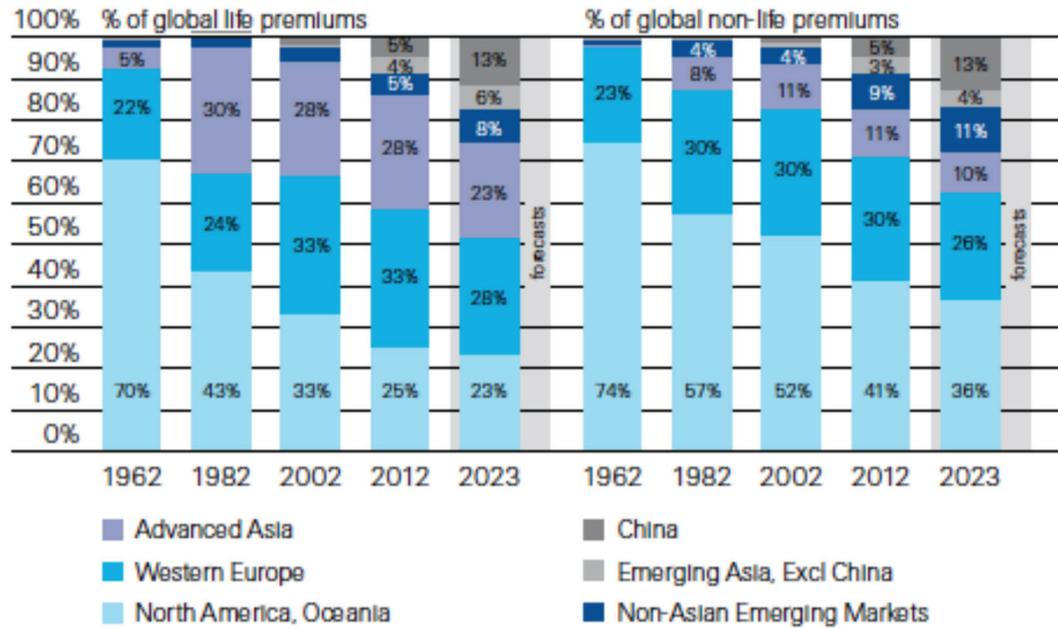
Insurance is a truly global industry, with most major firms operating on multiple continents. Yet, insurance is at an earlier stage of evolution in the developing world and takes a different form there. While insurance markets are largely saturated in industrialized countries, the growth rate of insurance in developing countries routinely outstrips GDP (Appendix I). Premium growth in emerging Asian markets is projected at 11 percent per annum (Munich Re 2013a), while developed markets are relatively saturated.

Despite relative market growth in the developing world, as the incidence of weather-related catastrophes has tripled in the past three decades, the underdevelopment of insurance markets renders a high proportion of losses uninsured, and thus a rising importance of new loss-resilient infrastructure in conditioning the market for growth.

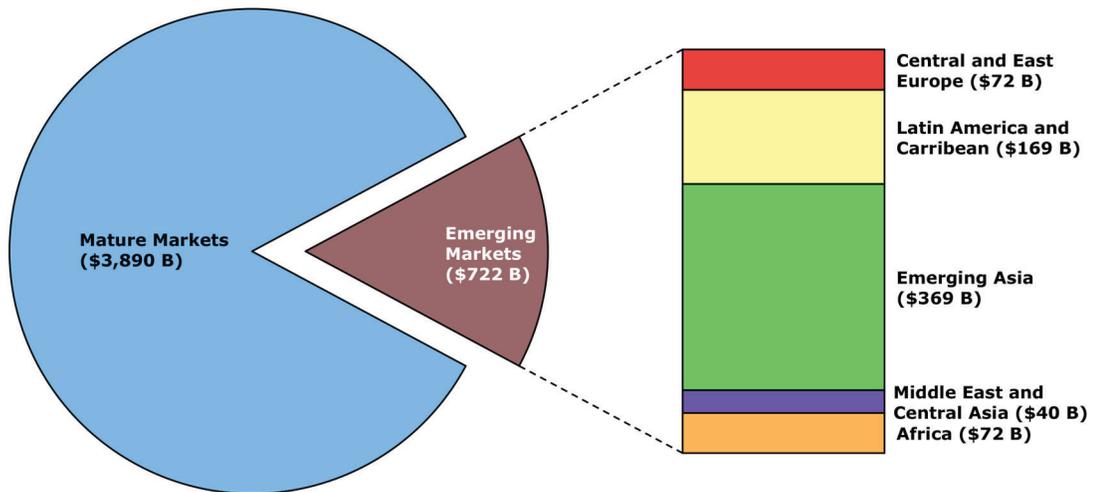
In many developing countries, insurance has been historically dominated by public entities.

¹ Defined in the Swiss Re statistics (Swiss Re 2012a): Advanced economies include the US, Canada, Western Europe (excluding Turkey), Israel, Oceania, Japan and the newly industrialized Asian economies (Hong Kong, Singapore, South Korea and Taiwan). All other countries are classified as “emerging” and generally correspond to the IMF’s “emerging and developing” economies.

FIGURE 1: Insurance markets have grown steadily in the developing world



16 Percent of \$4.6 Trillion/year Global Insurance Market is in Developing Countries and Economies in Transition: 2012



Source: Swiss Re Economic Research & Consulting.

Note: 16 percent of the \$4.6 trillion insurance revenues are in what insurers deem "emerging markets", as of 2012, with the share projected to roughly double by 2023 (Swiss Re 2013).

Liberalization that has allowed commercial entrants has taken place in many cases, beginning in China in 1992 and in India in 1999. Conversely, Chinese insurers have begun writing policies in the United States (Kenealy 2013).

Concerns about having sufficient capacity to pay claims in the face of rising catastrophic losses have stimulated efforts to develop alternative ways to transfer financial risks. In response, insurance companies have begun to venture outside of their traditional business model, using a variety of alternative risk transfer (ART) financial instruments which do not always involve the core business of funding losses with premium revenues (Box 1).

Among the forms of alternative risk transfer are instruments such as weather derivatives and Insurance Linked Securities (ILS), wherein

traditional insurance portfolios (assets) are in effect bundled and resold to investors on secondary markets. There are many mechanisms for ART (Appendix II), the most well known of which are the catastrophe bonds (which thus far have been limited almost exclusively to industrialized countries) (Cummins 2012).

From the perspective of the inclusive green growth policymaker, differences in tax treatment of ART and traditional insurance transactions could have implications for national treasuries (GAO 2002). Consumer protections should also be considered in light of potential lack of oversight by insurance regulators, a concern voiced by the Lloyd's of London Chairman recently in which he likened the risk to that of the damaging "systemic risks" recently experienced in the banking industry (*Business Insurance* 2013a). Moreover,

BOX 1: ALTERNATIVE RISK TRANSFER MECHANISMS

The common aim of alternative risk transfer (ART) mechanisms is to attract new sources of risk capital and thereby diversify and expand the capacity of individual companies (and the industry as a whole) to remain solvent in the wake of catastrophic losses, while mitigating reinsurance price volatility (RMS 2012). Proponents tend to position ILS as a substitute for reinsurance; others, as a complement (if needed) (GAO 2002). In every case, their value is linked to the incidence and outcomes of insurance-loss events.

These instruments are new to markets, first appearing in mid-1990s, in the wake of unprecedented losses from Hurricane Andrew and the Northridge Earthquake. A second wave of new products followed the extreme hurricane season of 2005. The growing use of both insurance and alternative financial vehicles to generate capital for paying losses is often referred to as "convergence." The market is small in comparison to traditional insurance. Approximately 280 Cat Bonds have been issued to-date (http://www.artemis.bm/deal_directory/). There has been a resurgence of activity in 2012–2013 (aggregate capital of \$45 billion), enough so to create downward pressure on traditional reinsurance prices (Guy Carpenter 2013).

Of importance to the broader finance community is that ILS payouts had historically been assumed to be un-correlated with global financial markets, but this was not borne out in recent years (Boucher 2009). Moreover, a large natural catastrophe hitting a major financial center (earthquake or typhoon in Tokyo) can of course have widespread economic repercussions.

Insurance-linked securities have brought new risks to insurers and investors, along with new concerns to regulators. Investors cannot monitor the underwriting and loss-prevention practices of the insurers, and so may assume more risk than they realize (Thomas 2013). While a niche market within the broader structured-finance market, ART techniques have been more affected by the global financial crisis than anticipated (Weistroffer 2010). The value of four ILS instruments fell precipitously in the global financial crisis, by 40–80 percent in the case of those owned by Lehman (Boucher 2009). Derivative instruments are now being regarded with more scrutiny. Regulatory oversight may be quite different than for traditional insurance, and likely varies widely by country.

According to the *Wall Street Journal* (Thomas 2013): "[T]he sustainability of alternative capital in this kind of investment hasn't been tested by widespread, major losses. . . . As the market has expanded, it has become more concentrated. More than 70 percent of outstanding cat-bond volumes are exposed to U.S. hurricane risk. They could yet be called catastrophe bonds for a reason."

not all ART mechanisms are applicable to important green growth populations, e.g., smaller farmers would not be likely to have access or sophistication necessary to employ weather derivatives, or to all types of insurance activity (e.g., insurance of real estate against non-catastrophic losses). It is not clear whether, if at all, ART can be used synergistically to stimulate inclusive green growth in the same ways as can traditional insurance. Among the important distinctions between ART and traditional insurance is that the former manages risk by using financial mechanisms. These issues should be further investigated in the context of inclusive green growth.

The globalization of commerce and information technology has created unprecedented supply chains that stretch around the planet, which globalizes previously “local” risks. As a result, natural disasters routinely disrupt global supply chains, networks, workforces, and distribution systems (UNISDR and PwC 2013). It is not surprising that insurers are among those who focus most on supply chain risks spanning sectors as diverse as manufacturing, agriculture, and telecommunications.

The Supply Chain Risk Leadership Council identifies climate change as the foremost among 14 major emerging risks (SCRLC 2013).

Among insurers focusing on this issue, Allianz found that natural disasters are the number one trigger of supply chain disruptions (59 percent of the cases) (*Business Insurance* 2013b). Interestingly, “oil reliance” is cited as the top “weak link” among supply-chain risks that can be directly managed. Almost half of 170 global executives surveyed by Zurich and the *Economist* pointed expressly to the risks of natural catastrophes on IT infrastructure (Veysey 2013a). As a case in point, the developing world is at the heart of Apple’s supply chain. Although headquartered in the U.S., disruptions in many other countries have a material effect on the company’s fortunes.

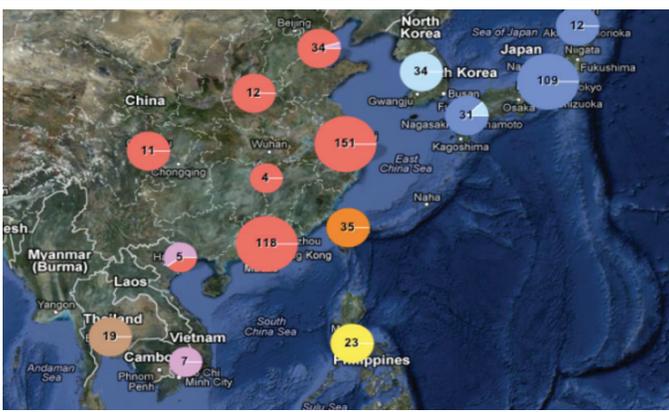
The 2011 flooding in Thailand was a wake-up call for insurers about the sensitivity of customers in the developing world and the insurance industry burgeoning exposure to those risks (Box 2).

The Importance of Extreme Weather and Natural Disasters

Data compiled over four decades by the Munich Reinsurance company offer a unique profile of global impacts from natural catastrophes in aggregate (Figure 4) and allow for a more in-depth look at impacts by types of event, including those related to climate and weather extremes (Figure 5).

It is clear that the insurance industry materially participates in spreading the costs of natural disasters. Managing approximately a quarter of total catastrophe losses globally, their engagement varies widely by region. For the period 1980 to the present, the insured fraction of total losses is 44 percent in North America, 29 percent in Europe, 9 percent in South America, and 8 percent in Asia. Insurers’ exposure, however, is rising everywhere. In sum, the developing world experiences fundamentally different patterns of impacts from climate and weather extremes, as follows:

FIGURE 2: Apple Computer’s supply chain in East Asia (ChinaFile 2013)



**BOX 2: THE 2011 THAILAND FLOODS:
A Teachable Moment in the Vulnerability of Insurers to Growth that is not Green**

Following the highest rainfall rates in 50 years, the massive 2011 floods in Thailand made world news, affecting businesses in many other countries and catching the global insurance industry largely by surprise. Total costs approached 9 percent of GDP (Lloyds of London 2012). Dams built with an excessively narrow focus on impounding water for irrigation were filled to capacity, subsequently requiring large water releases in short periods of time. Flooding across an area the size of Switzerland continued for five months.

Households and small businesses in Thailand held almost no insurance (~1 percent penetration rates). Meanwhile, high-tech and automotive manufacturing entities had developed infrastructure fortified only to average flood conditions, leaving exceptional vulnerability to extremes. The combination of unprecedented floods and inadequate preparedness led to \$30 billion overall economic losses, of \$12 billion were insured (the world’s largest-ever insured fresh water flood loss, four times larger than the previous record). The World Bank (2012c) has estimated a substantially higher cost (\$46.5 billion), attributed to a fuller accounting of supply-chain impacts.

As a metric of the financial impact on insurers, their entire relevant industrial premiums the prior year had been only \$0.37 billion. Consequently, flood insurance availability in Thailand contracted, and the government was forced to step in and create a pool (Hall 2013).

Investigations conducted by the insurance industry following the event identified seven other developing countries have become even more vulnerable than Thailand (Figure 3), particularly China (Swiss Re 2012).

FIGURE 3. Flooding “hot spots” in the developing world

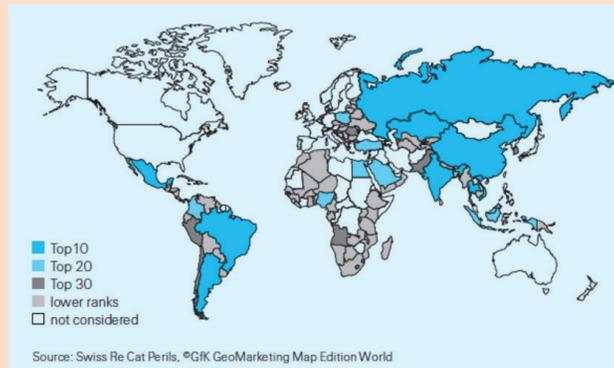


FIGURE 4: Allocation of natural disaster impacts by region: 1980–2012 (Munich Re 2013b)

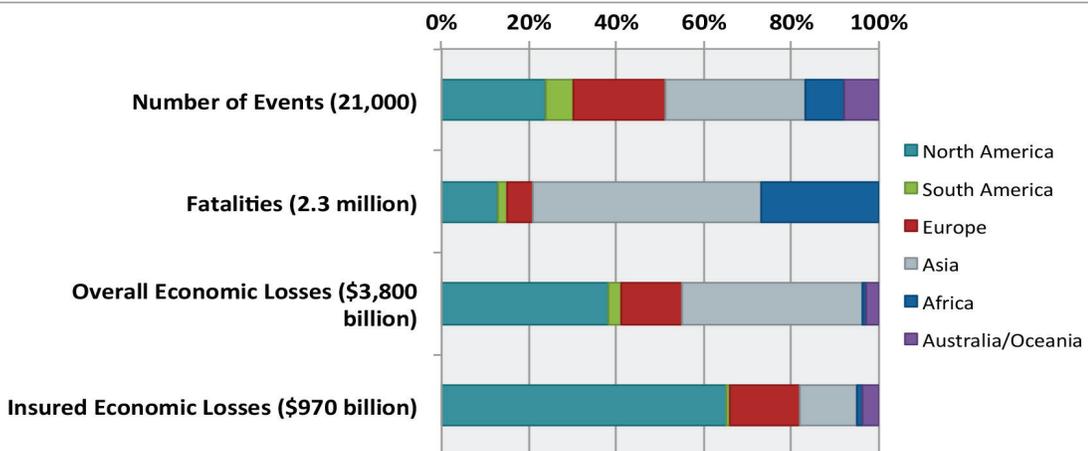
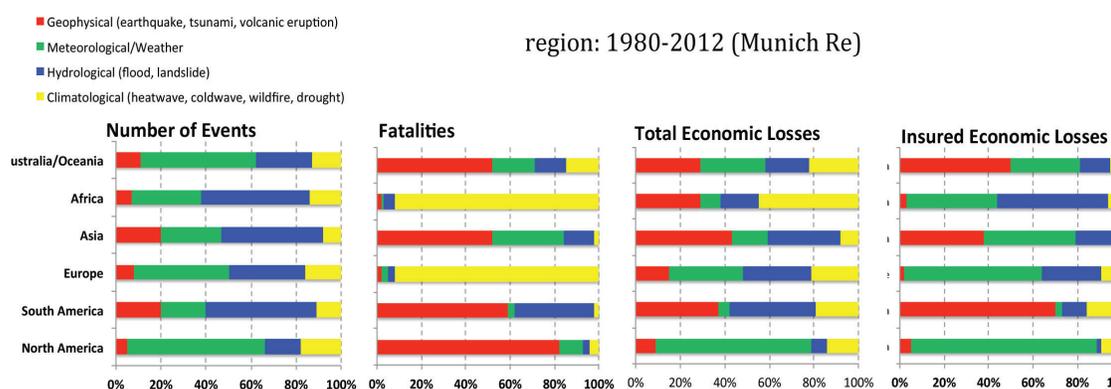
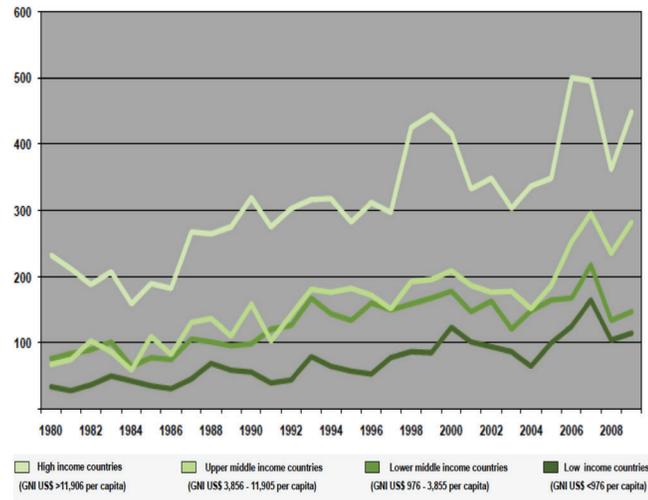


FIGURE 5: Allocation of natural disaster impacts by type and region: 1980–2012 (Munich Re)


- Number of events**—The incidence of natural disasters is spread somewhat evenly throughout the world, with more than half of the events in Asia and the balance in industrialized regions. Events arising from weather and climate extremes (as distinct from those attributable to earthquakes, tsunamis, and volcanic eruptions) represent the vast majority of natural disasters: 80–95 percent in each region. In the developing world, hydrological events (primarily floods) are the largest category, followed by storms and other meteorological events.
- Fatalities**—When considering human costs, measured in terms of fatalities, the developing world bears the brunt of impacts. In the Americas, the dominant number of fatalities arises from non-weather-related events (especially earthquakes and tsunamis), while in Africa and Europe, climatological events (particularly heat waves and drought) claim the greatest number of lives. (Health insurance costs from extreme events are not comprehensively tracked.)
- Overall economic losses**—Here the balance of total developing world impacts shifts considerably to Asia, with the remainder almost completely in Europe and North America. Weather- and climate-related events cause the majority of economic losses, particularly due to extreme weather (primarily storms). The dominance of climatological losses in Africa no doubt arises from agricultural and livestock losses stemming from droughts.
- Insured economic losses**—North America shoulders the majority of global insured economic² losses from natural disasters, with Europe in a distant second position. The balance—20 percent of the world’s total—is spread throughout Asia and the rest of the developing world. Pronounced differences in the distribution of total versus insured economic losses exist in most regions. Areas without private earthquake

² The qualifying term “economic” is used here because the allocation of insured losses arising from natural disasters is not tabulated by Munich Re.

FIGURE 6: Trends in numbers of natural disaster events (Munich Re)

insurance (notably North America) have a very low proportion of non-weather/climate-related insured losses. Weather extremes and associated impacts such as floods and landslides are dominant in most developing regions.

The numbers of natural catastrophes events are rising around the world (Figure 6) and Appendix III), seemingly fastest in the poorest countries.

Insurance, Development, and a Changing Climate

Every sector of the economy telegraphs unique climate risks to its insurers. In turn, climate change—and the systemic risks that result—stands as the ultimate stress test for the industry as it threatens to reduce insurability, hinder growth (as prices rise), or even trigger contraction (Mills 2005b; Lloyds of London 2006; Dailey et al., 2009). Reaching back to the Code of Hammurabi, insurers' social and regulatory agreements must balance maintaining solvency following losses with availability and affordability of their products. These

challenges are vastly greater in a developing country context than in the industrialized world (Mills 2004).

Insurability requires sufficient understanding of the actuarial likelihoods and locations of losses, market factors such as the willingness of customers to pay the associated premiums, and the broader societal context with respect to policy and law. Among the myriad challenges in this regard are those arising from the expected increase in frequency and intensity of extreme events, along with shifting geographies (Table 1).

Insurers are not new to the problem of climate change. Their earliest expressions of concern date to the 1970s. By virtue of their cross-sector risk-taking, insurers experience the full range of climate change impacts. Drought provides a clear illustration, as it simultaneously affects insured activities in agriculture and livestock production, energy production, wildfire, and supply chains (including fuel) dependent on river-based shipping. The U.S. drought of 2012 exacted \$15–\$17 billion in public and private insurance claims, out of a total economic impact of somewhat over \$20 billion (Munich Re 2013c).

TABLE 1: Implications of climate change for insurability*

Category	Criterion	Must be	Complications presented by climate change
Actuarial	Risk/uncertainty	Measurable	Increasingly complex, volatile, decreasingly predicted by past loss experience, and increasingly challenging to model
	Loss occurrences	Independent (uncorrelated)	Risk of increased correlation as events become more complex, frequent, and extreme
	Maximum loss	Manageable	Reserves must grow in proportion to magnitude and frequency of events
	Average loss	Moderate	Will increase
	Loss frequency	High	Will increase
	Moral hazard (fraud)	Not excessive	Unlikely linkage
	Adverse selection (disproportionate purchasing of insurance by high-risk customers)	Not excessive	Requires that changing risks are understood, premiums are sufficiently risk-based, and risk pool remains large and diversified
Market—and regulator-determined	Insurance premium	Adequate, affordable	Insurance regulators must allow prices to reflect risks
	Insurance cover limits	Acceptable to customers	Gap between limits and need will likely increase, as will deductibles and exclusions
	Insurance capacity	Sufficient to weather extreme events	Increasingly difficult
Societal	Public policy	Consistent with cover	Increasing tension between public versus private risk-sharing
	Legal and regulatory	Permits the cover	Insurance regulators will be on critical path to allow “green” innovation

* Adapted from Herweijer et al (2009)

Adding to a highly problematic baseline situation, insurers are experiencing increasingly complex weather-related events, begetting multiple cascading losses from property damage across every customer class, global supply-chain and business disruptions, life and health impacts, and even liability claims against emitters of greenhouse gases (Ross et al., 2009; Carroll et al., 2012). Forward-looking insurers are far more compelled by the presence of these risks than they are dissuaded by the exact degree of certainty about climate science. In parallel, insurers must adapt to emerging risks stemming from society’s responses to climate change. This includes how customers construct buildings, transport people and goods, design products, and produce energy. Reflecting these considerations, a 2008 survey of 70 insurance analysts ranked climate change as the industry’s primary strategic risk (Ernst and Young 2008).³

Where there are risks, there are also opportunities. Insurers have deeply rooted traditions of assessing, communicating, and managing risks. The thought leaders have evolved a nuanced view of climate change, considering abrupt as well as slow-onset events within a framework of enterprise-wide risk spanning underwriting, investments, daily operations, shareholder relations, and regulation. Recognizing that the marketplace has moved beyond most policymakers in embracing new technologies and business models designed to address climate change, a vanguard of insurers and affiliated institutions are proactively responding.

³ More recent surveys showed global economic concerns ranking first. These concerns, however, are presumably more temporary than those of climate change.

While elements of the industry have historically been ambivalent about publicly expressing concern about climate change, primarily in the United States, recent interviews of 30+ insurance executives indicate a realistic shift in perspective toward recognizing that climate is changing, the impacts are increasing, and delayed action is imprudent (Rousseau 2013):

Push politics aside. To us it is very clear: The risk of climate change is very real, and it has a real potential to be disruptive to our business.

Chris Lewis

Senior vice president of insurance risk management, The Hartford

We are seeing and feeling the effect of what we know is climate change. We know more intense storms and weather will continue....

Mario Vitale

CEO, Aspen Insurance

We're not sticking our heads in the sand. Clearly there is a change in temperature. We need to mitigate and adapt.

David Zona

Chief underwriting officer, Fireman's Fund, a unit of Allianz

Climate change is real, and you don't risk the solvency of your company by saying, 'I don't believe it.'

Maurice "Hank" Greenberg

CEO, Starr Companies

In our SEC filings, we have stated that we believe climate change is occurring and is contributing to an increased probability of more severe weather events.

Stephen Weinstein

Senior vice president and general counsel,
Renaissance Re

The climate is changing, and it is increasingly more reliable to associate certain kinds of events—such as wildfires and drought—with climate change.

Lindene Patton

Chief climate product officer, Zurich Financial

Statistically, it's clear something is happening. An increase in the frequency and severity of natural catastrophes can be plotted—and they're getting worse. ... We have to rethink damage amounts, rethink risk management, rethink the planning and design of buildings. The assumptions we have made based on the past are no longer valid. We have to plan for a much different future with more frequent droughts and forest fires in areas where they never had them before.

Rod Taylor

Managing director, Aon's Environmental Services group

Given all the attention around climate change, clients, naturally, are asking us when it's going to happen.... Given the loss experiences of the last two to three years, our answer is: 'It's starting to happen now.'

Cliff Warman

Head, Marsh's Environmental practice in Europe
The Middle East and Africa

The insurance industry finds itself as the conduit through which a significant proportion of climate change impacts reach the broader economy. In this role, insurers are witnessing, first-hand, the intensification of natural hazards, more rapid return periods between major events, a changing geography of impacts, and

mounting claims. As climate changes, and populations move increasingly into harm's way, historically based models of vulnerability and loss costs are losing predictive power. The uncertainties surrounding all of these factors constitute a material challenge to the insurance business.

In tandem with changes in the physical environment, insurers are embedded in an equally rapidly changing business and regulatory environment. Rising losses translate to rising premiums that jeopardize affordability, and providing insurance at any price becomes untenable when the uncertainties are too high. Meanwhile, responses to climate change bring new risks. Foremost among these are climate engineering, but virtually every new technology (or revival of those, such as nuclear power, that had languished in the past because of excessive risk) has a unique risk profile (Mills 2012b).

Some insurers, nonchalant about climate risk, point to annual renegotiation of prices (through policy renewals) as a sufficient "escape hatch," coupled with the optionality of serving a given market. This approach of course carries reputational and regulatory risks, among them that regulators often reject proposed price increases, and, as seen in the wake of Hurricane Andrew, have impeded insurers' ability to exit markets. Moreover, demand for insurance is certainly price-elastic, particularly in a developing country context where premiums represent a far higher proportion of income than is the case in developed markets.

In any case, a reactive response by this industry (such as reduced coverages, exclusions, withdrawal, or price increases without accompanying support for loss reduction) would have adverse effects for inclusive green growth, insofar as the erosion of insurance availability and affordability would put a chill on economic activity and development (Mills 2005b). This could occur both directly, via a reduced contribution to economic activity by the insurance sector, and indirectly, through reduced infrastructure investment where insurance cannot be procured and thus debt not secured. Ultimately, a reactive approach is not in the business interest of insurers, as it equates with market contraction.

Disaster risk financing using traditional alternative risk transfer (ART) techniques compensates for losses but does nothing to physically shield populations and assets from natural hazards. A number of recent innovative disaster risk financing tools have forged more explicit links between disaster risk financing and disaster risk management. These instruments make access to financing contingent upon engagement in disaster risk management activities. The World Bank, for example, established a contingent credit facility in 2008 with an eligibility requirement of implementation of national disaster risk management strategy; the Inter-American Development Bank (IADB) has since followed suit with a similar facility.

3 The Greening of Insurance

Driven by the potential for commercial and reputational rewards, insurer engagement in green growth themes extends well beyond increasingly definitive statements. Tracking with the perspectives of the broader climate research and policy communities, insurers have applied a variety of tools toward climate change mitigation and adaptation. Nearly 400 insurance companies from more than 50 countries have engaged in climate change adaptation and mitigation activities (Figure 4 and Appendices IV and V) (Mills 2012a). Box 3 notes early examples of activities in emerging markets.

Climate-focused insurance innovations (aside from direct investment) have been limited almost exclusively to property insurers. However, the case for engagement on the part of life/health insurers is relatively strong in emerging markets, e.g., as suggested by recent research showing that air pollution (largely related to coal burning) shortens life expectancy by 5.5 years in Northern China (Chen et al., 2013).

Modalities of Insurer Engagement in Inclusive Green Growth

Building on a solid base of experience, there is a potential for significantly increasing the insurance industry's engagement with inclusive green growth. Several major avenues exist, which can be illustrated with real-world precedents.

Extending the Availability of Insurance To Manage Risks in the Developing World

Although collecting \$72 billion per year in premiums in emerging markets, insurance penetration in these markets is far lower than in the industrialized world. The absence of insurance can deter investment and growth, particularly the riskier investments typical of many green growth markets. With a potential of \$40 billion per year in premiums, micro-insurance (which some now refer to as “inclusive insurance”) has emerged as one category of risk-transfer products appropriate for the lower-income segments of developing countries.

In some cases, insurers are working directly with governments to bolster public insurance programs. The World Food Programme (WFP), in cooperation with AXA Re, developed and pilot-tested drought insurance for the Ethiopian government. The product was designed such that in the event a drought index was exceeded, AXA would pay a pre-agreed amount to the Ethiopian government (via WFP), which would then be distributed to the impacted households (Herweijer et al., 2009).

Insurers are recognizing coverage gaps that amplify vulnerabilities to climate change. Insufficient purchasing power within small countries led the World Bank to collaborate with the Secretariat of the Pacific Community to finance an insurance pool to aggregate coverage for a set of Pacific states ((Samoa, Tonga, Vanuatu, Solomon Islands and Marshall Islands) (MacLellan 2013). The mechanism will also ensure

BOX 3: EXAMPLES OF GREEN INSURANCE IN DEVELOPING COUNTRIES

Promoting green buildings and vehicles—203 examples in the marketplace. Mileage-based insurance, with premiums paid by the mile, drivers are rewarded for reduced driving. While most products have been offered in industrialized countries, Nedbank and MiWay have done so in South Africa. Other companies (e.g., HBN Assurance in Sri Lanka) offer significant premium credits for hybrid vehicles. Green buildings products and services; Fireman’s Fund penetration 150 million square feet. Other players: ACE, Aon, Allianz, AXA, Chartis, Chubb, FM Global, The Hartford, Nationwide, Sampo Japan, The Travelers, and Zurich Financial.

Forestry projects—Obtaining carbon offsets and enhanced resilience, Tokio Marine Nichido has reforested 8,200 hectares of mangroves in Fiji, India, Indonesia, Myanmar, the Philippines, Thailand and Vietnam.

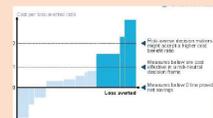
Carbon markets: CDM credits for carbon neutrality and risk services—At least 155 insurers have engaged in substantive in-house energy management projects and 28 have become carbon neutral, primarily through the use of credits obtained via developing country projects financed under the CDM. In some cases, the projects are performed directly by insurers, as done by AIG in China. Some firms offering services for carbon project risk, e.g., (upstream) project development advisory and (downstream) non-delivery insurance.

Industry-driven climate change policy and corporate governance initiatives—129 insurers; 29 countries participating in initiatives launched by UNEP, Geneva Association and ClimateWise. Emerging market members include insurers from Brazil, China, Colombia, Nigeria, South Africa and Thailand.

Participating in climate science, including next-generation climate modeling—Dozens of studies conducted. One example is analysis of outlook for torrential rainfall, wildfire, and coastal risks under climate change in collaboration with Santam (South Africa). Partners: WWF, the University of Cape Town, Council for Scientific and Industrial Research (SA), UNEP-FI.

Cost-benefit analysis of climate change adaptation projects—in one large effort, focus countries included India, Guyana, Tanzania, Mali, China and Samoa. Led by Swiss Re, partners include McKinsey, Global Environment Facility (GEF), European Commission, the Rockefeller Foundation, Climate Works, and Standard Chartered Bank.

Public-private partnerships to improve post-event liquidity and access to post-disaster finance for recovery efforts—Many examples, e.g., the Caribbean Catastrophe Risk Insurance Facility is a public-private partnership across 16 CARICOM governments provides short-term liquidity following hurricane and earthquake events while the slow process of insurance loss-estimation and claims handling is completed. Munich Re and insurers in the Philippines have teamed up to insure low-income microinsurance borrowers and associated loan portfolios against liquidity problems after major catastrophes. World Bank is helping Island states pool insurance purchasing power +120M donor funds for enhanced resilience. Lastly, an initiative with AXA and World Food Program used drought index to trigger food relief payment to Ethiopian government.



that recover funds flow more quickly than is the case with traditional disaster relief, and will be augmented with \$120 million in donor contributions for improved resilience and adaptation, allowing practical projects such as raising road elevations. Another example of this pooling approach is the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which provides

governments with immediate funds following hurricane or earthquake catastrophes.

Bes practices proactively employ techniques to physically “de-risk” a customer or an insured asset. If climate change progresses unchecked, a widespread insurability crisis can be expected in the developing world, thereby undercutting growth (green and otherwise).

Facilitating Resilience and Adaptation To Changing Weather and Climate Extremes

Insurance is a centuries-old technique for managing risks, although in modern times it has focused more on financial risk spreading than on loss prevention. Risk-based, insurance pricing also sends signals to the market that can foster less risk-taking and underscore the cost-benefit tradeoffs for risk-reduction.

The process of adapting to hazards is familiar to insurers, and is echoed in their historical involvement in the founding of fire departments, and development of building codes and auto-safety test procedures. This, coupled with use of insurance to transfer risk, makes it a relatively minor conceptual step—and one with a strong business case (Herweijer et al., 2009)—for insurers to engage in global environmental issues. Insurers with banking operations can also engage in financing client-side adaptation improvements

Insurers are in a unique position to apply highly developed loss-estimation models to estimate the costs of climate impacts on existing infrastructure, as well as the cost-benefit tradeoffs of making adaptation investments. As a case in point, insurers used their models and actuarial data to map climate risks and evaluate potential adaptation investments, finding that a \$120 billion investment in adaptation on the U.S. Gulf Coast would avoid \$200 billion in losses over the next two decades (America's Wetland Foundation and Entergy 2011). Similarly, analysis undertaken by Lloyd's of London and catastrophe modeler RMS found that insurance losses from unmitigated coastal risks could nearly double in high-risk areas under 2030s sea-level rise, or be reduced by far below current levels with concerted efforts at adaptation (Lloyd's of London 2008).

While insurers have begun to reactively adapt to rising weather-related losses by adjusting insurance prices, contract terms, and availability (Mills et al., 2006), at least 22 have sought to directly or indirectly help

customers proactively improve their physical and economic resilience to a changing climate (Appendix V). One evaluation compiled insurer efforts to enhance adaptive capacity (Surminski 2011) to flood, windstorm, hail, wildfire, rain, and mold, spanning 15 countries at scales from individual buildings to entire regions. The strategies include a mix of financial and physical risk management, and most include engagement from non-insurance entities. Canada's largest insurer (Intact) sponsored a major assessment of climate change adaptation needs, calling for active collaboration among the insurance, science, construction, and regulatory communities on efforts such as improving the construction of new homes, fortifying existing homes, and enhancing risk communication (Feltmate and Thistlewaite 2012). Recognizing the deficiencies in building code enforcement, the U.S.-based Insurance Services Office promulgates a voluntary Building Code Effectiveness Grading Scale, intended to spur reward for the development and enforcement of codes via insurance discounts or surcharges. That said, even relatively straightforward efforts to reward customers for reducing risks remain the exception rather than the rule in this industry.

Introducing Innovative Products and Services That Support Green Growth

Many insurers, primarily in the industrialized world, offer "green" insurance products that incentivize energy-efficient and renewable energy use among their customers (e.g., lower premiums for energy-efficient housing or vehicles), or fill coverage gaps that otherwise stand as barriers to development and infrastructure investment (e.g., coverage for offshore wind energy infrastructure). With one of the more long-standing offerings, the products from Fireman's Fund have been applied to 150 million square feet of commercial floor area. ACE, Aon, Allianz, AXA, Chartis, Chubb, FM Global, The Hartford, Nationwide, Sampo

Japan, The Travelers, and Zurich Financial are also among the active companies in the green buildings area. An emerging category of green insurance helps de-risk clean energy investments, e.g., via performance (aka “efficacy”) insurance or warranties for energy-efficiency and renewable energy projects. Where insurers assume these risks and apply engineering skill to preventing losses, their interests become productively aligned with the broader policy-level importance of verifiable and persistent emissions reductions. This form of risk transfer also makes it easier for innovative projects to secure financing.

In tandem with their underwriting activity, insurers have brought forward technical services in support of climate change mitigation efforts on the part of their customers. These include inspections, energy auditing, carbon accounting and risk management, technology assessments, and financing.

Some “green” technologies are advantageous in that they intrinsically align with lower-risk behavior. Progressive Insurance, for example, pioneered pay-as-you-drive products that achieve more accurate roadway accident insurance premiums by using telematics to verify actual distances driven. Driver responses to this price signal (equivalent to a \$1/gallon gas tax) could reduce U.S. driving by 8 percent (4 percent of national oil consumption), yielding consumer savings of \$50-\$60 billion per year while reducing the probability of accidents and premium cross-subsidies from those who drive little to those who drive a lot (Bordoff and Noel 2008). Ford and State Farm are collaborating on a similar offering. About 2.5 million such policies have been issued across Europe and the United States, and 7 million premium credits have been awarded to low-emission vehicles (the purchase of which is seen as a proxy for safer driving habits) by Sompo Japan and Tokio Marine and Nichido, based on the assessment that those selecting such vehicles exhibit less risky driving behaviors.

Engaging in Public Policy and Land-Use Planning Processes

For centuries, insurers have influenced public policy on issues ranging from land-use planning in flood zones to automobile safety, frequently striking agreements on the pricing of risk and the establishment of public risk management activities. As an example of the latter, insurance industry associations have supported reduced speed limits (citing co-benefits of improved fuel economy and reduced accident rates) and public transit (citing benefits of reduced vehicle use and roadway congestion and public health). Insurers have been engaged in climate policy forums since the mid-1990s, participating in every international climate negotiations meeting, in addition to national venues such as the U.S. Climate Action Partnership, in which Marsh and AIG were members. Lloyds of London is one of the more prominent voices on the international stage, identifying climate change as the industry’s number one issue and admonishing its market to take the risks more seriously (Lloyds of London 2006). Insurer advocacy has promoted proactive loss-prevention efforts and helped overcome excessive risk-taking induced by subsidized insurance and publicly financed disaster recovery.

Through engagement in discussions of flood planning and policy in the United Kingdom, the Association of British Insurers employed climate and catastrophe models to create a policy-relevant synthesis of the opportunity costs of not mitigating emissions and a window into how climate change could increase macroeconomic insurance expenditures. Given questions of insurability, the specter of complete exit from the U.K. flood insurance market was raised and then averted as government produced better flood maps and tightened land-use planning criteria. Similarly, Allstate exited the Mississippi homeowners market until building codes were improved so as to reduce hurricane risk. Insurance Australia Group has

performed precipitation modeling for local governments, enabling them to revise their long-term flood planning.

Investing in and Financing Green Growth, Resilience, and Adaptation Projects

Insurers could bring large amounts of new funds to bear on inclusive green growth projects, and have already made a strong start in devoting resources to green projects in the industrialized world. Insurers may also seek to assume some of the risks of donor investments and public finance mechanisms seeking to leverage private investment, or otherwise help address risks perceived by third-party investors (e.g., via political risk insurance). Insurer investment is discussed at length in the next section. In an example of the latter,

a recent political risk insurance policy provided \$150 million in coverage for an equity investment in a 147MW hydroelectric project in Pakistan (Insurance Journal 2013).

Insurers are recognizing that truly sustainable infrastructure is both disaster resilient and energy/water efficient. Beyond their core role in sending market signals that loss-prone activities are not sustainable, some insurers recognize instances of emissions reduction and adaptation co-benefits. Zurich Financial combines incentives for post-loss reconstruction of buildings to green standards with improved fortification to extreme weather (Patton 2008). Projects with adaptation mitigation co-benefits would thus be particularly attractive to insurers, as they generate unique revenue streams that help offset adaptation costs.

Insurance Capital for Green Growth



The need for green growth finance is enormous, pegged at \$1 trillion per year beyond current levels (Kaminker and Stewart 2012). Public funds can set good examples and provide leverage, but will provide perhaps only one-quarter to one-fifth of the investments needed (Figure 8).

The 2012 G20 Leader's Declaration mandated its Development Working Group to explore ways how to mobilize more private funds for green investments in developing countries, especially lower income countries:

"We encourage further exploration of effective mechanisms to mobilize public and private funds for inclusive green growth investment in developing countries, including through the public-private Dialogue Platform on Inclusive Green Investments."

The acute remaining need for infrastructure investment in low-carbon energy systems, combined with the current environment of low interest rates, slow growth in industrialized countries, and new constraints on the ability of banks and bond issuers to scale up their activity, suggests that clean energy is an ideal "play" for institutional investors.

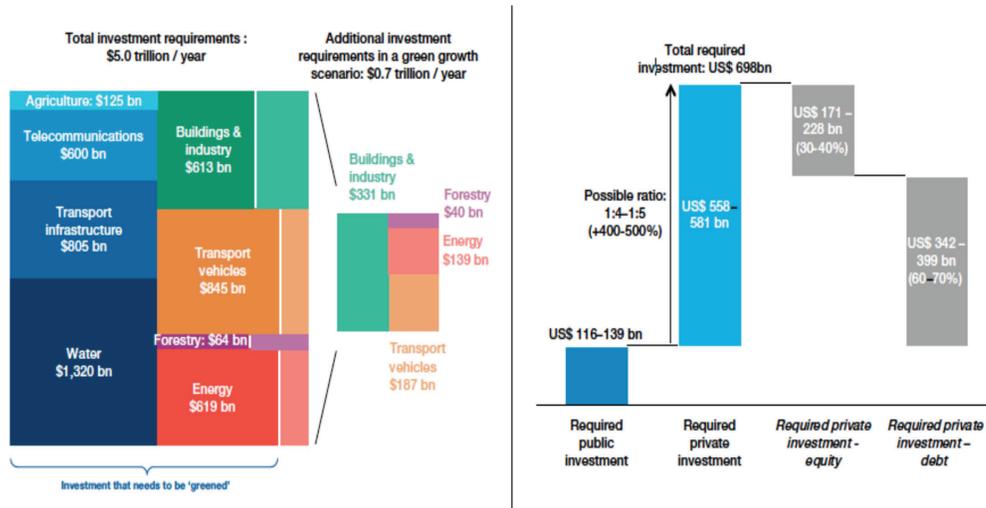
Finance and Investment

Insurers provide nearly one-third of the \$71 trillion currently managed by institutional investors globally (Figure 9). As evidence that the G20's vision for inclusive green growth may be met, the Green Insurance Data Service has identified 25 insurers that have collectively made over \$40 billion in finance and direct investments relevant to climate and environmental concerns (Figure 10; Appendix VI).⁴ Of this, \$23 billion has been directed to climate change mitigation activities. In addition, insurance companies provided asset financing in balance sheet funding and convertible/term loans in at least 29 transactions (valued at approximately \$10.8 billion between 2004 and 2011). This is coupled with an additional \$7 billion in broader social-screened investments that include but are not limited to environmental criteria. At least 31 major insurers routinely prepare environmental, social, and governance (ESG) reports.⁵

⁴ Other investments are known, but the amounts not documented.

⁵ For a list of insurer ESG reports, see <http://insurance.lbl.gov/cr-reports.html>

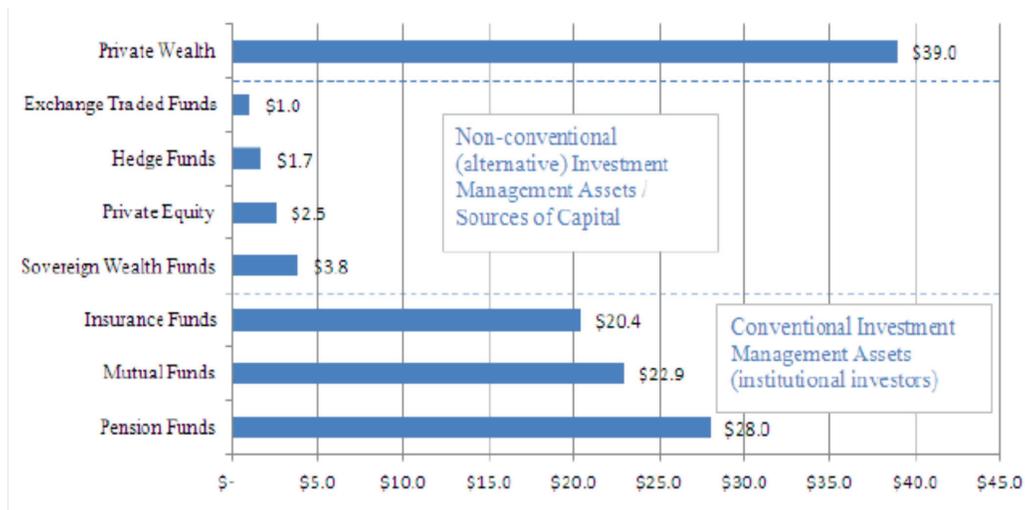
FIGURE 8: Investment Requirements to Limit Global Warming to 2°C, Compared to Business as Usual, and Sources of Finance to Close the Gap (World Economic Forum 2013)



Companies such as Allianz, Manulife, Metlife, Munich Re, and Prudential have each made billion dollar equity investments in acquisition of renewable energy production facilities. Allianz now owns 34 wind farms with a total generating capacity of 658 megawatts

plus 7 solar-electric generating facilities with a total capacity of 74 megawatts (Kaminker and Stewart 2012). In some cases, these investments are made through funds, e.g., by Aviva via the European Renewable Energy fund valued at approximately €250 million, which

FIGURE 9: Global fund management industry, assets under management, \$ trillion: 2009 (Della Croce, et al., 2011)



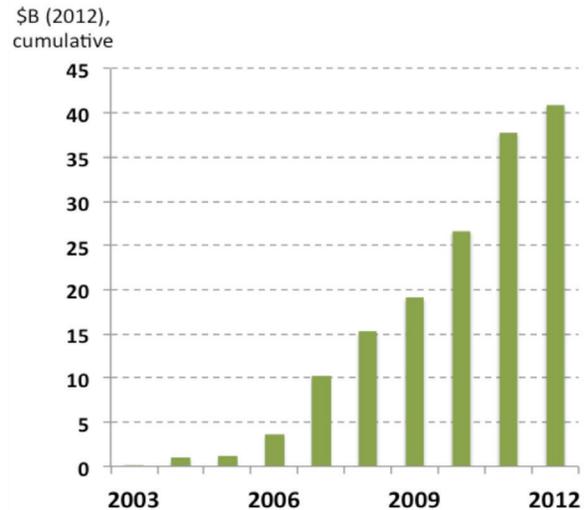
has been allocated to a full range of renewable energy projects, with funds provided by the insurer as well as from life insurance annuities, and from external investor clients (e.g., pension funds). Others such as AXA and Tryg have taken equity positions in startups developing new clean energy technologies. Many insurers, e.g., AXA and Prudential, participate in clean infrastructure projects through municipal and corporate bonds.

Insurers are also investing in energy efficiency projects in the developing world. For example, in one of its 20 such projects under development, Allianz invested in an energy-efficient lighting project in India under the Clean Development Mechanism (CDM) (Allianz 2012). The project will deploy 8.5 million compact fluorescent lamps, reducing emissions equivalent to one million German cars. Allianz will, in turn, purchase some of the resulting tradable CDM credits to offset a portion of its own corporate emissions. Allianz has also made an equity investment in project developers of forest conservation that plan to generate emissions reductions under the Reducing Emissions from Deforestation and forest Degradation (REDD) scheme.

While significant, the current level of activity may foreshadow an even greater level of investment. Munich Re is among the founders of an ambitious initiative to supply 15 percent of Europe's electricity through a \$500 billion investment in renewables across North Africa and the Middle East.⁶

Despite these strong indications of ability to invest in green infrastructure, insurers and other institutional investors traditionally allocate a small share of their resources to infrastructure projects (although more comes from bond investments). That said, with increasing emphasis on the fiduciary duty of firms to address issues such as climate change, the emergence of large gatherings of institutional investors intent on increasing such investment (e.g., the Carbon Disclosure Project (CDP),

FIGURE 10: Green finance and investment by global insurers: as of Q3 2012



United Nations Principles for Responsible Investing [UNPRI], and the Investor Network on Climate Risk (INCR) is encouraging. Unlike other institutional investors, insurers both own and manage investments.

Facilitating Investment by Other Parties

Insurers have long-standing experience in facilitating investment by third parties (e.g., via annuities). Insurers have developed or participated as founding investors in a number of green funds, the first of which was the Environmental Value Fund established by Storebrand and Scudder in the mid-1990s.

In other cases, insurers have developed risk management products to help other investors manage risk. For example, several companies (Swiss Re, Munich Re, Tokio Marine/Kiln) have offered products that respond to non-delivery of carbon credits to the European Trading

⁶ See <http://www.dii-eumena.com/home.html>.

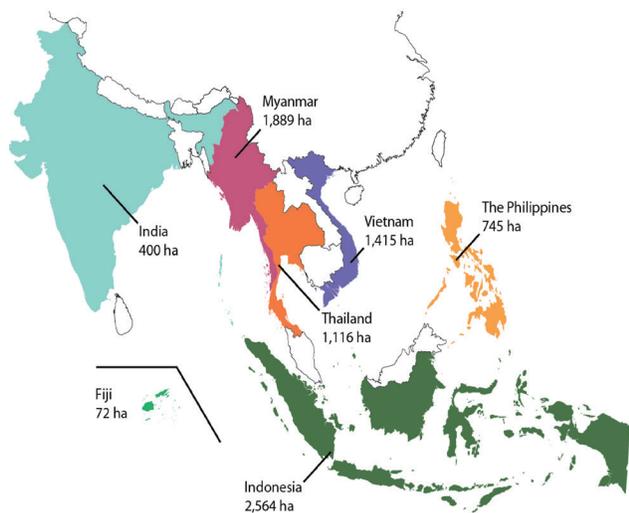
FIGURE 11: Vegetated roof on Allstate Corporate headquarters



Note: The company installed a 1,254m² (13,500ft²) vegetated roof in 2008, accessed from its cafeteria. The technology sequesters carbon, reduces water runoff, and lowers air conditioning energy requirements. <http://www.greenroofs.com/projects/pview.php?id=801>

System. These products address potential loss mechanisms ranging from the efficacy of underlying projects to political risks.

FIGURE 12: Tokio Marine Nichido's mangrove reforestation project (Mills 2012a)



“Efficacy insurance” is a particular promising product category. A significant number of insurers have launched products that respond to underperformance of energy efficiency or renewable energy projects. Geothermal energy exploration risk insurance has also been developed. Those financing renewable power or green buildings projects (e.g., under the GEF, CDM, or via development banks) can procure these insurance products to reduce financial risk throughout the project cycle (UNFCCC 2007).

Insurer In-House Greening Projects

Insurers have also invested in “green” projects in more direct ways, i.e., as part of in-house energy management efforts and programs to reduce carbon footprint or even achieve carbon neutrality. According to the Green Insurance Data Service, at least 155 insurers have engaged in substantive in-house energy management projects (Figure 11) and 28 have attained carbon neutrality (GIDS 2013). Given the sheer size of this industry, and its real estate holdings, these projects can be significant.

Insurers have also engaged in major green projects outside their own sphere of operations. A notable set of examples is embodied by AIG’s carbon-neutrality plan, under which projects involving agriculture, energy, water, and land-use management were placed in China (Box 4). In another example, Tokio Marine Nichido (Japan’s largest insurer) eliminated its corporate carbon footprint. To achieve this, it embarked on a mangrove reforestation project in 1999 (Figure 12). The project is approaching its target of just over 8,200 ha (20,265 acres) across seven countries. The company cites carbon sequestration (contributing to its own carbon neutrality since 2008) and enhanced resilience to storm damages as joint mitigation-adaptation benefits of the project.

BOX 4: AIG'S CARBON OFFSET STRATEGY FOR CARBON NEUTRALITY (MILLS 2009)

To attain carbon neutrality as part of an overarching plan to reduce emissions from its business operations, in 2008 AIG announced a portfolio of agricultural projects in China and the United States to offset 630,000 metric tons of carbon dioxide emissions, at a cost of \$4 million, or about \$6.50 per ton.

The China projects, located in the Xinjiang and Sichuan provinces, were developed by U.S.-based Environmental Defense Fund and supported and assessed by Boston-based nonprofit EcoLogic. The offsets are being registered and retired in the China Beijing Equity Exchange.

Among the most notable benefits, the China projects:

- Allow crops to be grown with lower consumption of water and fossil fuels through drip irrigation [a].
- Promote use of more efficient nitrogen fertilizers through "precision fertilizer" production. Produce bio-gas from human and agricultural wastes that will be used for cooking and lighting [b, c].
- Improve water management in rice farming and production.
- Help retain water, control dust, and reduce soil erosion through trees planted in desert lands.

In the United States, a portfolio of three projects focuses on reforestation and ecosystem enhancement.

- A project funded through Equator Environmental, LLC, in the prairie pothole region of North Dakota, South Dakota, and Montana to protect native grasslands that have been converted from marginal farmlands. This effort is registered and offsets retired in the Environmental Resources Trust, Inc. (ERT)/Winrock GHG Registry®. [d]
- A project funded through Trust for Public Land to reforest marginal cropland in the Mississippi River delta region of Louisiana. This effort also is registered and offsets retired in the GHG Registry.
- A project funded through The Conservation Fund to improve management of California harvested timberlands and to produce increased standing volume biomass. This effort is registered in the California Climate Action Registry. [e]



a



b



c



d



e

5

Pinpointing Opportunities

The insurance industry routinely marshals a versatile set of techniques that could be used to enhance efforts at inclusive green growth in the industrialized world. A high-level summary of demonstrated best practices in this regard is outlined in Box 5.

The insurance business is a combination of underwriting and asset management. Insurers' potential to finance and make direct investment in green technologies and projects is vast. Even when not acting directly, insurers are a significant resource for understanding and managing financial risks, be it through engineering methods to reduce project development and subsequent operating and performance risks, hedges against uncertain prices or weather, property insurance, or removing political risk with specialized insurance policies (UNFCCC 2007; UNEP 2009).

Importantly, the industry is not a monolith, and must be engaged in an appropriate fashion. The many thousands of direct insurance companies operate largely independently, while a vastly smaller number of reinsurers pool layers of risk from large numbers of direct insurers. An array of related firms and organizations are also essential players. These include brokers, agents, actuaries, and loss modelers. Insurance industry associations, regulators, and consumer groups also play a role. Many existing green insurance initiatives are conducted in partnership non-insurance entities such as governments, academic institutions, and nongovernmental organizations.

Table 2 more specifically illustrates how insurance considerations could be applied

to virtually every major green growth activity area, helping manage key risks of infrastructure projects; disaster preparedness, recovery, and resilience; and in commerce and financial services associated with inclusive green growth. Most efforts to date, however, have taken place in the industrialized world, and without much focus on social inclusiveness. Box 3 provides examples of activities in the developing world.

Following are some broad themes and strategies to be kept in mind.

Making Markets

Insurers must first be present in a given market and committed to expanding their operations in order to participate in broader inclusive green growth efforts. Analyses find that low insurance penetration rates (insurance per GDP) correlate with low foreign direct investment, together with the absence of a strong "rule of law" (Swiss Re 2012a). Cultural factors often apply, e.g., in the case of Muslim markets where Sharia law does not accept conventional western insurance business models. Takaful insurance has been developed for these situations, and with Islamic world assets at \$1.6 trillion, demand is on the rise (Veysey 2013b).

Risks must be sufficiently well characterized for insurers to be able to set prices and terms, and the resulting insurance products and services must then be affordable. Related barriers to wider availability and uptake of insurance include excessive risk-taking inadvertently

BOX 5: INSURANCE BEST PRACTICES FOR INCLUSIVE GREEN GROWTH

An insurer that integrates best practices into its business will implement the following 10-point strategy (Mills 2007):

1. Make concerted efforts to restore and maintain the insurability of extreme weather events. This may require partnerships with governments (e.g., in cases of improved land-use planning and enforced building codes);
2. Improve modeling and other methods of analyzing climate change risks;
3. Utilize terms and conditions to foster the right decisions by customers. This could range from rewarding risk-minimizing behavior to excluding climate change liabilities for those who make imprudent decisions either as emitters of GHGs or as managers of risks associated with climate change;
4. Develop new products and services to facilitate maximum customer utilization of climate-friendly technologies and practices, especially in cases where they yield loss prevention co-benefits;
5. Invest in strategic R&D and rebalance investment portfolios to recognize climate-related risks to investments and capitalize on climate change solutions;
6. Actively participate in carbon markets, both as an investor and risk manager;
7. Lead by example in minimizing the insurer's own "carbon footprint." This includes minimizing the climate impacts of real estate owned by the insurer, as well as the "carbon footprint" of business operations. Analyze and disclose exposures to climate change;
8. Take an active role in the education of customers about climate-related risks and opportunities for minimizing them;
9. Actively engage in public policy discussions about appropriate responses to climate change; and
10. Tighten terms and conditions, withdraw from markets, or increase insurance prices only when the aforementioned best practices have first been exercised to their full cost-effective potential.

caused by other actors, legal systems that inadequately enforce contracts, and regulation of pricing that doesn't reflect both true risk levels and affordability. Only through public-private collaborations can this process be optimized.

Insurers can clearly offer a spectrum of green innovations relevant to inclusive green growth. However, there is no market without buyers. Major users of insurance in association with green growth infrastructure projects can use "market-pull" techniques to foster introduction and speed the scale-up of green insurance products in developing countries. They can also mandate or otherwise incentivize best practices in terms of resilience in the projects they fund. Similarly, public-sector deployment programs may find use for insurance products such as agricultural micro-insurance coupled with enhanced resilience or product warranties (backed by insurers) for emerging technologies where private market offerings are in a

nascent and uncertain stage of development (e.g., off-grid lighting products being promoted by the World Bank's Lighting Africa program and UNEP's en.lighten program).

Intra-Industry Transfer of Best Practices

There is considerable scope for insurers from more advanced markets to engage in relevant technology transfer and capacity building.

Insurers have organized within several global initiatives to develop and share information within their industry and with the broader market and policy community (under ClimateWise, the Geneva Association, and UNEP) (Mills 2012a). Participation in these initiatives by insurers domiciled in developing countries could be improved.

Enhanced Availability and Affordability of Insurance

Economic growth cannot fully manifest without insurance or analogous risk transfer and risk management mechanisms. Third parties providing upstream corporate finance to newer and smaller insurance market entrants could usefully focus on those companies.⁷ Conversely, investor assessments of candidates should benchmark the subject firm's positioning to contribute to green growth as well as its vulnerabilities to climate change and other consequences of environmental degradation.

For inclusive green growth, consumers and microenterprises at the lower end of the economic spectrum must be served. An already widespread market of micro-insurance, predicated on inclusive principals, has the potential for \$40 billion per year in premiums (Swiss Re 2010).

On the one hand, risk-based pricing is essential in order to compel rational decision-making, minimize mal-adaptation and risk-taking, and maximize the adoption of loss prevention techniques. Premiums that are subsidized, or cross-subsidized (e.g., diverse risks pooled into an "average price" situation, distort market signals. On the other hand, a rush toward risk-based pricing, particularly under climate change and with insufficient attention to enhanced resilience, could create a palpable crisis of insurance affordability. Interested intermediaries, such as development agencies, may look for ways to buy down insured costs such as premiums or deductibles. This sort of financial support could even be directed at the incremental costs of green insurance.

To accelerate the introduction of green insurance in emerging markets, public entities and offshore investors could lead by example. This would take the form of voluntary purchase of green insurance for the projects they finance or otherwise oversee.

Public entities may also opt to provide insurance where the private market deems the

risks uninsurable. This has wide precedent in the industrialized world, e.g., for nuclear power, terrorism, flood, and crop risks. While these interventions are often couched in the terms of insurance, they are in practice not always based on strict insurance/actuarial principals.

Improved Hazard Detection, Characterization, and Models

Baseline data on catastrophe loss costs are lacking even in developed countries (Pendleton *et al.*, 2013). Insurers play a critical role in collecting and analyzing such information, and improvements are particularly needed in the developing world.

Insurers are already bringing "risk-detection" technology (e.g., via remote sensing) into developing countries for the purposes of identifying triggers for paying micro-insurance claims to farmers.

In one example of areas where best practices could be more widely disseminated, insurers have worked for decades to develop data and loss models to help pinpoint and manage risks. While these models are relatively well established in industrialized countries, they are often non-existent or very primitive in developing countries (Hall 2013). Data incompleteness and bias are also of particular concern in developing country settings (Corona 2013). Closing this gap can mitigate informational market failures, making uninsurable risks insurable, while helping manage pricing, which will inevitably be higher where risks are not well characterized. Recently, these have been adapted to understanding emerging risks associated with climate change.

Engagement of the allied industry of catastrophe ("Cat") modelers is essential. These

⁷ An example is LeapFrog Investments, which provides venture capital for microinsurance companies. <http://www.leapfroginvest.com>.

TABLE 2: Demonstrated insurance strategies for managing risks associated with inclusive green growth projects

Sectors & activities	Risks potentially mitigated	Demonstrated strategies for insurer engagement
Infrastructure		
Residential and non-residential built infrastructure	Physical damages and losses	<ul style="list-style-type: none"> Conventional insurance Micro-insurance for poorer segments
Commercial and industrial infrastructure	Physical damages and losses Losses arising from supply chain issues and other triggers of business interruptions	<ul style="list-style-type: none"> Conventional insurance Micro-insurance for poorer segments
Transportation	Urban air pollution, congestion	<ul style="list-style-type: none"> Conventional vehicle insurance
Water	Availability; quality	<ul style="list-style-type: none"> Risk-management re: role of water in business continuity and health
Food security	Drought, pestilence, loss of soil carbon	<ul style="list-style-type: none"> Conventional crop insurance (public or private) Microinsurance for poorer farmers Risk-management assessments and risk-mapping services
Forestry	Wildfire	<ul style="list-style-type: none"> Standing timber insurance products
Public health	Infectious diseases, consequences of eroded water quality, air pollution	<ul style="list-style-type: none"> Health insurance Health micro-insurance for lowest-income groups
Energy		
Renewable Generation	Shortfall in performance and associated revenues	<ul style="list-style-type: none"> Output efficacy insurance Technology warranty enhancement products Engineered risk-management services for proper design, construction, and operation
Residential, commercial, industrial energy end-use efficiency		<ul style="list-style-type: none"> Betterment clauses (upgrade-to-green following loss) Energy savings efficacy insurance Technology warranty enhancement products Engineered risk-management services for proper design, construction, and operation
Transportation		<ul style="list-style-type: none"> Differentiated insurance premiums for low-emission vehicles Mileage-based premiums for all vehicle types Public policy interventions for speed limits, public transportation, etc
Disaster preparedness, recovery, resilience		
Coastal protection	Storm surge, gradual erosion, salt water intrusion	<ul style="list-style-type: none"> Ecosystem-enhancement projects (e.g. mangrove reforestation) Conventional property insurance Microinsurance for lowest-income consumers and businesses Risk-differentiated premiums to discourage maladaptation or other tendencies to develop in harm's way
Buildings	Natural disaster damages	<ul style="list-style-type: none"> Differential insurance premiums, services, guidelines for resilience Advocacy for improved building codes Business continuity and supply chain risk assessment and risk services Betterment endorsements to ensure post-event reconstruction to higher level of "green" and loss-resilience
Food and food security	Crop damages	<ul style="list-style-type: none"> Risk-mitigation services
Modeling	Inadequacy of present models to inform essential planning decisions	<ul style="list-style-type: none"> Best-in-class loss models. Improved models allow for insurance underwriting, enhancing insurance availability and optimal pricing

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(continued)

TABLE 2: Demonstrated insurance strategies for managing risks associated with inclusive green growth projects

Sectors & activities	Risks potentially mitigated	Demonstrated strategies for insurer engagement
Commerce and financial services		
Employment	Underemployment	<ul style="list-style-type: none"> ■ Insurers are a major employer ■ Growth of insurance and allied industries creates a variety of job types (agents, brokers, inspectors, underwriters, financial specialists, regulators)
Investment	Inadequate capital	<ul style="list-style-type: none"> ■ Insurer investment in green-growth-related projects
Finance	Inadequate financing	<ul style="list-style-type: none"> ■ Insurer financing in green-growth-related projects
Emissions reductions	Loss of persistence (eroded energy savings, forest destruction, etc.)	<ul style="list-style-type: none"> ■ Performance-based insurance products ■ Insurer-provided risk management services for inventorying and maintaining carbon-reduction projects
Political risk	Expropriation of green technology assets or property constituting the basis of carbon credits owned/financed by foreign entities	<ul style="list-style-type: none"> ■ Political-risk insurance products

models also enable insurers to make pricing more risk-based, thereby encouraging and rewarding resiliency in planning. Models should also capture instances in which resilience and green growth work synergistically. Disparate efforts have been made to incorporate sustainability considerations, such as those associated with climate change, into insurance models (Mills 2007; Mills 2009).

Access to detailed, reliable data on exposures underpins the entry of insurers in a market, and their ability to maintain availability and affordability. Insurers and non-insurer stakeholders can each play a role in collecting and mobilizing this information.

Responsive Policy and Regulatory Environments

The policy and regulatory environments clearly shape insurers' ability to engage in business generally, and green growth in particular. Regulators are often in the position of approving new insurance products and services. Insurance think tanks recognize "systemic risks" as being of particular concern, and advocate policy interventions (Geneva Association 2013). While normally viewed as financial in nature

(witness the current protracted global economic crisis), insurers have also counted climate change among the systemic risks.

The ability for insurance markets to function is contingent on the presence and enforcement of contract law, control of corruption, and other factors.

Direct regulation of insurance plays a key role, both in underwriting practices and in asset management. Ideally, regulators and rating agencies will not stifle innovations that will contribute to inclusive green growth, but, rather, will support it (Mills 2007). Innovative products and services must be given careful consideration by regulators and not dismissed out of hand. The "Solvency II" regulations (anticipated to go into force 1 January 2014) will likely call for greater capital reserves than at present for riskier and/or unlisted investments. Since the perception of systemic risks drives such regulations and concern by parties such as the G20, it is critical that assessments of insurers' vulnerability—as individual companies, and as an industry—incorporate considerations of their exposure to climate risks, together with steps taken to reduce those risks.

Regulated insurance premiums are also a concern. As previously noted, if insurers perceive that prices inadequately reflect risks, they

will shy away from markets. This is of course a material concern under climate change, given that insurance rate-setting is often based on historic losses as opposed to projections of future losses. The broader energy and development policy environments can enhance or detract from insurer engagement; the latter case can apply, for example, where there is no price on carbon or other forms of uncertainty or risk of policy reversals. Thus, agents of inclusive green growth may find it prudent to engage with insurance regulators.

Maximizing the Value of Public Insurance Systems

In the developing and industrialized worlds alike, the public sector often finds itself in the role of insurer, sometimes on its own in the case of risks deemed commercially uninsurable, or as a backstop insurer of last resort where the private market is not willing to assume the full extent of a risk. In either case, the aforementioned green insurance concepts fully apply. Private insurance thought leaders could be engaged to help transfer their methodologies to public insurers in developing countries. This is needed, even in the industrialized world, as pointed out recently by a U.S. Congressman, Rep. Matt Cartwright (Lehmann 2013):

"...[L]ook, our country is acting as an insurance company," ... "We have flood insurance. We have FEMA bailing out natural disasters constantly. And ... every insurance company in business engages in actuarial science [and] makes an assessment of what its potential liabilities are. We don't do that. That's crazy."

After Hurricane Sandy threatened the underlying solvency of the U.S. National Flood

Insurance Program (as had Hurricane Katrina just a few years before), public insurers took the politically unpopular step of making terms more risk-based. This included requirements that homes in at-risk areas be raised, or face steeply increasing insurance rates (*ClimateWire* 2013).

Public insurance entities (particularly common in the case of crop and flood risks) can fruitfully engage with leading green insurers in an effort to transfer best practices from the private to public spheres. The Caribbean Catastrophe Risk Insurance Facility is an example of government-operated mechanism created in close cooperation with private insurers.

Public-Private Partnerships

Many risks are beyond the control of insurers. Subsidized disaster insurance, coupled with disaster relief for those opting out of the commercial insurance system (or commercial insurers exiting markets), is a widely noted example. Properly conceived, this type of risk sharing is of benefit to all parties.

Insurers are particularly wary, however, when governments support policies that lead to maladaptation and moral hazard. Distortions created by insurance taxes have been noted to create barriers to climate change adaptation in Australia (Productivity Commission 2012). Similarly, policy uncertainty (e.g., lack of resolve on electricity feed-in tariffs) creates material financial risk for insurers or other private investors contemplating engagement in renewable energy projects. Policymakers must make a place at the table where matters potentially adversely affecting insurers are discussed.

It will increasingly be prudent for private entities, e.g., real-estate developers to proactively engage with insurers in order to understand trends that may erode the value and/or insurability of their projects (Herweijer et al., 2008).

In many cases, collaboration of private insurers, other private concerns, and public entities will thus be essential to success of inclusive green growth projects. In the words of the Geneva Association, an insurance industry think tank:

“With regard to climate risk and providing greater resilience against natural disasters, improved private-public cooperation could truly harness the insurance industry’s usefulness as a risk management tool in better preparing for and responding to mega-events, thereby mitigating the resulting human, social and economic loss.” (Grant 2012)

A key precedent is insurer engagement in the establishment or improvement of building codes and land-use planning decisions.

* * *

The potentially holistic breadth of insurer engagement is consistent with urgings by the African Development Bank and others to approach inclusive green growth in a cross-sector, integrated manner rather than a piecemeal project-by-project fashion (AfDB 2012). Best-practice insurer involvement could reinforce the proper valuation of otherwise unrecognized constructive linkages among diverse development projects. For example, the value added by forestry projects that improve soil management and erosion control could be reflected in reduced premiums at risk of flooding and mudslides. Similarly, value added to public health by projects that improve water availability and quality could be reflected in preferential pricing of health or crop insurance or micro-insurance. Many other examples can be imagined. One opportunity area is to augment traditional

micro-insurance offerings that merely spread risk to include an explicit physical adaptation component. Incentives could include better terms and conditions where there is a simultaneous effort at adaptation, affecting improved practices as a condition of claims payment, or limiting product availability to circumstances where there is associated adaptation effort.

Insurers have demonstrated their concern about global climate change, and their desire to mobilize market-based strategies to understand and mitigate those risks. Virtually all green growth projects could benefit from the risk assessment and risk management perspective that insurers bring. The World Bank, for example, has long recognized that climate change can present new risks to infrastructure investments (Burton and van Aalst 1999). Where there are losses due to climate and weather extremes, insurers paying those claims can promote betterment at the time of reconstruction so as to enhance both ‘greenness’ and disaster resilience—true sustainability. Engagement may also take the form of lobbying for improved building codes or land-use planning.

While insurers’ outward-facing role is to manage risks for their customers, they must also do so internally. Developing markets are the most risky markets in which they operate: physically and politically. Public sector entities and organizations seeking insurer engagement can take steps to mitigate these risks.

If barriers to constructive engagement by insurers can be alleviated and opportunities grasped, green growth will yield more and better infrastructure, translating to more premium volume for insurers. Engaging insurers proactively in inclusive green growth requires a hospitable political environment and the ability to earn a return on investment, be it in the form of green insurance products and services or direct finance of green infrastructure.

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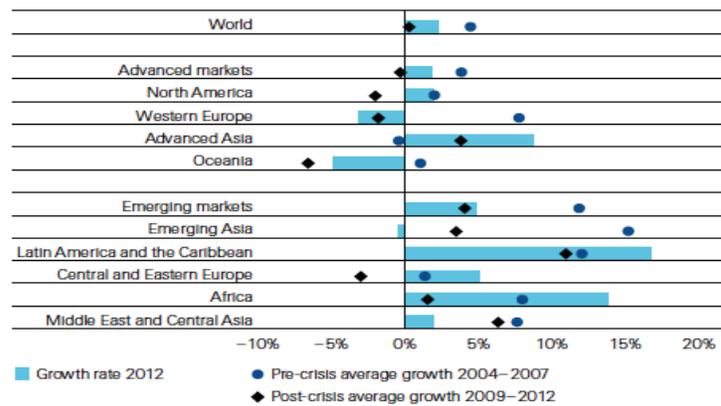
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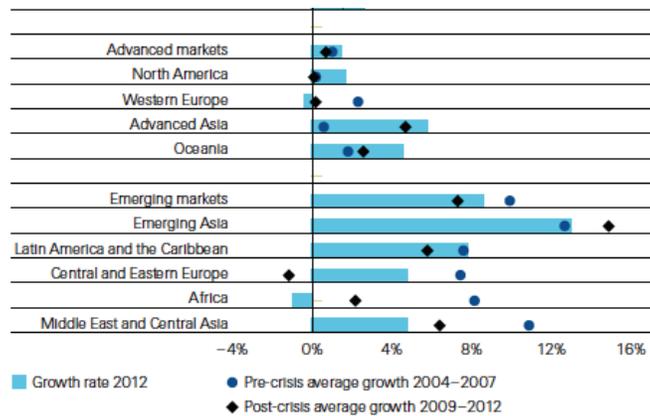
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Appendices

APPENDIX I: Statistical Overview of Insurance in Emerging Markets (top: Life; bottom: Property/Casualty). (Swiss Re 2013)



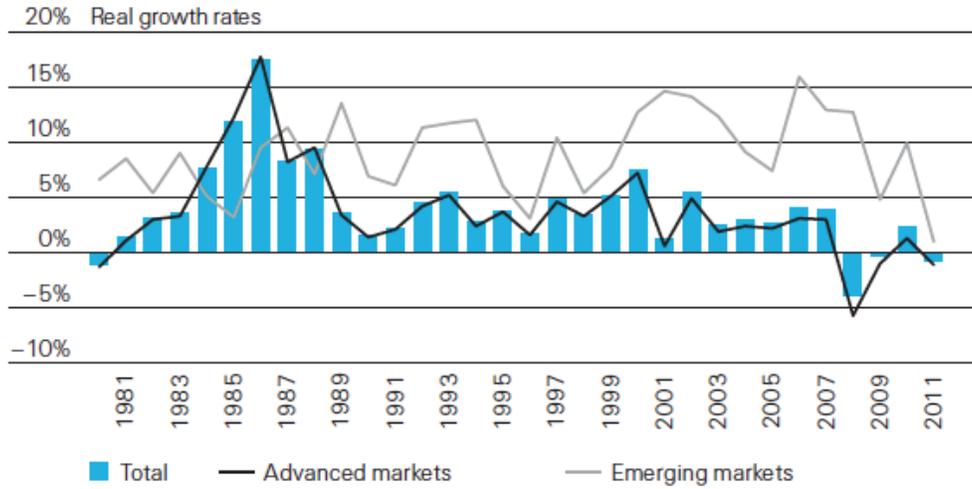
Source: Swiss Re Economic Research & Consulting.



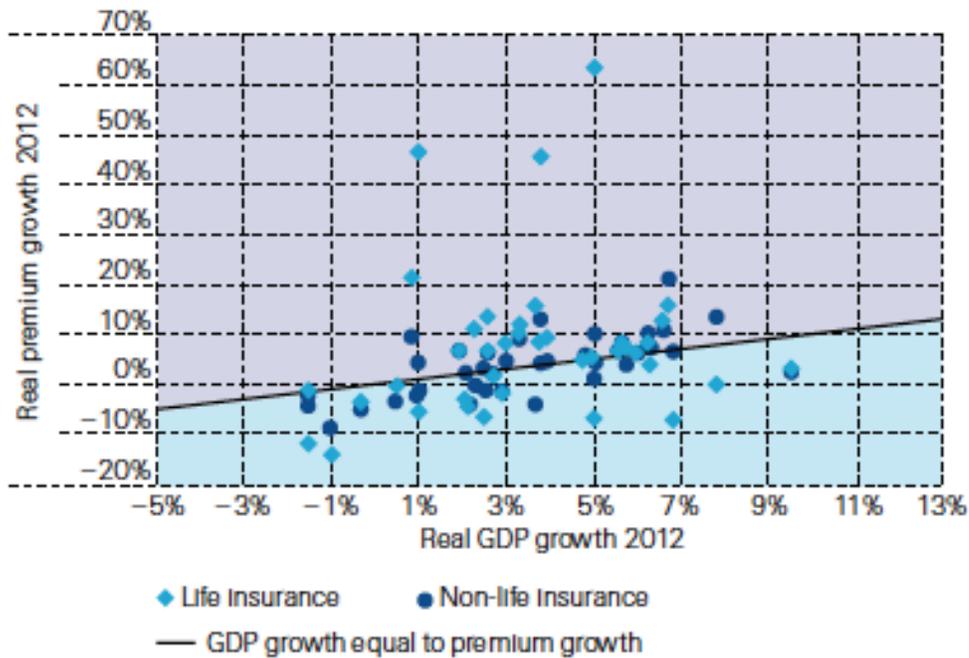
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APPENDIX I: Statistical Overview of Insurance in Emerging Markets (top: Life; bottom: Property/Casualty). (Swiss Re 2013) (continued)



Source: Swiss Re Economic Research & Consulting.



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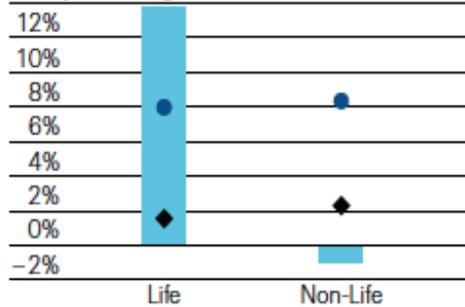
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APPENDIX I: Statistical Overview of Insurance in Emerging Markets (top: Life; bottom: Property/Casualty).
(Swiss Re 2013) (continued)

Premiums in 2012 in Africa

	USD bn	World market share
Life	50	1.9%
Non-life	22	1.1%

Real premium growth

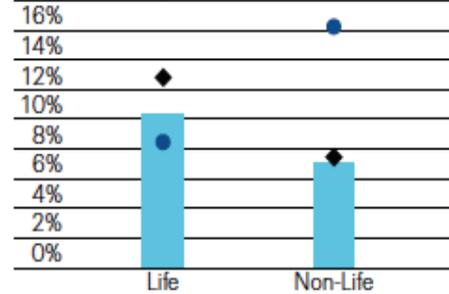


- Growth rate 2012
- Pre-crisis average growth 2004–2007
- ◆ Post-crisis average growth 2009–2012

Premiums in 2012 in the emerging Middle East Central Asia, and Turkey

	USD bn	World market share
Life	5	0.2%
Non-life	35	1.7%

Real premium growth

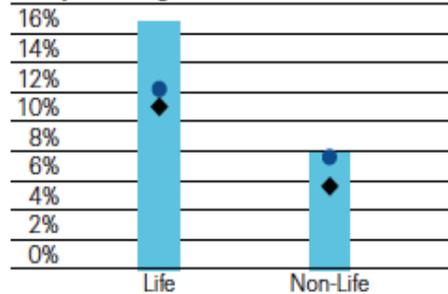


- Growth rate 2012
- Pre-crisis average growth 2004–2007
- ◆ Post-crisis average growth 2009–2012

Premiums in 2012 in Latin America

	USD bn	World market share
Life	72	2.7%
Non-life	97	4.9%

Real premium growth

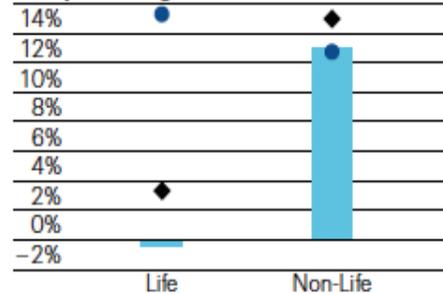


- Growth rate 2012
- Pre-crisis average growth 2004–2007
- ◆ Post-crisis average growth 2009–2012

Premiums in 2012 in emerging Asia

	USD bn	World market share
Life	231	8.8%
Non-life	139	7.0%

Real premium growth

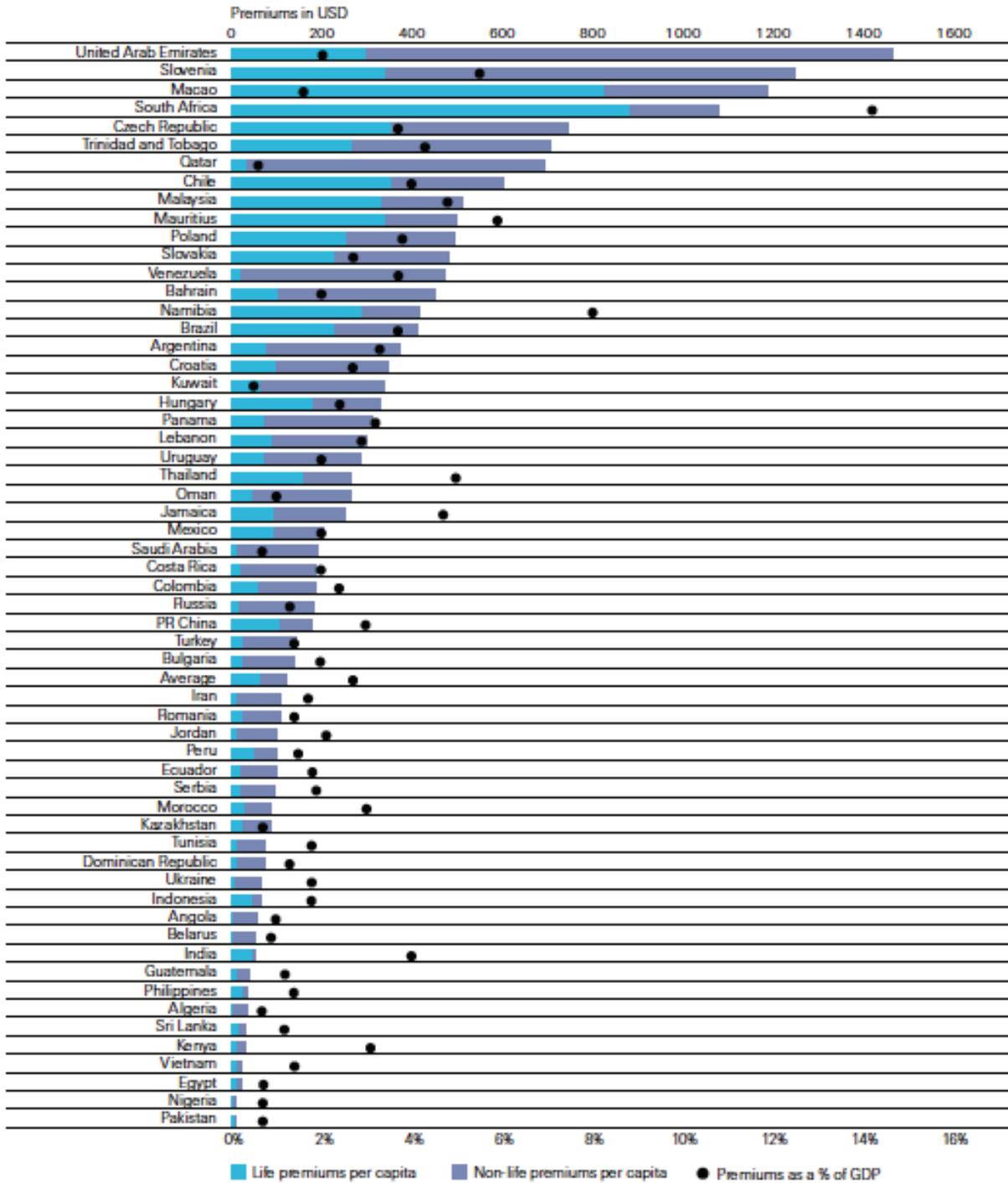


- Growth rate 2012
- Pre-crisis average growth 2004–2007
- ◆ Post-crisis average growth 2009–2012

(continued on next page)

APPENDIX I: Statistical Overview of Insurance in Emerging Markets (top: Life; bottom: Property/Casualty). (Swiss Re 2013) (continued)

Insurance density and penetration in emerging markets in 2012



Source: Swiss Re Economic Research & Consulting.

Appendix II: Alternative Risk Transfer (ART) Strategies and Definitions

Captive Insurance – Captive insurance companies are formed by firms to receive premiums internally and thereby prefund potential losses. The practice is often referred to as self-insurance.

Catastrophe Bonds – Typically sold by insurers to investors, “Cat bonds” are a class of insurance-linked security. If the underwritten catastrophe event (life or property) occurs, the investor loses its principal, which shifts to the issuing insurer or reinsurer and used to pay claims. If no event occurs, an attractive rate of return is earned. Contracts and trigger definitions can be complex, and can apply to single events or any events occurring over a period of time (e.g., one year).

Catastrophe Equity Put Options – Insurers sell these options on the financial markets, which enable them to sell their stock at an agreed upon price in the event of a catastrophe. Proceeds reduce the need to liquidate assets at “fire-sale” prices to pay claims.

Catastrophe Options – Options exchanges sell options which compensate insurers if aggregate industry losses for a given region fall within an agreed upon range.

Catastrophe Risk Equity Puts – Cat-E-Puts are not asset-backed securities, but options. In return for a premium paid to the writer of the option, the insurer obtains the option to issue preferred stock at a pre-agreed price on the occurrence of a contingent event. This enables the insurer to raise equity capital at a favorable price after a catastrophe, when its stock price is likely to be depressed. Because they are not collateralized, these securities expose the insurer to counterparty performance

risk. Issuing the preferred stock can dilute the value of the firm’s existing shares.

Catastrophe Risk Swaps – Catastrophe swaps can be executed between two firms with exposure to different types of catastrophic risk. Swaps are facilitated by the Catastrophic Risk Exchange (CATEX), a Web-based exchange where insurers and reinsurers can arrange reinsurance contracts and swap transactions, and is used by the Caribbean Catastrophe Reinsurance Facility. If the paired events have equal risk, funds only change hands in the event of a triggering event.

Contingent Surplus Notes – Insurers typically have difficulty borrowing money to cover excess claims in the event of a disaster. With a CSN, an insurer establishes a trust which issues notes paying a premium yield (y) to a limited group of investors. To pay the interest, the CSN trust invests the proceeds in stable, fixed income securities earning a lower yield (x) while the insurer makes up the difference ($y-x$). If an agreed upon disaster strikes, the insurer can claim the trust assets and is then responsible for paying the entire interest (y) and principal, over an agreed upon period of time. The premium interest rate (y) is notably lower than what an insurer could get from borrowers following a disaster.

Extreme Mortality Securitization – Transfers “peak mortality risks” to capital markets, analogous to CAT bonds for property losses in the event of extreme mortality events.

Industry Loss Warranties – A form of reinsurance or derivative contract through which an entity (often an insurer) receives a capped payout based on the aggregate insured loss experienced by the industry rather than its own losses from a specified event.

Sidecars – Sidecars are special-purpose vehicles (off-balance-sheet, with extra premiums) formed by insurance and reinsurance companies, usually for property catastrophes and marine risks. Most sidecars are capitalized by private investors such as hedge funds. In addition to providing capacity, sidecars also enable the sponsoring reinsurer to move some of its risks off-balance-sheet, thus improving leverage.

Value-in-Force Securitization – Monetizing the estimated future profits of a portfolio of insurance policies.

Weather Derivatives – A put- or call-hedge for adverse weather, in the context of risks such as those associated with event cancellation, energy production or costs, or crop yields. They are activated when a pre-negotiated trigger is reached, such as a level of degree days, temperature, and rainfall. Enron was among the early popularizers of weather derivatives.

Note: This list is indicative of an even broader array of related products.

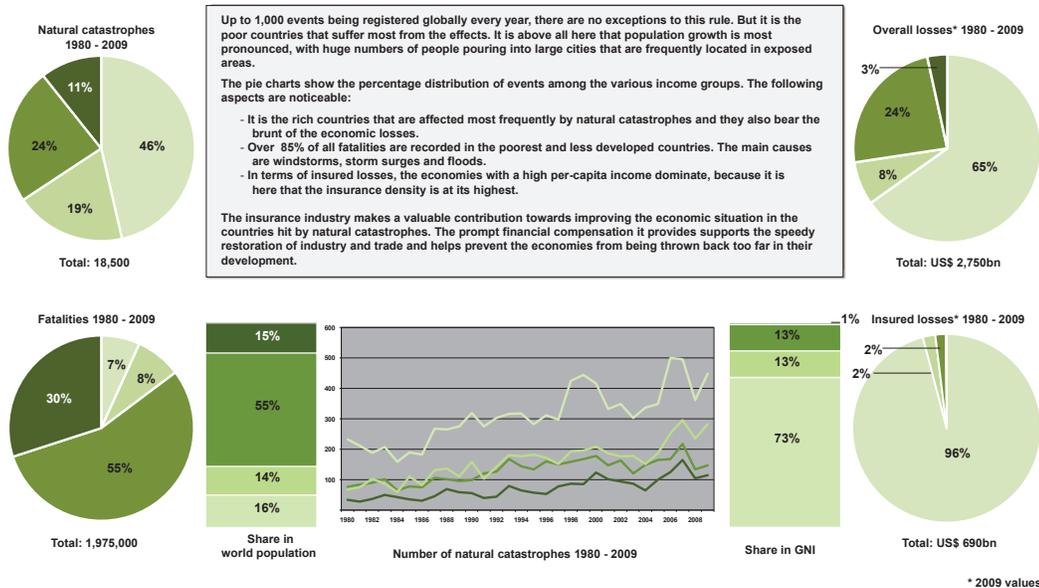
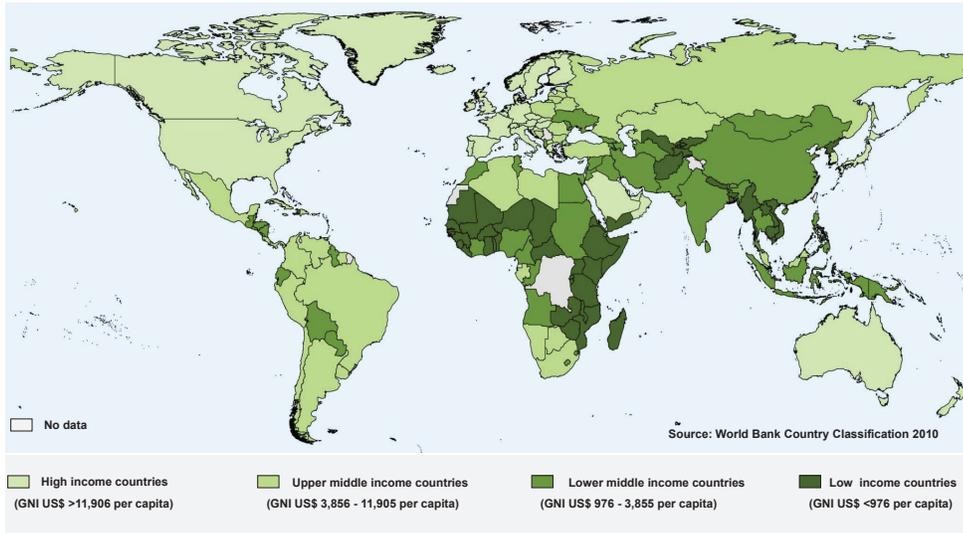
Sources: Boucher (2009), Cumins (2012), Mills, et al., (2001), RMS (2012), and http://www.artemis.bm/deal_directory/

APPENDIX III: Trends in Global Natural Catastrophe Events, by Income Group



Natural catastrophes in differently developed economies

Classification of the world economies defined by world bank



Appendix IV: Framework: Insurer Engagement in Climate Change Responses

Commitment to a comprehensive response:

Defined by participation in the ClimateWise group, UNEP Finance Initiative, and/or Kyoto Statement of the Geneva Association. The terms of the associated agreements are characterized by a commitment to addressing climate change that stretches across the insurance enterprise, from products to investment to corporate governance. Participating companies are listed in table S1. Participation signals a systematic (rather than piecemeal) approach, coupled with a willingness to make that commitment public. In the case of ClimateWise, participants also agree to annual reporting and independent audits of compliance.

Engaging in climate science and communications:

Defined by the funding or conduct of research on climate change, and the presentation of climate science to stakeholders. Includes analyses of historical data, forward-looking modeling, field-based research, and integrated assessments.

Promoting loss prevention and adaptation:

Defined by customer-focused activities or inducements to advance the state of the art in weather—and climate-related disaster resilience generally, and climate change adaptation in particular.

Aligning terms and conditions with risk-reducing behavior:

Defined by activities that simultaneously reduce the risk of insured losses while contributing to climate change mitigation. A prominent example is mileage-based insurance, which provides discounted premiums for reduced driving to lower the probability of roadway accidents as well as emissions of greenhouse gases from vehicles.

Crafting innovative insurance products:

Defined by insurance contracts and provisions that remove barriers to adoption of climate change mitigation practices (e.g., energy efficiency or renewable energy) on the part of insurance customers, often proactively incentivizing better practices (e.g., by differentiating premiums for hybrid vehicles or green buildings). Includes new products that fill coverage gaps, e.g., microinsurance for weather-related hazards in developing countries.

Providing technical services:

Defined by engineering or financial services offered to customers to identify and manage risks associated with climate change responses or otherwise assist in the implementation of improved practices. Examples include energy audits, carbon footprint accounting, and adaptation cost benefit assessments.

Offering carbon risk management or offsets:

Defined by products that assist customers in managing risks associated with carbon-reducing projects, including risks of associated financial transactions such as carbon trading. In some cases, insurers couple emission offsets with their core products, e.g., vehicle emissions offsets with auto insurance.

Financing customer projects:

Defined by insurers offering debt financing to customers or other entities for climate change mitigation or adaptation projects.

Investing in climate change mitigation:

Defined by direct investment in climate change mitigation projects, e.g., an equity stake in a wind power development or a company manufacturing an energy-efficient technology. Also includes investments in funds by using selective environmental screening processes that incorporate climate change factors. In some cases, insurers are disinvesting in companies with risky environmental practices.

Building awareness and participating in public policy: Defined by specific activities to improve understanding of climate change among policy-makers. Examples include participation in climate change negotiations, engagement in efforts to reform land-use planning to proactively anticipate sea level rise, or promotion of building codes that improve disaster resilience or energy efficiency.

Leading by example: In-house carbon management: Defined by specific activities to

reduce the carbon footprint of insurers' internal operations (buildings, business travel, computing, and supply chains). For inclusion, a threshold level of activity is required, beyond highly routine activities such as "using energy-efficient light bulbs."

Disclosing climate risks: Defined by responding to climate risk disclosure requests from the CDP, F& Investments, or the U.S. Securities and Exchange Commission (SEC).

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