

Exploiting International  
Financial Markets  
to Manage Natural Hazard Risks  
in Latin America

Ivar Pettersen  
John Magne Skjelvik  
Nils Atle Krokeide

**Inter-American Development Bank**

Washington, D.C.

**Sustainable Development Department  
Technical Papers Series**

**Cataloging-in-Publication provided by the  
Inter-American Development Bank  
Felipe Herrera Library**

Pettersen, Ivar.

Exploiting international financial markets to manage natural hazard risks in Latin America / Ivar Pettersen, John Magne Skjelvik, Nils Atle Krokeide.

p.cm. (Sustainable Development Department Technical papers series ; ENV-146)  
Includes bibliographical references.

1. Emergency management—Latin America—Finance. 2. Capital market—Latin America. 3. Risk—Latin America. I. Skjelvik, John Magne. II. Krokeide, Nils Atle. III. Inter-American Development Bank. Sustainable Development Dept. Environmental Division. IV. Title. V. Series.

363.348 P341—dc22

Ivar Pettersen is General Director of the Norwegian Agricultural Economics Research Institute, and was previously a partner at ECON-Centre for Economic Analysis, where he was involved with agriculture and international development research. John Magne Skjelvik works at the ECON Oslo office. Nils Atle Krokeide, also associated with ECON, is owner/partner of consulting companies in Norway and Slovakia.

The El Salvador case study was conducted by the Escuela Superior de Economía y Negocios in San Salvador, under the supervision of Director General Rafael Barraza. Mr. Armen Kouyoumdjian, an independent national consultant, prepared the Chilean case. The study for Peru was carried out by Marco A. Gonzalez, José E. Salazar and E. Rafael Sánchez from Finanzas Ambientales, Lima, Peru.

This report was reviewed by Torben J. Andersen, Copenhagen Business School, and Stuart Miller of the London School of Economics. The paper was discussed at a Disaster Risk Finance Seminar held on September 9, 2004, at the IDB in Washington, DC, with approximately 40 participants. In addition, preliminary draft reports of the three country studies were discussed in workshops held with national authorities and private sector representatives in Chile, Peru and El Salvador, as well as with the IDB in Washington, DC in 2003. At the IDB, Kari Keipi supervised the work together with Edgardo Demaestri. Kim Staking, Caroline Clarke and Niels Holm-Nielsen commented on the paper in its different phases of preparation. Lisa Levine, a consultant, edited the document.

The opinions expressed herein are those of the authors and do not necessarily reflect the official position of the Inter-American Development Bank. Permission is granted to reproduce this paper in whole or in part for noncommercial purposes only and with proper attribution to the authors, the Sustainable Development Department and the Inter-American Development Bank.

December, 2005

This publication (Reference No. ENV-146) can be obtained from:

Environment Division  
Sustainable Development Department  
1300 New York Avenue, N.W.  
Washington, D.C. 20577

Email: [infoenv@iadb.org](mailto:infoenv@iadb.org)  
Fax: 202-623-1786  
Web site: [www.iadb.org/sds/env](http://www.iadb.org/sds/env)

# Foreword

Natural hazards present important challenges for the attainment of the social and economic development goals of the countries in Latin America. The costs of disasters are increasing and exacerbated by a regional underinvestment in prevention and mitigation, and the lack of financial protection strategies. Post-disaster financing of damage creates a serious drag on development, contributing often also to greater vulnerability to future events. Policymakers in the region recognize that their economies may be seriously affected because post-disaster investments for reconstruction may cause increased indebtedness, potentially higher inflation, and dampened investment in important geographical areas and sectors not included in reconstruction. Post-disaster borrowing causes development priorities such as poverty reduction efforts, public health, education, and other social goals to be sacrificed.

Some countries in Latin America and the Caribbean have established specific financial protection strategies to meet disaster-related expenditures. Financial instruments are available to meet hazard losses. They include budgetary transfers, use of reserve funds, contingent credit and insurance. More advanced techniques such as catastrophe bonds, weather derivatives, and index-based (parametric) insurance are not yet widely used to manage disaster risk in the region, but are receiving increased interest.

This technical paper analyzes the potential practical application of financial instruments for natural hazard risk finance and transfer in Latin America. The study first presents an overview of the role of financing and risk transfer in disaster risk management. It then investigates the sources of natural hazard risk and presents use of financial instruments for managing risk for the cases of Chile, El Salvador and Peru. The document also discusses the role donors and multilateral development banks should have in supporting disaster risk financing in the region.

This publication follows the path outlined in the Action Plans of 2000 and 2005 for Disaster Risk Management. It will create awareness in the Bank and among its member countries, of the opportunities for risk financing and transfer involving both public and private sectors, particularly in Chile, El Salvador and Peru. We hope that the publication will be useful to officials from ministries with responsibilities in areas such as finance, planning and civil protection as well as to Bank staff working in disaster risk management to support the development strategies of its borrowing member countries.

Janine Ferretti  
Chief  
Environment Division

Pietro Masci  
Chief  
Infrastructure and Financial Markets Division

# Contents

Executive Summary	1
Introduction	5
Financial Aspects of Natural Hazard Risks	7
Practical Steps Toward Improved Financing of Natural Hazard Risks	15
Risk Assessment and Risk Financing in Chile, El Salvador and Peru	36
Conclusions	49
References	52

# Executive Summary

## **The Importance of Financing for Risk Management**

Natural hazards have significantly disrupted socioeconomic development in Latin America and the Caribbean over the past 30 years, with yearly loss estimates in the order of US\$3.8 million. Financial protection helps improve resilience against social and economic losses and should be implemented within a coherent framework of national risk management and institutional development.

This study first analyzes the role of financing and risk transfer in disaster risk management; it then investigates the application and potential use of financial instruments for managing natural hazard risks in Chile, El Salvador and Peru and discusses the role of donors and multilateral development banks in supporting disaster risk financing.

Risks associated with natural hazards include both natural and socioeconomic elements. The frequency and severity of natural hazards are mainly determined by nature. Vulnerability is influenced by society, as the potential loss is directly related to prevention and mitigation investments. It is impossible to avoid all losses; therefore risk financing will become a necessity.

The basic objective of risk financing is to improve the ability of asset owners and governments to effectively re-establish living conditions and productive capacity in a post-disaster situation. Effective risk financing may cover the direct losses caused by the natural incident and indirect losses resulting from discontinuity in economic activities in the aftermath of an incident, thereby enhancing overall economic stability. Underfinancing disaster risk may have substantial negative consequences on current and future consumption, unfulfilled and potential investments and long-term growth. Adequate financial protection should form a central element of national risk management policies. An effective risk finance system will require a clear set of commitments, the necessary

institutional arrangements and the appropriate financial instruments.

Properly constituted risk financing systems will also contribute to sustainable economic growth through strengthened incentives for risk mitigation. For example, allowing insurance premiums to vary according to reduced risk due to prevention investments creates an incentive to explore and strengthen risk mitigation measures. It is, however, important to note that some forms of risk transfer contracts may effectively reduce risk mitigation and induce moral hazard. This may be the case with the situations listed below.

- Pure loss-based insurance, where premiums are independent of the insured's own risk mitigation.
- Government intervention to ensure the sustainability of living standards in the case of natural hazards.
- The availability of post-disaster relief assistance from the international donor community, which may undermine the development of risk mitigation and financing in developing countries.

It is also important to take into account that different financial instruments should be used to finance different aspects of risks depending on the probability and the scale of the impact. By selectively combining a set of instruments, the risk manager may both improve risk coverage and reduce total costs.

The main challenge of financing risk management is ensuring that it becomes an integrated part of an overall risk management process, and that this process includes the establishment of a proper institutional framework within which financial entities can function appropriately.

## **General Obstacles for Risk Financing in Latin America and the Caribbean**

The net benefit of risk financing depends on three cost factors that must be weighed against welfare gains. The costs include: the defined level and pricing of risk related to natural hazards, transaction costs, and the net social costs of losses and changes in consumption. If these costs are high, the usefulness of financial instruments to cover natural hazard risks in Latin America and the Caribbean may be limited.

Transaction costs are generally significant when institutions are weak and when risk statistics are not well developed or unreliable, which is unfortunately common for most countries in the region. Spreads (the yields offered in order to attract investors) are often more than five percentage points above the risk-free interest rate for bank loans.

Policymakers' incentives for national risk management and finance may also be insufficient. Many countries in the region face severe public budget constraints while simultaneously having to address a variety of basic needs presented by their populations. It may be politically difficult to assign resources to protect against a probable future impact. In addition, natural hazards that manifest themselves in the form of infrequent natural disasters often induce international relief assistance and remittances. Reliance on these resource transfers (especially when they are grants) may be attractive and thereby reduce the incentives for mitigation.

### **Insufficient Risk Financing in the Three Countries Studied**

The three countries studied for this report, Chile, El Salvador and Peru, are exposed to significant natural hazards, particularly earthquakes and El Niño-related weather phenomena.

The public sector and some housing segments are poorly covered by risk transfer or financing arrangements in all three countries (for instance, insurance penetration is limited). Though risk financing in these sectors was found to be insufficient in all three countries, the lack of financial protection against natural hazards is most evident in Peru and less so in Chile. The three case studies

suggest that the underdevelopment of risk financing stems from a combination of supply and demand factors, with the latter being more significant.

All three countries pursue policies of open financial markets. Peru, however, still has a relatively undeveloped financial sector, particularly with respect to supply-side hindrances. The penetration of mortgage financing is low in Peru and plays a limited role in private real estate financing, partly due to a weak legal and institutional framework that limits value assessments and building. In Chile and El Salvador there is a rather well-developed supply of risk financing and insurance available. Although national insurance markets are open to international competition in these countries, the limited size of the markets in El Salvador may restrict supply.

In all three countries, the public sector generally lacks well-founded policies on risk financing, and typically acts as a self-insured asset owner. Furthermore, the public sector fails to sufficiently coordinate financial and physical emergency planning. In Peru, funds are allocated to finance future crises management, but the total amount of funding is small and the deployment of the resources is limited. In Chile, infrastructure and public services assets are increasingly being insured.

As noted, it seems the supply side of risk financing is relatively well developed in Chile and El Salvador. Therefore, it is likely that the underfinancing of hazard risks in these countries stems from deficient demand from both the public and private sectors. As discussed above, this lack of demand might be explained by the incentive structure governing current versus future spending. In addition, populations are well acquainted with volatile living conditions due to a wide range of risk factors, including political instability, crime and natural hazards. Protection against other types of risks may or may not be more desirable than against natural hazard risk.

Independent of the interest in risk transfer through insurance, all three countries exhibit a need to strengthen risk prevention and mitigation investments. Investment decisions should be based on adequate risk and vulnerability analyses. The three

country studies indicate that a national natural hazard financing pool initiated by the government may be an appropriate option in certain situations. Pooling could help aggregate sufficient assets to manage financial instruments. However, the necessary, efficient public/private sector cooperation may be difficult to accomplish.

The conclusions arising from the studies vary and there is a need to further investigate the social value of institutional and financial measures to improve risk financing, in particular with regard to Chile. Chile has achieved a significantly higher rate of economic stability and growth than Peru and El Salvador. Chile's policies have, to a large extent, been based on no interference and liberalized market economics. The challenge for national policies is therefore to understand the importance of market imperfections and the role for the public sector in managing market failures in risk management and finance sectors.

In general, natural hazard risks are underfinanced in Latin America. Findings from the national studies and from the general economic development experience of the region indicate a need to combine mitigation and risk financing in any financial protection approach.

### **Steps That May Lead to Improved Risk Financing**

The challenges of sound risk management and financing are great. The conditions for success resemble those for sustainable growth in general. Instruments for risk financing have proven to be of most value in countries with well functioning institutions for risk management and financial markets, where the volume of assets, risk statistics, transaction mechanisms, claim settlement procedures and supervisory institutions are well-developed.

It is important to highlight that good risk financing is dependent on a coherent framework for specific national risk management policies. The selection of particular financial instruments requires consideration of the political and institutional contexts within which they will function. Integrated risk management and risk financing require a political commitment to include risk management as a nec-

essary component in achieving sustainable economic growth.

The first step to establish sound natural hazard risk financing is to define the objectives by answering important questions such as: What share of risks should be retained? What are the government's responsibilities? How will risk management be integrated into the overall development perspective? The benefits of expected future socio-economic resilience to natural hazards must be valued against the costs. These costs may be substantial.

The second step is to develop the proper institutional framework for coordination and financial risk management that corresponds to the defined national objectives. Scale is a critical variable in risk financing and must be considered in the establishment of these institutions. In any case, most countries in the region would benefit from institutional developments in the financial sector. There would be important positive effects, for example, from well-coordinated actions in mortgage financing, microfinance and risk finance at the national level. International cooperation can also play an important role in facilitating institutional developments.

The final step is the development of a portfolio of financial instruments that may be used to cover potential losses. Rational risk financing requires continuous risk assessments and monitoring, estimations of potential losses, and supervision of the effectiveness of risk mitigation. In addition to insurance and reinsurance, new instruments for risk transfer, such as catastrophe bonds and derivatives, have proved an ability to enhance the funding of disaster risk underwriting.

The extended range of options for risk financing has motivated multilateral development institutions to investigate the potential for socially profitable application among less developed countries. So far, no issues of catastrophe bonds (or "cat bonds") have covered risks in the developing countries of Latin America, Africa or Asia.

Based on this study, it seems likely that sound macroeconomic and fiscal policies are important in contributing to resilience and economic stability

in the event of socioeconomic losses caused by potential natural hazards. Our conclusion raises serious doubts about the value of implementing new, sophisticated securitized risk instruments in a weak institutional environment with unclear asset management practices in the public sector, poor risk statistics and inadequate systems for loss valuation and claim settlements. Financial resources are only part of the remedy in case of an incident. The physical capacity to provide effective prevention and response mechanisms must be secure.

### **The Role of Donors and Multilateral Development Banks in Risk Financing in Latin America**

Donor countries that seek to stimulate longer-term economic growth should aim to support the replacement of the currently predominant emergency transfers with risk mitigation practices and national risk finance. To succeed, developing countries should be motivated to pay attention to long-term institutional development for improved risk management rather than rely on relief in acute and often repetitive emergency situations.

There are some solutions that may be implemented relatively easily without the need for deep-rooted institutional changes. These include support of natural hazard-related credit risk insurance for microfinance institutions and existing ordinary credit institutions. Such institutions have well-established relations with asset owners, a proven capacity for asset valuation, and experience with reducing risks on their own books (e.g., through credit risk insurance) to enable more effective long term asset financing.

Donors currently operating as *de facto* disaster risk underwriters have good cause to redirect a significant share of resources normally spent in emergency situations to supporting well-founded mitigation investments and national risk-financing schemes. Helping exposed countries develop their own capacity for rational risk financing is a natural element in the development of proper frameworks for sustainable growth in the countries of Latin America.



# Introduction

Direct and indirect losses from natural hazards in Latin America are an important obstacle to reducing poverty and increasing environmentally sustainable economic growth in the region. Improved natural hazard risk management is therefore high on the agenda of most national authorities and multilateral development institutions.

Natural hazard risk management covers a chain of activities prior to, during and after the incident. Risk financing forms an important element of this chain. The purpose of this study is to better understand the potential value of new instruments for risk financing and transfer. This introductory chapter first presents the purpose of the study in more detail and then introduces the risk management concept and key elements of risk analysis and finance. The report reviews the available financial instruments for natural hazard risk management and discusses the potential social value of introducing these new instruments into national natural hazard risk management. The national and international framework for risk financing and the potential application of the instruments are discussed with reference to the risk exposure and general risk management in three Latin American countries: El Salvador, Chile and Peru.

The report shall discuss the benefits and costs of the use of financial instruments, specific financial instruments that could be adequate for Latin America and the Caribbean, and relevant guidelines for implementation of the identified instruments in Chile, El Salvador and Peru.

This paper explains the basic concepts of risk management and finance. Next chapter presents our suggested practical guidelines for application of improved natural disaster risk financing, including institutional reforms, donor country participation and selection of an optimal finance structure. The three country studies are summarized in the third chapter, and the main conclusions are presented in the last chapter of this paper.

## **Risk Management and the Role of Risk Finance**

The next sections describe observed risks and practical aspects of risk management and offer a general assessment of the attractiveness of risk financing and transfer for Latin American countries. The chapter goes on to introduce some theoretical aspects of financial risks and the characteristics of individual financial instruments to better manage natural hazard risks. First, we describe the loss potential and define direct and indirect losses, which are important for the valuation of risk financing.

Financial protection forms part of overall risk management activities. An integrated perspective on risk management is needed to properly relate risk financing to risk assessment, prevention and mitigation; the management of emergency situations, and reconstruction.

Figure 1 defines risk management as a set of activities in the pre and post hazard situation. The development of proper institutional solutions is constant throughout all phases. Risk finance and transfer is the main topic of this study. Every element described in the chart contributes either directly or indirectly to resilience. The elements are interdependent as the performance of each impacts the performance of the others.

Risk finance is the provision of financial resources to match the economic value of potential losses. Risk transfer is one way of financing risks by establishing a third party, an underwriter, to absorb risk and guarantee the economic value of the loss if and when it occurs.

The correlation between risk financing, institutional frameworks, and prevention and mitigation investments is important for implementation of comprehensive risk management. Prevention and mitigation may lower the loss potential and thus also the need for risk financing. It will normally not be possible to develop physical resilience to the extent that all potential loss is removed. Ra-

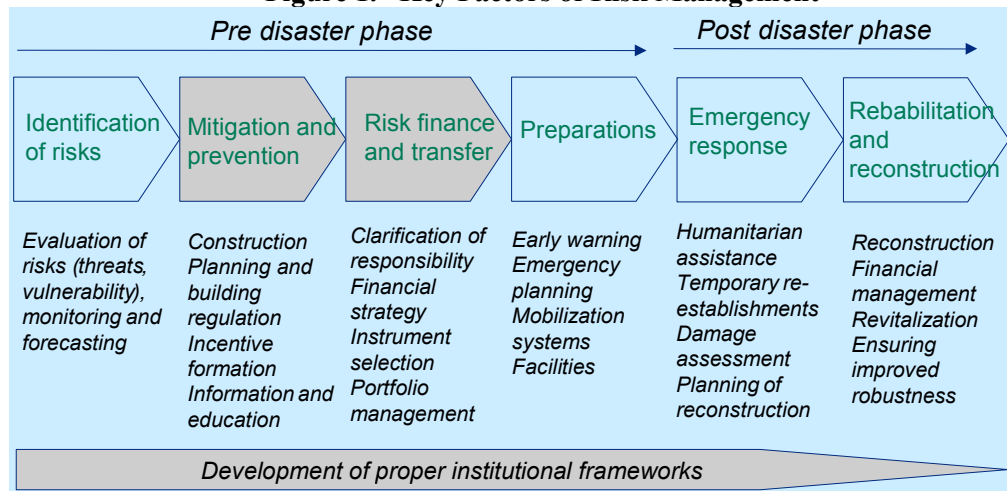
tional risk management involves developing an effective balance between prevention, mitigation, risk financing and deciding how much potential residual risk to leave without financial protection.

The relationship between mitigation and risk finance is reciprocal; mitigation requires financing and risk financing schemes may impact incentives for mitigation. Risk financing schemes must therefore take into account the potential effects of risk financing and transfer on risk mitigation.

The theoretical argument for risk transfer runs parallel to the argument for open economies. Goods and services are exchanged internationally as a result of differing resource endowments. National risk characteristics also vary and risk pricing would benefit from an international exchange of risks through the purchase and sale of risk transfer instruments like insurance contracts and risk-linked securities.

Governance issues play a significant role in disaster risk management. The establishment of a national system is a worthwhile goal for countries with high vulnerability. The adequacy of emergency and risk management institutions may be critical to the provision of security for the population living in risk-prone areas. Furthermore, financing of losses and relief assistance imply the transfer of substantial amounts of money that, in turn, may cause corruption. The disruption of normal infrastructure, communication, and control mechanisms provides room for illegitimate transactions. The capacity to regulate private sector behavior (e.g. through the enforcement of building codes in the construction sector) is itself an important prerequisite for effective risk mitigation. Natural hazard risk management therefore depends fundamentally on the quality of national institutions.

**Figure 1. Key Factors of Risk Management**



Source: Keipi and Tyson, 2003, ECON Analysis

# Financial Aspects of Natural Hazard Risks

## **The Loss Potential and Direct and Indirect Losses**

Natural hazard risk depends on underlying risk and vulnerability. Actions taken before the disaster occurs and the capacity to absorb post disaster losses will determine vulnerability. The social function of risk finance is to ensure sufficient capacity for appropriate actions during and after the disaster situation.

Depending on the availability of resources, and the adequacy of planning and organization, the indirect losses of a natural disaster may be significant compared to the direct losses. The relationship between direct and indirect losses as defined here is illustrated conceptually in Figure 2.

Insufficient risk financing may result in a serious lack of resources to limit damage from the incident and salvage remaining assets from complete destruction. Furthermore, when interrupted operations lack resources to reestablish infrastructure or recover input factor flows, further deterioration in production capacity will ensue. Finally, uncertainty about the capacity for, and timing of, reconstruction in general may cause new investments and productive resources to neglect the affected communities.

Risk financing is one important factor for avoiding unnecessary indirect losses. However, financial resources will not help limit losses if the institutional capacity required to aptly fulfill the planned mitigation and response activities is inadequate. Again, risk financing will only provide the social benefits intended if implemented within a framework of rational risk management.

## **Adjusting Risk Profiles**

Provided that a framework for rational risk management is in place, the question still remains: What risk profile should be established to serve the social interest of the community?

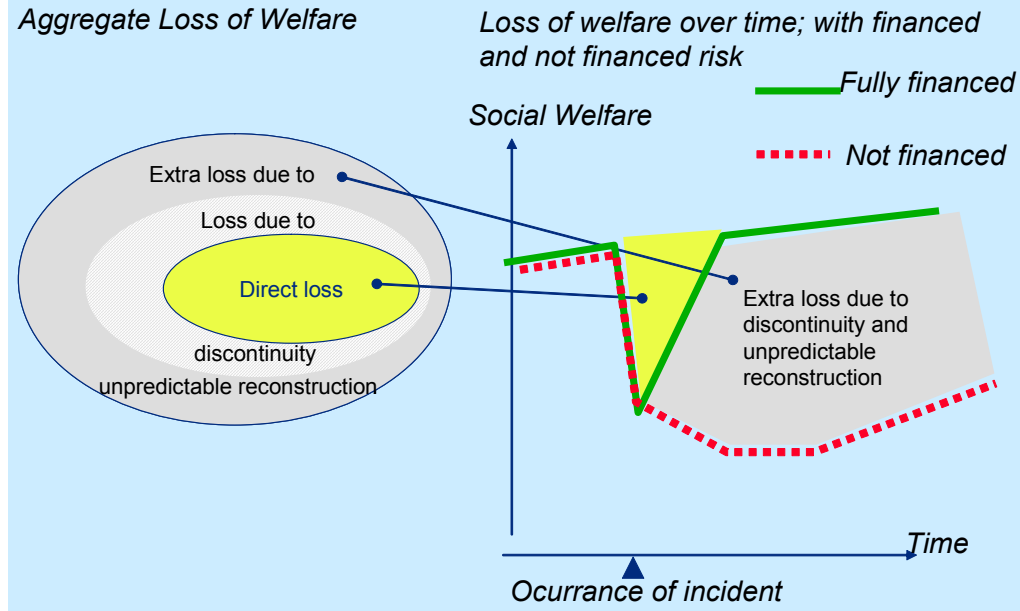
From a financial perspective, risk management is the adjustment of an investment portfolio to regulate the variability of returns. The risk profile of any asset portfolio may, through the use of various financial instruments, be selectively adapted to suit the preferences of its key stakeholders, owners or creditors. When risks related to natural hazards are well described statistically, there is reason to believe that a national economy can use a portfolio of financial instruments to adjust its risk profile to suit its social preferences. The underlying idea is that the application of financial instruments may enhance welfare by adjusting the variability of social welfare over time.

Table 1 classifies the four types of risk associated with financial instruments for managing risks: timing risk, credit risk, investment risk and underwriting risk. Pure risk financing implies the asset owner still carries the underwriting risk, that is, the risks associated with the calculated loss potential. The asset owner undertaking a pure risk finance scheme is still responsible for the full coverage of losses, but coverage of losses and the financing of reconstruction are spread over time in a predictable way. Risk transfer, as defined previously, means the underwriting risk is transferred to another party

When discussing relevant financial instruments of risk finance, this report makes a distinction between *risk finance* and *risk transfer*. Risk financing schemes redistribute all or some of the elements: timing risk, credit risk, investment risk and underwriting risk. Alternative risk financing instruments are defined by the way various risks are distributed in time and between asset owner and the financing agents.

In risk transfer arrangements, the underwriter (e.g. the insurance or reinsurance company) accepts the liability to settle the insured's future claims for losses covered by the insurance contract.

**Figure 2. Aggregate Potential Loss and the Relation Between Direct and Indirect Loss. Conceptual Illustration**



Source: ECON Analysis

**Table 1. Four Types of Financial Risk**

Risk element	Underlying uncertainty	The effect of risk transfer
<b>Timing</b>	Time of occurrence of a loss.	The time period used to accumulate funds or entitlements to loss compensation is independent of the time of occurrence of a loss.
<b>Credit</b>	Creditors' solidity e.g. the solidity of the reinsurer in case of heavy losses or creditor's solidity in contingent credit line arrangements.	Resulting risks are not impacted by financial solidity.
<b>Investment</b>	Return on deposits and funds set aside to finance future losses, e.g. in cat bond arrangements.	More predictable annual costs of financing a particular risk.
<b>Underwriting</b>	The potential loss that is transferred to the underwriter/insurer	The potential loss is for an agreed period of time converted into a predictable stream of payments. The asset owners' may be left with no remaining basis risk.

Source: ECON Analysis

*Timing risk* may be transferred from the asset owner to a financing agent through a pure risk financing arrangement like a savings and loans scheme. This enables an asset owner to develop full risk financing irrespective of the timing of a

subsequent incident provided that the asset owner is solvent and able to make deposits or pay the necessary installments. A risk transfer arrangement will imply the transfer of timing as well as underwriting risk.

Pure risk financing and risk transfer normally distribute *credit risk* elements differently. A credit institution providing credit facility to finance post-disaster reconstruction accepts the credit risk related to the future solvency of the asset owner. An insurer normally does not take on any credit risk because the transfer of underwriting risk normally expires when the insured is no longer able to pay his premiums. However, the insured will always be exposed to the credit risk related to the balance sheet and solvency of the underwriter. Insurance-related credit risk gives rise to significant price and premiums differentiation among insurance and reinsurance companies.

*Investment risks* arise from the accumulation of funds to cushion future losses. An insurance company normally accumulates funds to finance future losses. The returns on these funds will have an impact on the premiums necessary to finance a specific risk or the potential compensations. Pure risk financing may also have an impact on the distribution of investment risks depending on the specific arrangements made.

The insurance contract will determine how the insured and the *underwriter* share the investment risk.

### Risk Financing Instruments

There are two basic types of risk financing instruments. Pure risk financing transfers the timing risks to (for example) a savings and credit institution. The asset owner still has to pay his/her loss through the withdrawal of savings or down-payments on loans. The risk transfer arrangements relieve the asset owner of any obligation. The repayment will be received from the insurer.

There are also numerous alternative mechanisms for risk transfer. Traditional means of risk transfer are insurance and reinsurance. More recently, a range of instruments categorized as risk-linked securities have been developed. Catastrophe bonds (cat bonds) and weather derivatives are examples of such instruments and were introduced during the 1990s. Most of these instruments apply mainly to the insurance or reinsurance industries. Only a few among the almost 80 issues of cat bonds so far

**Table 2. Examples of Instruments for Pure Risk Finance**

- **Ordinary financing**
  - Standby LOCs (Letters of Credit)
- **Captives** (normally among insurance/reinsurance companies)
  - Ordinary Captives at direct insurance, reinsurance or group/association level
  - Rent captive (rent out the balance sheet to a 3<sup>rd</sup> party)
  - Protected cell captives
- **Finite structures** (mainly for insurance companies)
  - Spread loss (pre and post funding)
  - Loss portfolio (transfer of liabilities for losses already occurred/usually long tail)
- **Contingent Capital**
  - Contingent Equity Plus/contingent surplus notes
  - Subordinated Debt Finance via. Debentures/Preferred shares

Source: Andersen (2002), ECON Analysis

have been made directly by the primary insured (i.e. the exposed asset owner). Normally, a reinsurance company sponsors the cat bond issue (see e.g. Swiss Re, 2004) while individual asset owners, including public authorities, address ordinary insurance companies for the purpose of risk transfer. The insurance companies usually reinsure to strengthen their underwriting capacity and reduce basis risk. For the reinsurance industry, cat bond issues and ordinary equity capital are potential sources for increased underwriting capacity and reduced basis risks (see table 3).

Risk transfer arrangements may have different formulas for measuring losses. The distinction between loss-based and index-based or parametric risk transfers in table 4 is important. Loss-based risk transfer implies claims and compensations are determined according to observed losses. Index-based or parametric risk transfer replaces actual loss valuation with a pre-determined index or parameter. Loss compensation is then a function of the objective value of the parameter or index, and only indirectly related to the actual loss. An example of a typical parameter may be the strength of an earthquake or hurricane in a certain region.

**Table 3. Examples of Financial Instruments for Risk Transfer**

- **Insurance: the contract with the primary insured**
  - Direct insurance company
  - Mutual insurance
  - Governmental insurance provision
  
- **Reinsurance: serving insurance industry**
  - Traditional reinsurance
  - Finite reinsurance
  - Cat bonds;
    - Index linked (parametric)
    - Real loss based
  
- **Other financial market instruments** (normally parametric)
  - Derivatives (weather) i.e. Caps(calls)/Floors(puts)/Collar/Swaps
  - Catastrophe Derivatives like CBOT/Bermuda Exchange instruments (discontinued since 1999)

Source: ECON Analysis

The two types of risk transfer give rise to distinct risks, claims settlement procedures and transaction costs related to the issuance. The use of a parametric instrument simplifies the contracting, transactions, and claim settlements, and reduces the negative impacts on risk mitigation incentives. However, parametric-based insurance leaves the risk to some extent with the insured. Loss-based insurance means the insured will be compensated according to the loss suffered, while parametric or index-based insurance implies that there is no fully predictable relationship between the actual loss suffered and the compensation received.

The difference between a parametric and loss-based risk transfer varies from case to case. Cummins, Lalonde and Phillips (2004) have tested the degree to which a catastrophic-loss index to be used for hurricane risks in California would cover the insured's basis risks. They found that a state-wide index would effectively cover basis risks for the majority of assets (i.e. of asset owners comprising the two quartiles of the population possessing the largest asset portfolios). Most insureds in the quartile possessing the smallest asset portfolios would, however, still encounter significant risk. This result implies that parametric risk transfer covering windstorm-related risks might provide satisfactory risk transfer for the majority of insureds. A significant share of asset owners may, how-

ever, need complementary loss-based risk transfer in order to fill the gap between loss-based and index-based risk transfer.

A study by Doherty and Richter (2002) investigates the potential for combining index-linked and loss-based insurance. The sole use of the former will, as already mentioned, leave an uncovered gap of basis risks for a significant group of insureds. Rational agents will, according to the authors, prefer to combine the two instruments to take advantage of the attractive features of the index-linked coverage and, at the same time, the ability of loss-based insurance to match risks more exactly.

The authors stress the importance of transaction costs associated with loss-based risk transfer. These specific costs arise to counter behavioral problems like moral hazard and adverse selection. The loss-based and index-based instruments are different from the perspective of both insurers and insureds. In particular, the two raise different needs for monitoring risk management practices; they have different risk profiles, require distinct types of retail distribution and claim settlement systems, and so on. The associated transaction and administrative costs are clearly lower for parametric risk transfer.

Parametric and loss-based risk transfer may thus be regarded as complementary. Doherty and Richter (2002) postulate that rational asset owners will always apply indexed instruments to some extent when there is a positive correlation between the index and the actual loss. So-called “gap insurance” may be used as complementary loss-based insurance to transfer remaining risk.

Evidence suggests that temporary shortages of capacity experienced in reinsurance markets have been a major reason for the need to remove obstacles to growth in the market for risk related securities, such as cat bonds (Ozimir, 2002). According to Doherty and Richter (2002), the need for more efficient means of risk transfer is the main reason for the spread of risk-linked-securities. Today, cat bonds are predominantly parametric or index-based. The authors expect that tailored financial instruments for gap insurance will develop as markets for risk-linked securities develop further.

Table 4 reviews the relative value of the three main types of instruments; pure risk financing, parametric-/index-based and loss-based risk transfer. The table delineates the extra costs and subsequent benefits associated with each instrument.

It follows from the arguments listed in table 4 that the attractiveness of different instruments will vary with market segments due to the distinct risk and cost characteristics of individual instruments. Table 5 presents a simplified evaluation of alternative risk financing mechanisms. The relative attractiveness of alternative instruments is seen as a function of two factors: (i) the quality of distribution networks for risk transfer arrangements, including claim settlements, and (ii) the relative importance of systemic versus non-systemic risks. Pure risk finance, loss-based risk transfer and parametric risk transfer are considered in each segment.

**Table 4. Costs and Benefits of Various Categories of Risk Financing**

<b>Position</b>	<b>Extra costs</b>	<b>Extra benefits</b>	<b>Net benefit</b>
<b>1. Pure risk financing</b>	Pre-disaster: The costs of postponed consumption net of interest. Post-disaster: debt servicing costs	More robust consumption and investment levels Reduced indirect loss due to discontinuity and uncertainty regarding reconstruction	Always positive longer term effects provided that there is risk aversion and risk assessments are correct.
<b>2. Parametric risk transfer</b>	Risk premiums Transaction costs for establishing and managing the parametric instrument	Reduced basis risk to the extent that parametric values correlate with actual losses.	Positive if low transaction costs and efficient pricing of risk, and significant positive correlation between index and losses. Net value depends on risk premiums, risk preferences and transaction costs.
<b>3. Loss-based risk transfer</b>	Risk premiums Extra transaction costs to document loss potential, to monitor risk management and settle claims.	Basis risk transferred to the underwriter	Positive if low transaction costs and efficient pricing of risk. Potentially positive as a supplement to parametric risk transfer.

Source: ECON Analysis

**Table 5. Alternative Financial Instruments to Improve Risk Management:  
A Simplified Approach to the Valuation of Alternative Instruments**

		Quality of distribution networks		
		<i>Low</i>	<i>Medium/varying</i>	<i>High</i>
Share of systemic/correlated risk	<b>High systematic risk</b>	Parametric risk transfer	Parametric risk transfer with supplementary gap insurance designed for selected segments	Primarily parametric, loss-based gap insurance used for selected segments
	<b>Combination of systemic and non-systemic risks</b>	Parametric risk transfer combined with pure risk finance	Parametric risk transfer with supplementary pure risk financing or loss-based transfer dependent of segment	Parametric risk transfer with general supplementary gap insurance
	<b>Non-systemic risk (low correlation)</b>	Mainly pure risk finance. Loss-based risk transfer might serve major institutions like governments and banks. Some parametric risk transfer if critical mass is achievable.	Pure risk financing combined with loss-based transfer dependent of segment.  Some parametric risk transfer if critical mass is achievable	Loss-based insurance. Some parametric risk transfer if critical mass is achievable

Source: ECON Analysis

The table describes the relative attractiveness of alternative instruments as a function of the share of systemic risk, which, in turn, is defined as the correlation between objective parameters and actual losses, and distribution network characteristics. The distribution network is defined as the set of interrelated agents and systems that facilitate risk finance contracting, and the associated exchange of information, documentation and payments of premiums, commissions and claim settlements. The relevance of pure risk financing is highest when both the quality of distribution networks and share of systemic risk are low. The reason is that low quality of distribution networks (ineffective claim settlement procedures, low capacity to enforce contract fulfillment and lack of standards for insurance contract formulation), implies high, and often unpredictable, transaction costs for risk transfer arrangements. Even parametric risk transfer would have to rely on the distribution network to establish the necessary contractual and payment transfer framework. High shares of systemic risk would call for parametric risk transfer. The use of loss-based insurance seems highly unattractive in an environment of ineffective distribution networks due to the resulting high transaction costs.

### Criteria for Determining Risk Finance Schemes

Various criteria will determine the net benefits of implementing an assortment of risk financing instruments.

The scale of the expected loss relative to current income levels will influence the need to finance risk ex ante. Reduced levels of consumption and investment in case of a disaster mean extra loss to asset owners and consumers. As argued above, the magnitude of indirect losses depends on the ability to finance reconstruction and bridge temporary income losses.

A country's tolerance for variation in production and welfare is an important consideration. The impact from sudden variations in economic capacity may depend on consumption levels among social groups and the interdependency of planned investments. Unplanned variation in consumption levels reduces social welfare. The costs of variation may be higher for low-income levels since basic values like life and health may easily be threatened for people with current incomes close to subsistence levels. It is also reasonable to assume that the indirect costs of an incident will be higher for low-income countries with fragile institutions and infrastructure than for more advanced



economies. If planned investments are interdependent, unplanned variations in investment capacity may severely hurt returns on investments already undertaken. Previous financing on uncompleted projects is wasted if investments are discontinued due to a disaster.

The relationship between natural hazard risk and parametric risk will determine the effectiveness of parametric risk transfer. Parametric risk transfer will, as explained above, suffice to transfer the main share of the underlying risk when there is a high correlation. If, for instance, the losses from El Niño for a farmer’s captive pool in Peru are strongly correlated with objective characteristics like changes in water temperatures, wind scale and so on, then parametric insurance will provide a good and cost-effective substitute for loss-based insurance. In the opposite situation, a parametric risk transfer will not be useful.

The time horizon and geographic scope of the risk financing arrangement may be important to enable the full exploitation of parametric risk transfer. The correlation between parametric characteristics and actual losses may increase with the geographic scope and time horizon. The expected gap between actual loss and expected loss, as a function of the parametric index, will normally diminish when the number of cases increases. Parametric insurance is

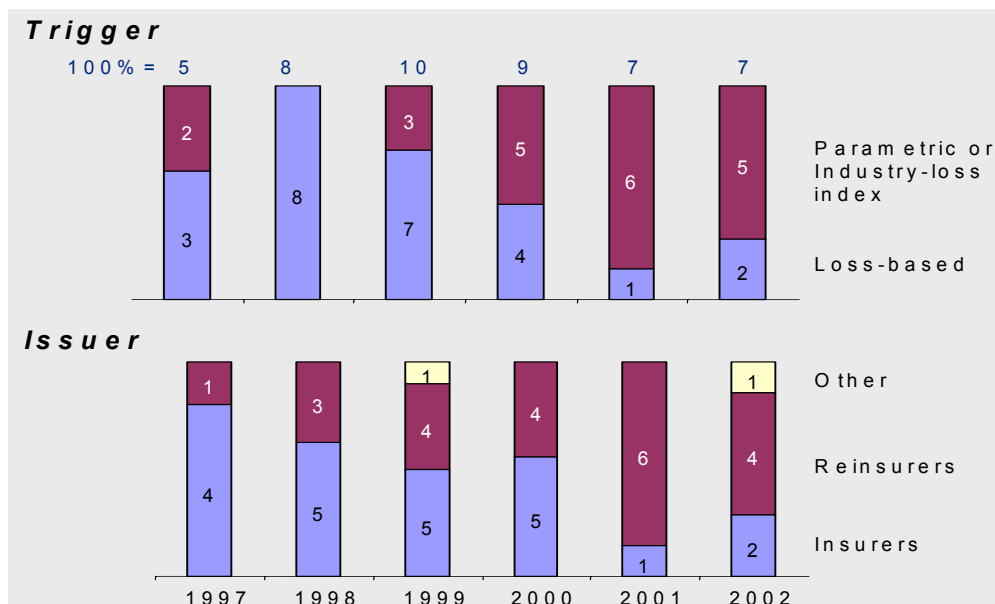
therefore primarily relevant for reinsurers or pool arrangements that cover a range of individual insurance contracts and a broad geographic scope.

Individual asset owners will primarily combine pure risk financing and loss-based insurance. For governments, large companies holding broad asset portfolios, or pools and underwriting agents, the most efficient way to finance risks may involve a combination of pure risk finance, like contingent capital arrangements, parametric insurance, and gap insurance in the form of a loss-based insurance contract.

Figure 3 shows the distribution of cat bond issues since 1997. There are two clear tendencies. Firstly, cat bond issues have moved toward a strong dominance of parametric over loss-based claim settlements. Secondly, reinsurers dominate over insurers as issuing agents. Both characteristics emerge substantially over the five-year span.

According to Marsh & McLennan (2003), cat bonds are typically targeted toward layers of risk with high estimated annual losses but very low probabilities, typically less than 1 percent per annum. Cat bonds are receiving increasing support from international investors. Investment companies are forming targeted investment funds to channel investments into the risk-linked securities

**Figure 3. Characteristics of Cat Bond Issues by Trigger and Issuer. 1997 – 2002. Number of Issues**



Source: Marsh and McLennan Securities, 2003

markets. Returns from investments such as cat bonds have thus far been attractive and no cat bond has been hit by catastrophic losses. Marsh & McLennan (2003) explain the reason for the growing predominance of index-based settlements by

the relative characteristics of the two. Their rather detailed review of the advantages and disadvantages of loss-based risk transfer and industry-loss index and parametric-based risk transfer is summarized in Table 6.

**Table 6. Overview of Triggers – Advantages and Disadvantages for Issuers and Investors**

Trigger	Advantages	Disadvantages
Loss-based	<ul style="list-style-type: none"> <li>–No basis risk for issuer– reflects ceding exact loss</li> <li>–(Investors have no preference for indemnity based compared to index or parametric)</li> </ul>	<ul style="list-style-type: none"> <li>–Detailed risk analysis by modeling firms needed</li> <li>–Longer ratings process with high scrutiny</li> <li>–Disclosure for portfolio details to competitors</li> <li>–Possibly less liquidity</li> <li>–Adjustment to provide for growth of ceding company’s portfolio</li> <li>–Longer loss recovery period adds uncertainty and extra costs for issuers and investors</li> <li>–Severe moral hazard issues</li> </ul>
Industry-loss index	<ul style="list-style-type: none"> <li>–Simpler process to execute than loss based coverage</li> <li>–Possible cost advantages due to greater investor interest</li> <li>–Shorter rating process</li> <li>–No need for ceding entity to disclose confidential information</li> <li>–Shorter payout period reduces uncertainty and costs to issuer and investor</li> <li>–No moral hazard</li> <li>–More liquid securities</li> </ul>	<ul style="list-style-type: none"> <li>–Basis risk retained for issuer</li> <li>–Requirement that “modeled-loss” approach be used if industry loss estimates are not available</li> <li>–Possible adjustment needed to provide for industry’s portfolio growth</li> <li>–Reliance on a black-box approach for modeled loss</li> </ul>
Parametric index	<ul style="list-style-type: none"> <li>–Simple process to execute</li> <li>–Possible cost advantages due to greater investor interest</li> <li>–Short rating process</li> <li>–No need for ceding entity to disclose confidential information</li> <li>–Same advantages for investors as industry-loss index based</li> </ul>	<ul style="list-style-type: none"> <li>–Probably more basis risk retained for issuer</li> </ul>

Source: Marsh and McLennan (2003), ECON

# Practical Steps Toward Improved Financing of Natural Hazard Risks

The first two chapters of this paper presented the financial aspects of natural hazard risk management and specific tools of risk financing and transfer. Based on the alternative concepts of risk finance and observations from three selected Latin American countries, a synthesis of practical steps to improve natural hazard risk financing is suggested below. The main challenge described is to manage risk financing as an integrated part of overall risk management, implying that institutional aspects deserve particular attention.

Practical guidelines for improved risk financing are presented in three steps setting the goal, developing institutions, and financing.

## Setting the Goals

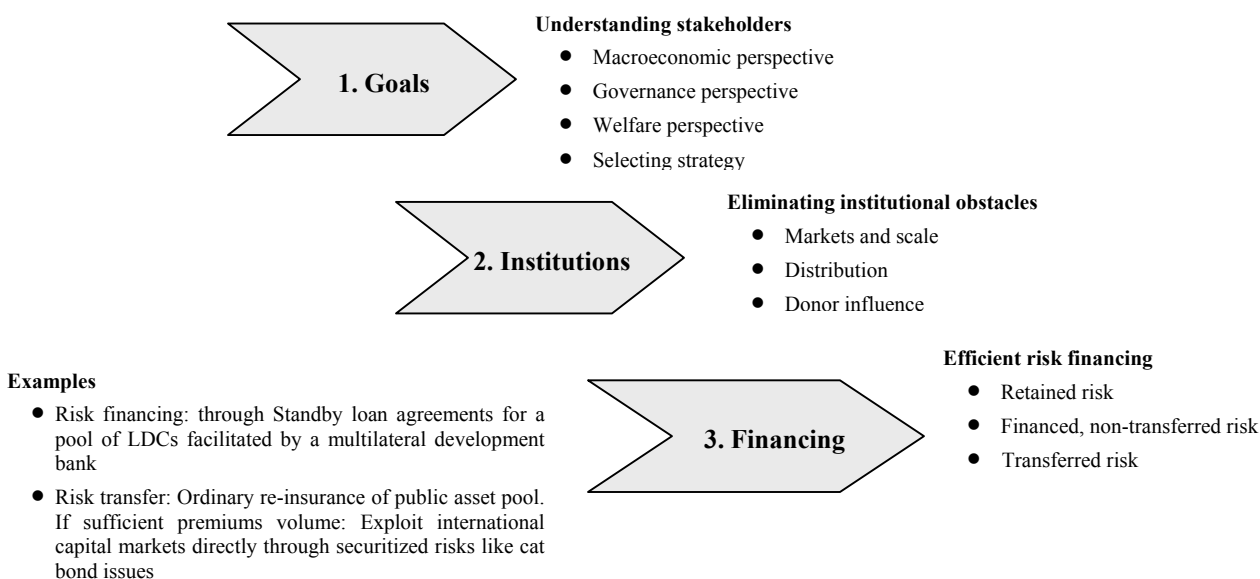
The first challenge is to establish a goal to institute an integrated risk management system at the national level. The initiative will include a comprehensive strategy for national risk financing (figure 4).

Rational risk financing for individual asset owners and public authorities generally implies that risks are treated in a stratified way. A significant share of the risk will be retained. Another share of the risk can be financed via pure risk finance and/or through other risk transfers (a combination of parametric and loss-based risk transfer). Rational risk financing must be based on a relevant set of risk preferences, that is, relative values of alternative risk profiles. This chapter starts with the definition of stakeholders, whose preferences should guide the development of risk financing. Then four perspectives on the risk management and finance goal are described before alternative coherent strategies are defined.

## Understanding Stakeholders and their Interests

The rationale for moving from ex post to ex ante risk financing depends on the value it provides to individual stakeholders. Stakeholders may comprise a variety of interest groups such as central and local governments, private companies and

**Figure 4. Steps toward improved risk financing**



Source: ECON Analysis

households, providers of financial services and donor countries. The various stakeholder groups are described in the sections that follow. The interests of donor countries are given particular attention.

Stakeholders are individuals and institutions likely to benefit or suffer losses from a shift in natural hazard risk financing. The groups that are likely to gain or lose directly are either involved as asset owners, consumers of services and goods with vulnerable supplies, or as providers of services that will be affected by the shift in risk financing.

Governments are important disaster finance clients due to the many assets they hold. However, several countries have problems valuing the public sector asset inventory. Later in this chapter we will discuss the extent to which private assets should be subject to public risk financing.

The second group essentially includes a country's entire population. No inhabitants are completely independent of public services. However, there may be a question of prioritization among groups as some groups are more reliant on public services than others.

The third group consists of a set of service providers. In the case of Chile, El Salvador and Peru, financial institutions are important stakeholders. Private insurance companies are also an important stakeholder group. For example, there is a concern that the implementation of publicly organized risk finance may undermine the penetration and market share of private insurance companies. Conversely, a public pool may stimulate the demand side of the insurance market. If the pool is to transfer risks directly into the reinsurance market, the pool in itself represents extra state-supported competition for national insurance companies and a huge buying block for the reinsurers.

The manner in which premiums or annual savings are financed may also imply negative impacts for some stakeholders. Financing these systems via tax bills or fiscal budgets necessarily implies reallocating resources from private consumption or other forms of current public spending.

Two main arguments are used to undermine the case for ex ante risk financing. Firstly, there is the normal strain on public finance implying that risk financing has to compete with other forms of public spending. Secondly, improved financing of prevention and mitigation may result in reduced motivation among international private and public donors to provide emergency transfer of financial resources after an incident. Ex ante financing itself reduces the visible loss and suffering which could decrease the motivation to donate money. The substitution of ex post financing may therefore mean that the nation leaves significant potential sources of external emergency and reconstruction finance untapped. In the case of El Salvador, donations form a significant source of funds. Ex ante international donations to fund insurance premiums or the payment of interest on disaster loans or cat bonds are unlikely. It may be difficult to convince potential international donors of the benefits of ex ante financing compared to ex post emergency funding.

### **Involving Donor Countries**

Donor countries usually respond to requests for emergency aid in the wake of a disaster. However, it has often been difficult to motivate donors to contribute to building long-term disaster risk management programs as an alternative or supplement to relieving victims of a natural hazard from their acute and highly visible suffering.

Donor countries' actions can have an impact on the risk financing behavior of developing countries in several important ways. Donors and relief organizations often act as de facto underwriters and international donations of relief money tend to substitute for ordinary risk finance and transfer. This substitution may be socially ineffective as emergency funds generally do not contribute to long-term development. It is likely that ex post transfers in place of long-term assistance to ex ante financing actually causes substantial losses in the long term. Ex ante financing requires integrated planning of physical and financial emergency management, while ex post financing requires expensive ad hoc organization. Furthermore, emergency assistance is often provided as tied and in-kind aid, which may not respond effectively to the real needs of the receiving country.

The challenge of implementing ex ante financing of natural hazard risks is therefore, to a significant extent, related to motivating donor countries to favor long-term capacity build-up for effective risk and crises management rather than ex post relief. Since the interest for support after an emergency may be quite significant, it should be possible to reallocate resources into long-term programs.

A shift from ex post to ex ante financing may provide a double dividend as the total loss is reduced due to a more predictable supply of funds and enhanced incentive to develop the institutional capacity that will secure long-term economic growth. Donor countries can contribute by offering long-term disaster risk management financing as a component of regular development programs in high risk areas or sectors. Such risk financing may be stimulated by conditioning certain development programs on preventative risk financing in high risk areas. In such instances, differentiated credit terms may be in order.

### **Donor and Recipient Country Responsibilities**

The need to finance natural hazard risk management is obvious. Underfinancing enhances potential losses. Several explanations could be offered as to why developing countries seem to pay limited attention to risk financing, even where risks are obvious and acute.

The countries of Latin America and the Caribbean are only in the initial stages of incorporating disaster risk management into their development agendas. The populations are more likely to seek government support for urgent poverty and short-term development needs rather than shifting resources to prevent potential events that may arise only every 50 years.

Incentives provide one explanation for current risk management behavior. Donor country behavior reduces the reward and incentive for responsible risk financing. The propensity to spend resources on risk finance will vary with the availability of alternative mechanisms to reduce risk exposure. Kelly and Kleffner (2003) have summarized findings on the behavior in markets for risk management services. The penetration of risk transfer varies in response to behavior within the insurance

industry, the availability of mitigating options, and the propensity of the authorities to intervene with assistance in post disaster situations. A more interventionist government tends to lower the rate of insurance and private mitigation.

Among less developed countries it is common to have a substantial and loyal emigrant population, and this community often provides an important source of ex post emergency transfers. The amount of such transfers naturally depends on the visible seriousness of the losses. Remittance funds are seldom assigned for prevention and longer-term emergency funding discourages proper risk management. The lack of incorporation of disaster risk management in the culture impedes the development of necessary institutions and structure for long-term risk management.

Ultimately, the responsibility to establish the commitment to developing an effective risk management system lies with the recipient country. Donor countries will subsequently be in a position to support these efforts. Multilateral lending institutions can encourage progress in this area by incorporating the risk management goals of each country into their development agenda and conditioning assistance on achievement of such goals. Again, establishment of the necessary institutional capacity within the countries will be essential to garnering support from donor countries.

### **Macroeconomic Perspective**

Improving the motivation for socially effective natural hazard risk management and finance is a real and important challenge in Latin America and the Caribbean. If the motivation is there, the ensuing steps to improving risk financing are rather practical and easily implemented technical applications. Defining the goal is a natural starting point when there is an interest among stakeholders to improve the state of risk financing.

Defining the goal involves the consideration of two aspects of economic policy formation: macroeconomics and governance. *The macroeconomic perspective* refers to the issue of acceptable variations in welfare due to natural hazards. *The governance perspective* relates to loss prevention through the valuation of reduced damages and to a

welfare approach that defines the role of public sector versus decentralized market-based decision-making.

National economic development planners must define the acceptable levels of variation in welfare based on underlying risks. Risk with low probability but high potential cost is often left without specific coverage since it may be impractical to finance (Miller and Keipi 2005). If it is not cost-effective to finance residual risk, a rational solution would be to develop the necessary macroeconomic flexibility in order to avoid negative long-term effects.

The valuation of alternative levels of macroeconomic volatility should be based on assessments of the willingness to pay for stable economic environments. Unless a study of preferences for stability and willingness to pay to avoid volatility is made, there is little reason to draw a specific conclusion regarding what should be the appropriate goal for economic robustness and risk financing. In addition to the preference for stable macroeconomic conditions, the need for resources to prevent future losses from natural hazard events will also determine the need for finance.

### **Governance Perspective**

Risk financing provides resources for both the reconstruction of damaged or lost assets and the restoration of production capacity. Preventing further indirect losses from deteriorated productivity and uncertainty creates social value, whereas loss compensation mainly redistributes welfare.

The stability of disposable income will never be the full responsibility of the public sector. There is no reason for the public sector to substitute private risk finance and to protect all private property from natural hazard risks. Instead, the task is to ensure that private demand and supply reflect social values and to provide complementary services where private markets are insufficient. The studies of the three Latin American cases in this paper illustrate the importance of national risk financing for minimum standards of housing and consumption for the poor, continuity in the provision of public services, and ensuring efficiency in financial markets.

Natural hazards may endanger fundamental life standards, especially for the poor. Social security is considered a public good in democratic nations. Supporting minimum sustainable standards of living for the poor is a public priority. For the middle- and high-income population there is little reason to consider the security of future income a public good if there are effective markets for insurance services. However, the provision of effective markets for risk finance and transfer is a natural priority for public authorities.

Ensuring the continuous operation of public services is itself a public good. This means that central and local governments need to finance their risks with the prospect of safeguarding continuity and certainty regarding operations and reconstruction of public services. This should include measures to restore employment and income for the necessary well-being of the affected population.

The existence of efficient markets for risk finance and transfer is also a public good and therefore within the scope of the social perspective of natural hazard risk management. The required efficiency will depend on the availability of financial services in a competitive price environment. Specific policies may include competition guidelines, surveillance bodies and measures to stimulate the demand for risk financing.

Having established a maximum acceptable variation in disposable income and the expected loss potential, the role of the public sector in risk management and finance, the gap between acceptable retained risks and potential loss may be quantified. The next steps in the implementation process are steps to fill this gap as described previously in figure 4.

Alternative mechanisms for financing risks and the appropriate trade-off between risk mitigation and finance have to be analyzed before specific goals are formulated. Therefore, the commitment at the outset of the process must be stated in terms of a rather general goal to reduce loss potentials through a mixture of mitigation, pure risk finance and risk transfer.

Provided that the goals have been agreed upon and resources are made available, the next step is to formulate a strategy.

### Selecting a Strategy

A viable strategy is needed to link goals and specific institutional and organizational solutions in a logical and realistic way. This section illustrates potential strategic options that seem relevant for the countries studied.

Figure 5 portrays four potential strategies that seem relevant for Latin American countries like Chile, El Salvador and Peru. Two dimensions are used to identify the strategies; one is related to the issue of pooling risks (vertical axis) and the other to the downstream relation, that is, how end customers relate to risk financing institutions (horizontal axis).

The two strategic dimensions shown in the chart are central characteristics of the supply chain for risk finance services. The issue of pooling illustrates how risk (timing risk, underwriting risk, etc.) is transferred to financial institutions. The two alternatives highlighted here are via a captive pool or without pooling. The downstream relation reflects how financial services may be distributed to end customers. The first alternative is direct distribution via branch offices, agents that are controlled or commissioned by the financial institutions or the clients. Distribution networks for direct distribution are normal in mature markets. It

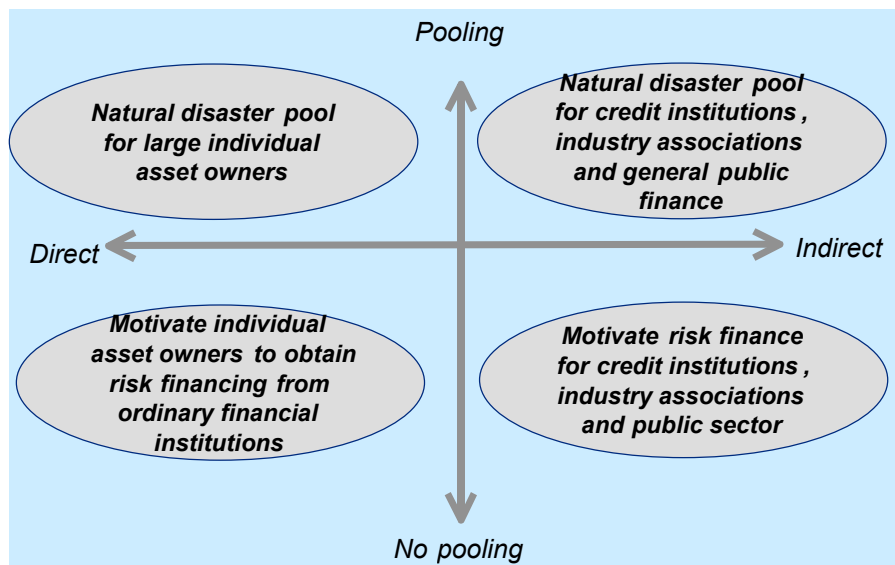
is, however, also possible to distribute risk finance indirectly via, for example, state social support systems, national natural hazard risk pools or credit insurance for ordinary banks.

*Pooling:* Risk finance may be organized through a captive pool or directly without a pool. Pooling provides three main benefits. First, a higher volume of premiums may be placed in the market under one single contract. Second, pooling reduces the risk carried by individual pool members since the relative standard deviation is diminished when the number of assets is increased. Third, the pool is an institution that may also be organized to take extended responsibility for risk management incentive regulation, information and distribution of services, and claim settlements.

*Downstream Relation and Distribution Networks:* The downstream relation links individual asset owners to the risk financing or insurance level. Effective downstream relations through modern distribution networks are costly and difficult to establish. Where, as in Peru, mortgage financing is rare, there is normally limited reliable information on property values and physical standards of real estate. The indirect approach to risk finance may be the only feasible solution when distribution networks for financial services are weak. However, indirect solutions will only cover the risks of individual asset owners to a limited extent.

Four alternative strategies are suggested based on this particular selection of risk finance strategic

**Figure 5. Four Strategic Options for Financial Protection**



dimensions: (i) pooled, indirect (upper, right corner of figure 5), (ii) pooled, direct (upper, left corner), (iii) non-pooled, direct (lower, left), and (iv) non-pooled, indirect (lower, right). The pooled, indirect strategy involves establishing a captive pool, including the central government, industry associations and individual credit institutions as members. End customers, including schools, hospitals, private enterprises and homeowners, would be covered indirectly through a cushion on the real balance sheets of public authorities, credit institutions, and other such organizations.

Indirect provision of risk finance, through credit insurance of mortgage banks, for example, has the potential to reduce interests since the risks for credit institutions related to natural hazards are financed more effectively than before. Public service providers will see a de facto reduction in risks since the state will have funds to compensate losses after a disaster. A substantial share of asset values will, however, remain uncovered since debt financing will be the only way to achieve risk finance or transfer if these services are provided in combination with ordinary loans. Some uncertainty for public service providers will also remain if the distribution of extraordinary public budget allocation is unpredictable.

Pooled, direct risk financing strategies involve individual asset owners, such as large industrial enterprises, municipalities, hospitals, universities and infrastructure companies, as pool members. The pool will normally be wholesale oriented, that is, it would not be oriented toward the retail market of private individuals. Private individuals will be limited to indirect coverage via their relationship with ordinary credit institutions, public services and social security systems.

Non-pooled, direct risk financing provides services via ordinary financial markets directly to asset owners. To achieve risk financing there may be a need to improve the penetration of risk transfer among asset owners due to market imperfections. As noted above, mandatory risk finance or insurance as well as subsidies, tax exemptions, and other such measures may be appropriate to reinforce private incentives. Chile has implemented policies to combine natural hazard insurance with private housing finance.

Non-pooled, indirect risk financing represents a situation where pooling is inappropriate or unrealistic and the capacity for distributing risk financing to end customers is underdeveloped. Policies aiming to improve risk financing are, in this case, directed toward institutions that provide financial services to end customers (e.g., mortgage banks, ordinary and life insurance, health insurance and the government itself). Incentives and regulations may be used to stimulate the financing and transfer of natural hazard risks for these institutions. The studies undertaken by multilateral development banks have paid particular attention to risk financing for state budgets.

Operational goals and institutional solutions need to be based on a clear strategy. Different economic characteristics will determine the choice of strategy, the necessary institutional development and the selection of specific risk financing instruments. The three countries studied vary according to distribution systems, status of insurance and financial markets, and the potential for pool organization. The two strategic dimensions forming the four strategies are also relevant as a basis for strategy formulation in the three countries.

### **Imperfect Markets for Risk Management**

Risk management and finance are subject to normal supply and demand dynamics. There are several reasons why market conduct may require public regulation. Some of the reasons relate to insufficient distribution systems and inadequate dissemination of information. The confidence needed to attract financing is achieved through the interaction of asset owners, intermediaries and financing institutions on several levels over time.

The importance of both market imperfections and the distribution network is described below with reference to the basic properties of markets for risk management services.

Most countries pursue policies of extensive regulation of risk management and finance. Risk financing of natural hazard risks is a particular area for governmental intervention in the economies of Western Europe and North America. The main arguments for regulation (for example, through mandatory insurance, public guarantee funds, etc.)



focus on the demand side. The reasons for government intervention in risk management markets include the undervaluation of risks, imperfect or asymmetric information, and undervalued effects of risk management.

*Undervaluation of Risks:* Risks may be undervalued for a range of reasons, including the financial situation of the asset owners and unclear property rights. Poor people are primarily concerned with near-term needs. The government can be seen to carry the risk exposure of the poorest part of the population. When coffee growers in El Salvador give low priority to natural hazard risk financing, they take only private risks into consideration. Their valuation may thus not reflect the preferences of the workers, the financing institutions supporting the coffee growers and the need for stable economic development. Unclear property rights may generally contribute to insufficient motivation for risk financing and mitigation.

*Imperfect or Asymmetric Information:* Adverse selection and moral hazard tend to arise from imperfect or asymmetric information. Distribution networks should include comprehensive control mechanisms to fix and differentiate premiums, monitor conduct and facilitate claims settlement. The penetration of insurance and other risk transfer instruments will be limited if the monitoring of risk management is particularly complicated. Only national natural hazard risk pools (e.g., the Norwegian pool) can afford to dismiss adverse selection and moral hazard as insignificant or politically unimportant compared to the value of universal and evenly distributed social security.

*Undervalued Effects of Risk Management:* The undervaluation of the effects of risk management tends to result in lower investment in risk mitigation than socially desirable. Private mitigation may benefit additional agents. One example is deforestation and soil erosion. While forestation may reduce flooding and landslide risks along the lower reaches of local rivers, the moving of soils may destabilize land surfaces over surrounding areas. Increasing insurance volumes may cause positive spillover effects by attracting additional insurance services into the market. Public policies may contribute to the undervaluation of risk mitigation. Responsibility for public risk mitigation is to a

large extent decentralized in Norway, thereby risking undervaluation of positive and negative spillover effects between neighboring municipalities (ECON, 2001).

Both complex distribution channels for risk management services and market regulations are needed to overcome some market imperfections. The distribution channels associated with the introduction and application of risk finance and transfer are discussed below.

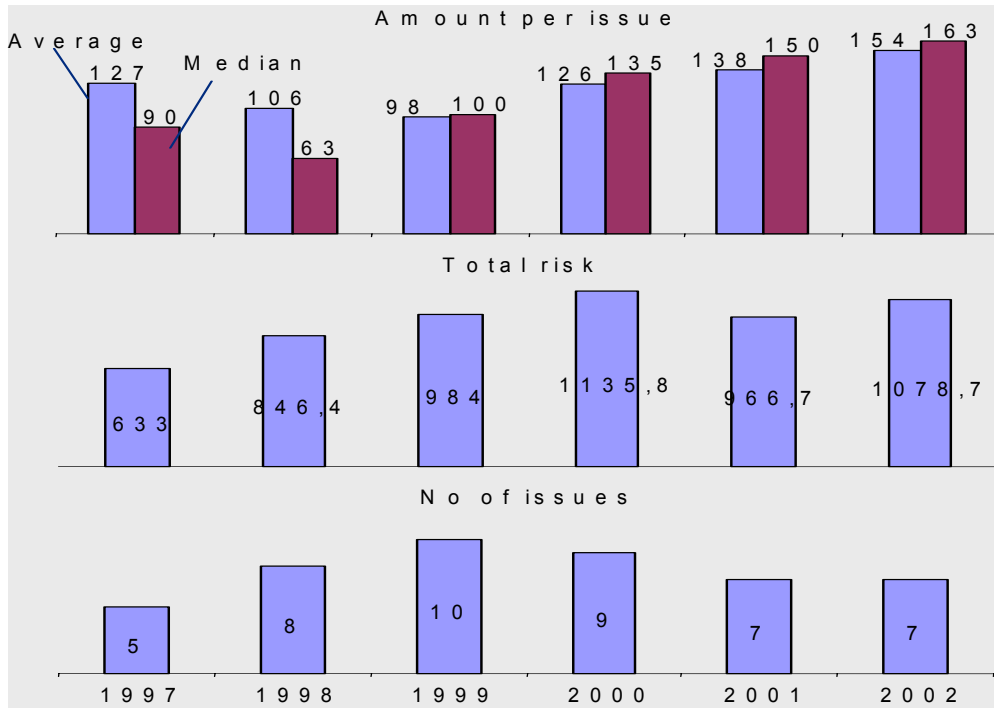
### **Lack of Scale**

Small markets limit the scope for scale of sensitive services and effective competition among suppliers. Economies of scale arise from factors such as efficient distribution networks and lower transaction costs associated with the introduction of new financial products

The optimal institutional solution should consider the appropriate scale of operations to help diversify risks, provide purchasing power in international markets, and provide adequate risk descriptions and analysis. If pooling of risks is recommended, a larger scale will allow for greater portfolio diversification, thus lowering the risks for individual members and enabling the country to hold a higher share of retained risks, provided that incentives and monitoring mechanisms prohibit moral hazard and adverse selection. Furthermore, the three countries considered in this paper may be able to establish a sufficient premium base on their own to approach international markets if they are able to build portfolios that include a significant share of assets. Finally, improved risk descriptions may help to lower risk premiums as pricing of risk in financial markets is sensitive to the quality of risk statistics and vulnerability estimates.

Figure 6 shows the average value per issue of cat bonds. In 2002, the average value was above US\$150 million and the median was more than US\$160 million. The difference between the average and the median indicates that there may still be a significant number of smaller issues. One small issue during 2002 was a placement of US\$33 million in cat bonds for the British retail insurer Hiscox Group, which was carried out by Aon. Today, there may be reason to establish a

**Figure 6. Cat Bonds: Number of Issues, Total and Average Risk Per Issue. 1997-2002.**  
**Number and US\$ Million**



Source: Marsh and McLennan Securities, 2003

US\$1 billion threshold for the installation of a new cat bond issue related to natural hazards in Latin America to provide a basis for substantial investments in risk modeling, institutional developments and transaction costs.

Provided that public authorities involve themselves in the provision of risk finance and transfer, scale requirements should not be a major obstacle for Latin American countries. The potential losses from natural hazards in the three countries studied may amount to five to seven percent of GDP when incidents of a frequency of 1 every 100 years are taken into account. In comparison, transferring risk of US\$200 million (i.e. slightly above the current average) would cover 1.5, 0.45 and 0.1 percent of GNP in El Salvador, Chile and Peru respectively (figure 7). Provided that cat bonds would only be used for a margin of total loss potential, it may be difficult to issue cat bonds to the amounts of US\$1 billion for one single country.

Both the private and public sector demand for risk financing and transfer is limited. The subsequent country studies show all three lack sufficient risk

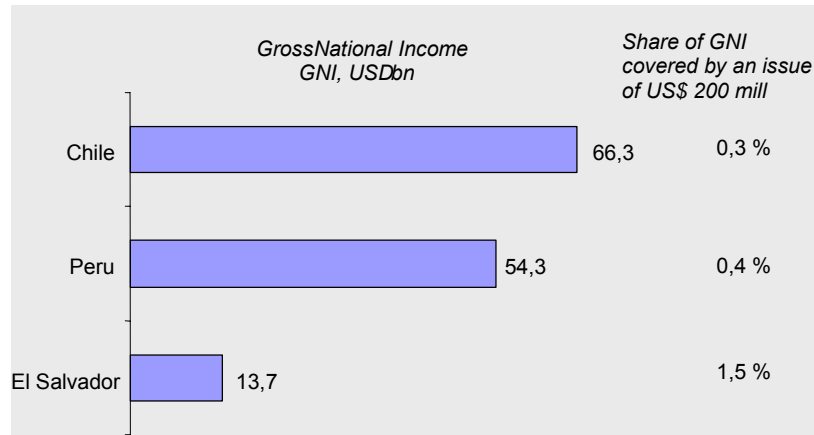
financing for public sector assets and private housing. Industrial assets are to a larger extent covered, often due to international ownership. There is, therefore, a need to coordinate individual agents and sectors in order to generate sufficient demand for the establishment of new insurance products.

### **Inadequate Distribution Networks**

Developing distribution networks is essential for risk financing and transfer. The distribution network is the system of agents, claim adjusters, surveillance authorities and channels for money transfers that connect asset owners and risk financiers and investors.

Characteristics of the distribution networks associated with risk finance resemble those of other prominent networks (e.g., telecom networks). Extra subscribers add value for those already within the network. One subscriber may, due to certain behavioral characteristics, add more value to some networked agents than another. For similar reasons, networks for distribution of risk financing

**Figure 7. Gross National Income Related to the Size of a Rational Cat Bond Issue. 2002**



Source: IMF, ECON Analysis

services may not be effective unless there is a certain volume of contracting, premiums and claim settlements taking place. In addition, the agents making use of and providing networked facilities must have characteristics that make the network more attractive. In the case of insurance, all asset owners having high standards of risk management will tend to lose out if the network is open to asset owners that exploit opportunities to transfer extra risk without premium increases.

Financial markets in some Latin American countries may be immature and the distribution systems for primary insurance may be insufficient to allow for widespread use of financial instruments. Beyond the local availability of agencies and brokers dealing with risk financing and transfer mechanisms, facilities connecting the potentially insured and insurers are critical for the application of financial mechanisms. These facilities (insurance agents, asset and loss valuers, claim settlement procedures, etc.) comprise the distribution network considered here.

The distribution network may determine both the volume of insurance premiums available and the reliability of information on risks and vulnerability. Provided that a distribution system is in place, widespread use of mortgage financing may facilitate quantifying the value of exposed assets. Businesses that provide real estate appraisals may improve the claim settlement process. Each part of the network can increase participation and enhance

efficiency. The requirements of the distribution system may vary according to the financial instruments applied. For instance, with no risk transfer there is no need for comprehensive claim settlement capacities and protection against moral hazard and adverse selection. Compared to risk finance schemes, risk transfer schemes require little need for credit risk assessments.

An insufficient distribution capacity has been found in each of the three country studies, but the deficiency is especially visible in Peru. The most likely solutions in such instances may be to rely on government channels (i.e. ordinary social security programs, industry associations, microfinance institutions, NGOs, donor supported projects, etc.) to develop risk management services. Earlier studies have focused on government networks, either using the government as the hub of the network for distribution and claim settlement or through regulatory reforms to trigger private interest in risk finance.

Extensive claim settlements must be distributed in a post-disaster situation. This process has the potential to create incentives for excessive transactions and corruption. The risk of corruption may be particularly important where governmental authorities are supposed to replace privately organized distribution networks and claim settlement systems. Risk financing with no effective distribution network may therefore be incompatible with socially efficient risk management.

## Donors' Influence

All organizations, for profit or nonprofit alike, are shaped by those who fund them (Lowell et al., 2001). Donor countries and development banks have a strong impact on government behavior in recipient and borrowing countries. Although El Salvador and Chile enjoy relatively attractive credit ratings in international capital markets, and the creditworthiness of Peru is strongly improving, the three countries also receive substantial credits via multilateral development organizations such as the IDB and the World Bank. All three will also most certainly depend on international emergency transfers in the case of severe natural hazards.

Donor behavior is considered a major driving force in institutional development. The way supporters shape institutions and organizations is described in both the literature on economic development and the analyses of nonprofit organizations. In a study of these organizations in the United States, Lowell, et al. (2001) concluded that:

- Most donors give money earmarked for specific programs and projects rather than for long-term investments in the organization. Tied assistance is also normal for relief and development assistance.
- Donors' time horizons are short, implying that NGOs and other nonprofit organizations are forced to focus continuously on near-term fundraising.
- Lack of substantive performance measures providing reliable and relevant information on the real value of transfers tends to cement donors' inclination to be short-term project oriented.

The World Bank's 2002 *World Development Report* identifies similar mechanisms on the macro scale. Recommendations suggest that donors should strengthen the relations between public institutions in the recipient countries. This means, inter alia, that donors should integrate their support into ordinary national budgets and service delivery systems of recipient countries rather than employ project specific distribution networks. Donor behavior has historically contributed incen-

tive-driven recipient institutions and organizations that operate at insufficient scale and capacity. Furthermore, specific field projects with tailored aid channeling are prioritized over less visible and longer-term organizational capacity building.

The priorities of donors will normally be reflected in recipient country priorities due to the incentive system in operation. Pre-hazard financing requires institutional development to enable fiscal policies that make risk financing a part of ordinary budgeting in the recipient country. It is arguably easier to motivate governments to finance emergency relief in post-disaster situations, but long-term effects are far less attractive.

The result, as observed by Lowell, et al. (2001), is that the receiver of donations pays too much attention to short-term finance. According to the World Bank, the compacts between policymakers, service providers and the population are bypassed and weakened by typical donor behavior.

Inappropriate donor behavior may increase the loss potential of developing countries. The lack of longer-term financing to prepare for emergency situations exacerbates the difficulties of developing economies to develop their institutional capacities. On the other hand, spontaneous organizing will certainly take place when money and in-kind transfers enter the economy in the aftermath of an incident. Such ad hoc organizing may, however, tend to increase corruption and provide more porous transfer systems for emergency relief than the preferred stable and long-term oriented transfer systems.

## Elements of Institutional Development

The practical tasks associated with institutional development are well documented. Operational objectives need to be formulated in accordance with the chosen strategy. However, objectives are insufficient without addressing the incentive systems for key stakeholders (e.g., participating agents and governors). The effects of inconsistency between objectives and incentives vary from general ineffectiveness to large-scale corruption.

Organizing institutions also means that certain resources must be provided. Competence and sur-

veillance capacity are among the most important factors in effective risk financing systems. Competence relates to motivational, financial and regulatory elements of the implementation process for improved risk financing. Sufficient surveillance capacity is needed to avoid moral hazard, corruption and fraud in a system where money transactions are numerous, often very large and, at the same time subjectively valued by claim adjusters.

An additional element is the provision of scale in financial operations. For risk transfer schemes (for example, cat bonds) to be viable, a certain minimum loss potential or volume of premiums is required. The pricing of other financial instruments also varies with volume.

### **Integrating Risk Finance with General Risk Management**

Risk financing should be integrated into other aspects of risk management such as national crisis management systems. According to Freeman et al. (2003) the proper integration of financial and physical aspects seems difficult to achieve.

Several aspects of the institutional development are discussed in the literature (including various case studies and normative reports). The Asian Development Bank's *Disaster Manager's Handbook* has a rather detailed description of a hierarchical and centralized national emergency system. The balance between local autonomy and flexibility on the one hand, and the need for central coordination on the other, is one important challenge that needs to be considered.

Another issue that deserves attention is the involvement of private financial institutions. Recommended institutional solutions for national risk and civil emergency management traditionally give little attention to the involvement of the private insurance industry. In addition, there are often weak links between the physical and financial aspects of risk management. This point was clearly made by representatives of the emergency services systems during the Chile case study.

### **Developing National Capacities**

There is no scope for a public authority to develop full risk financing services networks (unless moving toward a centrally planned economy). Rather, the institutional challenge is to make sure that two conditions are met: First that there is sufficient aggregation of demand and management capacity for socially important risk financing; second, that there is sufficient and effective surveillance of conduct among services providers. Decentralized decision-making alone may be expected to produce inefficient scale and market inefficiency due to asymmetric information, imperfect competition, and so on.

When financial markets are poorly developed and risk statistics and modeling capacities are underdeveloped, there is a need to aggregate volumes of risks and premiums to successfully finance national risks in international markets. Where there are inefficient distribution systems, a pool of assets may be needed in order to provide a critical mass. A substantial pool of public assets may also be more likely to enable the financing of important infrastructure like risk research and modeling capacity than individual insurance companies and asset owners.

Aggregation at the national level is also needed in order to achieve critical mass for the use of risk-linked securities (e.g., cat bonds). Substantial transaction costs necessitate scale. Issues of cat bonds may need to be of around US\$1 billion each with duration of one to three years. Limited periods of duration also make transaction costs substantial over time.

Finally, national pool arrangements imply a risk of negative incentives that may cause moral hazard and adverse selection. A pool administration should therefore have the capacity and power to implement incentive schemes and surveillance systems that motivate risk management for the benefit of the total group of pool participants.

### **Regional Efforts to Improve Risk Management**

Several Latin American countries may be able to secure a more efficient scale through international cooperation. Several transnational initiatives were

observed when the study was underway. One of the most important initiatives relates to research on and surveillance of the El Niño phenomenon. Several Pacific coast countries in Central and South America participate in international research programs that may help model risks, develop early warning systems and mitigate losses. The research may be of significant value in the ongoing efforts to improve risk finance in Latin American economies that are exposed to the effects of El Niño.

International cooperation may also provide opportunities for increased scale in the provision of risk financing and transfer. Cooperation along the Pacific coast could conceivably lead to an issue of sector-wide parametric or industry-loss index based cat bonds. Thereby, investors may have the opportunity to diversify investments in risk-linked securities by sector. Any opportunity for diversified risk management is normally considered an advantage.

The particular risks related to El Niño may illustrate the importance of diversification of risk-linked securities. Assume, for example, that an issue of cat bonds is linked to potential losses for the marine industries arising from El Niño. The production of fish oils and fats is largely based on the Pacific coast of Latin America. It can be expected that natural hazards in this area will affect the price of fish oils in international markets. Thus, the issuance of El Niño related cat bonds may provide international suppliers of fish oils with an attractive hedging opportunity, since the price of fish oils may be expected to vary negatively with the return on a cat bond linked to the losses for the marine industry in the region. To benefit from these attractive options for hedging, marine industries in the countries of the region should cooperate to provide a potential loss base of sufficient aggregate size to issue a securitized risk instrument with very clear risk characteristics. By pooling their risks they avoid having to individually approach international investors through ordinary channels of international finance, and equity owners of the same institutions.

## Financing Risks

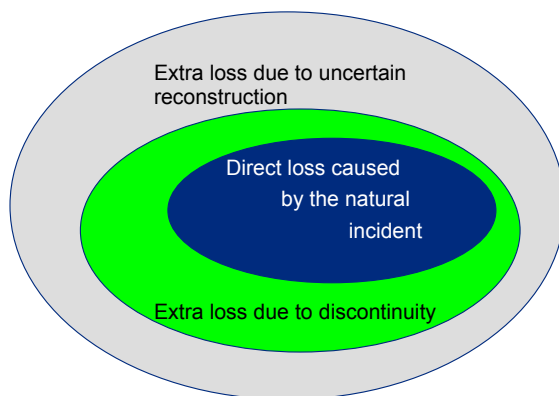
Evaluation and selection of specific financial instruments is a technical issue that must be solved within an adequate institutional and strategic framework. This section discusses the structure of financing, and the selection of instruments. It follows from the interrelationship between goals, institutions and operational financing that there is no professional basis for giving a general recommendation of which instruments to apply.

The motivation for improved risk financing can be strengthened if the potential benefits are made more explicit and 'visible.' The net benefit of risk finance, however, depends on four broadly defined factors: (i) the pricing of natural hazard risk; (ii) transaction costs; (iii) the net social costs of shifting the distribution of consumption over time; and, (iv) the welfare loss of insufficient risk finance.

Risks may be financed through the transfer of the underwriting risks or through pure risk financing (e.g., savings and loans arrangements). Risk transfer to insurers/reinsurers or international investors requires pricing of the underwriting risk related to natural hazards. The premiums to be paid to the underwriters provide valuable insight into the pricing of natural hazard risks. An inspection of available risk pricing data seems to indicate that risk pricing exceeds the levels that may be expected from simple theories of risk pricing in efficient capital markets.

The pricing of risks is discussed in capital market theory. Risk aversion causes investors to spread investments among a range of financial instruments constituting a broad and representative market portfolio of assets. International financial markets offer a range of options for developing rational investment portfolios to match the preferred balance of risk and expected returns of individual investors. The higher expected return, the higher the risk. Markets where there is a potential for improved expected return without incurring extra risks are inefficient. Due to effective dissemination of information, international capital markets may be expected to consistently require extra returns in order to finance extra risks.

**Figure 8. Different Types of Losses to Be Covered by Risk Finance**



Source: ECON Analysis.

According to the capital asset pricing model (Brealey and Myers, 2003), the pricing of a financial instrument depends on its systematic risk, that is, the covariation over time between the return on a highly diversified asset portfolio and the particular instrument in question. A high correlation among returns raises the price, whereas uncorrelated risks do not give rise to risk premiums. This means the margin above the risk-free interest rate needed to attract investments will be reduced when the correlation between the return on the market portfolio and the particular instrument is reduced and vice versa.

Two implications of this relationship are central to natural hazard risk management. Firstly, such risks may be favorably priced to the extent that natural hazard risks and highly diversified market portfolios are uncorrelated (i.e., to the extent that the natural hazard risk is unsystematic). Secondly, there are strong theoretical arguments as to why the transfer of risks to international capital markets will tend to reduce the costs of risk financing for risk-averse decisionmakers. Without such transfer, the nation will be exposed to most natural hazard risks, a significant share of the systematic risks and most non-systematic risks. Even at the national level there is limited room for diversification to reduce natural hazard risks.

Normally one would assume that there is no correlation between losses from natural hazards in Latin American countries and the performance of broad market portfolios in international financial markets. The risk is substantial but non-systematic and, thereby, diversifiable for investors. Being included in a broad asset portfolio, the natural

hazard risk financing instruments, therefore, add insignificant risk to the aggregate investment portfolio. The pricing of the risk itself should therefore in theory be negligible if transferred to international financial markets. Risk finance for natural hazards should be available at lower or negligible risk premiums compared to most corporate equity instruments. Only high transaction costs, costly distribution networks and institutional requirements may hinder the benefits of risk diversification from being available to nations prone to natural hazard risks. However, natural hazard risk pricing does not, in practice, reflect these theoretical assumptions (see below).

Access to international financial markets for risk financing may provide a valuable option for risk-averse nations. Pure risk financing (for example via savings and contingent loan capital) may suffice to achieve resilience; however, at the same time be ineffective from a cost perspective. In the pure and restricted national closed economy, natural hazard risks are to be considered systematic since the level of national consumption, the value of assets, and the natural hazard losses will most likely be strongly correlated. All natural hazard risks retained will add to the volatility of the welfare of the population.

The compensation paid to an insurer or investor buying securitized risks consists of three elements. The first is the interest element that is needed to compensate a buyer of, for example, a cat bond, for the alternative risk-free interest renounced. The second element is the expected annual loss that reflects the underlying risk. The third is the spread, the element reflecting the specific pricing of the

risk itself. The annual expected loss has to be an objective estimate calculated by a neutral risk modeling capacity and published and made available to all potential investors on an equal basis. The risk-free interest rates will reflect international risk-free interest rates and shifts in expected currency exchange rates.

Capital market theory states that natural hazard risks should be priced according to the extent of systematic risk involved. The discussion among scholars of the effects of the events of September 11, 2001 on international reinsurance markets provides an illustration of the mechanism and the extent to which risk pricing reflects theoretical assumptions. According to Jozef de Mey (2003), the perception of systemic risks shifted after September 2001. The correlation between the occurrence of terrorist attacks and the observed performance of global market portfolios implied that disasters outside the financial area should be considered increasingly related to financial markets risks.

Before September 2001, the liabilities of reinsurance companies (e.g. expected claims) were expected to perform independently of the companies' financial assets. Today, equity financing and solidity assessments need to take into account a new systemic risk. A terrorist attack may hurt both sides of the balance sheet, thereby providing a double effect of weakening the balance. One of the consequences observed by de Mey (2003) is a sustained rise in reinsurance premiums and more selectively adapted contracts with new kinds of reservations, escape clauses and flexibility for the reinsurer.

De Mey's analysis illustrates that perceptions of systemic risks change over time. A natural hazard in Latin America that has an impact on national credit ratings to the extent that international stock prices are shifted, may cause a new perception of the systemic risks from natural hazards. Except for some major countries like Argentina and Brazil, it is difficult to see that such a link is realistic today. Therefore, it may still be assumed that natural hazard risks are unrelated to market portfolio risks.

A second and more important implication for natural hazard risk financing is that the pricing of risks in reinsurance and international financial markets

may, for institutional reasons, be less selective than expected. According to de Mey (2003), reinsurance premiums were generally raised due to a tendency to place a greater weight on the solidity of the reinsurers. This "flight to quality" gave the most solid reinsurance companies strong bargaining power across most market segments. In this way, September 11 also had an impact on the markets for securitized natural hazard risks. Since most reinsurance companies hold broad portfolios of risks, the whole industry is essentially exposed to terrorist attacks and feels the increased need for solidity, coupled with a tendency for risk pricing to be raised.

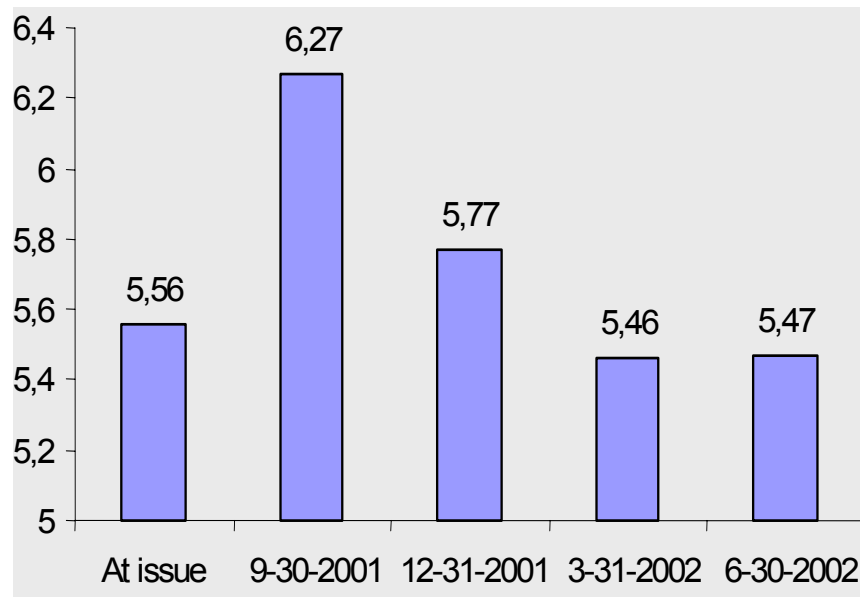
There is substantial variation in the valuation of financial instruments and their pricing that are neither related to interest rates nor to risk preferences. The price turmoil succeeding September 2001 in the market for cat bonds is illustrated in Figure 9. Cat bonds are priced according to the situation in the reinsurance market that serves as the dominating source of underwriting capacity for natural hazards. The availability of funds dried up while insurance companies were in need of extra funding. Therefore, the pricing of risks increased substantially without any shift in the correlation between natural hazard losses and the return on market portfolios or risk premiums in the financial market in general.

This kind of volatility may be explained by a combination of limited liquidity, even in global financial markets, and the "flight to quality" pointed out by de Mey. In some situations, supply or demand turns out to be insufficiently elastic to avoid stronger cycles than what may be explained by underlying risk preferences, interest rates and perceptions of volatility.

This analysis suggests that single events have the potential to swiftly shift risk pricing in the reinsurance and cat bonds market by up to 20 percent. The level of risk spreads that are portrayed in the exhibit are also above 5.5 percent, meaning that natural hazard risks are priced above the risk premiums that are normally observed for the market portfolio on average. The latter observation seems contradictory to the theory on pricing of unsystematic risk according to capital market theory.



**Figure 9. Yield spreads defined as the difference between annual calculated yield and LIBOR 3 months, i.e. the net price of underlying risk.**



Source: Lane (2002), ECON Analysis

Concerns about restricted capacity in the reinsurance markets were common long before September 2001. Cat bonds introduced after major hurricanes in the western United States during the 1990s were observed to ‘dry up’ reinsurance capacity. But since such instruments ultimately address the same financial market that provides equity to the reinsurance industry, the capacity issue is not a full explanation of rising costs. As de Mey (2003) points out, the reinsurance industry that lost about US\$30 to US\$60 billion was able to raise US\$20 billion in new equity in relatively weak markets within four months after the disastrous event.

Risk premiums in the cat bonds market rise strongly with expected annual loss, which is also difficult to explain from ordinary capital market theory. Figure 10 shows the relation between risk premiums (spreads) and expected annual loss. Risks above annual expected losses of one percentage point of total value imply risk premiums of up to eight percent. Real risk free interest rates of four percent will imply a yield on cat bonds related to rather normal natural hazard risks of more than 11 percent in real terms. Lane (2002) has emphasized the same relation between annual expected loss and spread (Figure 11).

There are other factors that may explain the high costs of natural hazard risk transfer. One is that the magnitude of single risks implies that reinsurers need to accumulate extra equity to back underwriting without losing too much in terms of credit ratings. Harrington and Niehaus (2003) have studied the impact of taxes on the costs for financing natural hazard risk underwriting. Their conclusion is that ordinary tax regimes in the United States may cause very high tax costs on the build-up of equity. Tax regimes necessitate the use of offshore single purpose vehicles (SPVs) for cat bond issues and fund management to reduce tax costs. However, since both cat bonds and reinsurance fund management are typically located in some form of tax haven, tax costs should not be a major cost driver for reinsurance and funding of natural hazard risk underwriting.

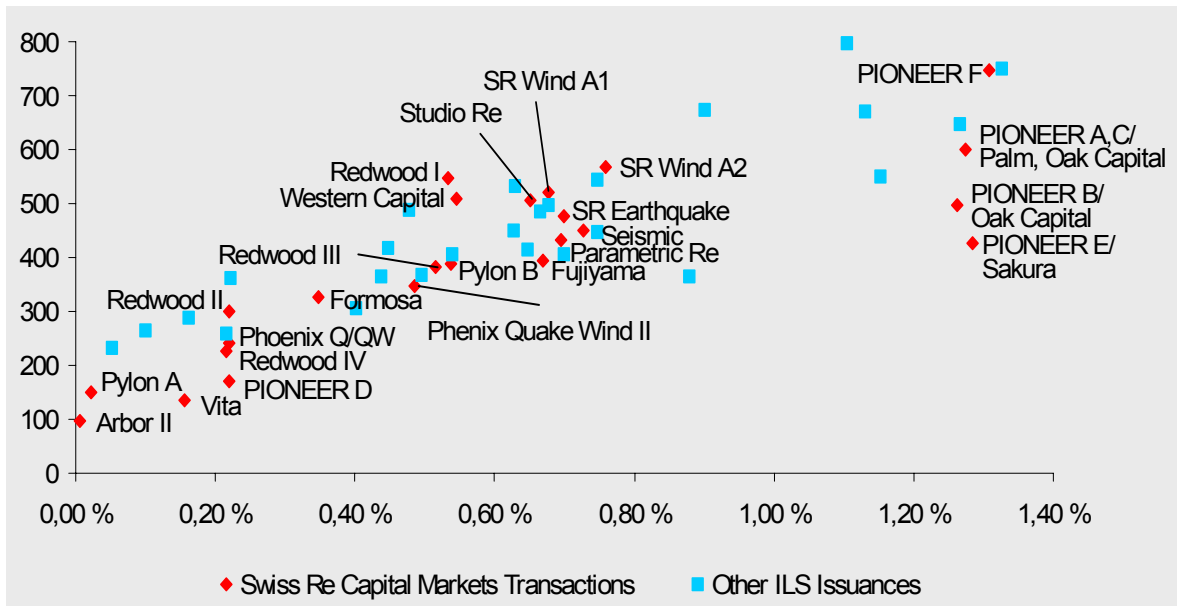
There are some signs of downward trends in the pricing of natural hazard risk. Figure 12 portrays the development of spreads for four different cat bonds. As is seen from the graph, all curves tend to fall toward December 2003. The variation in spreads is also diminishing.

## Transaction Costs

The second main element in the cost-benefit presentation is transaction costs. Transaction costs consist of three components: the cost of contracting, information costs, and the costs of monitoring performance over time. Transaction costs weigh significantly in risk financing and

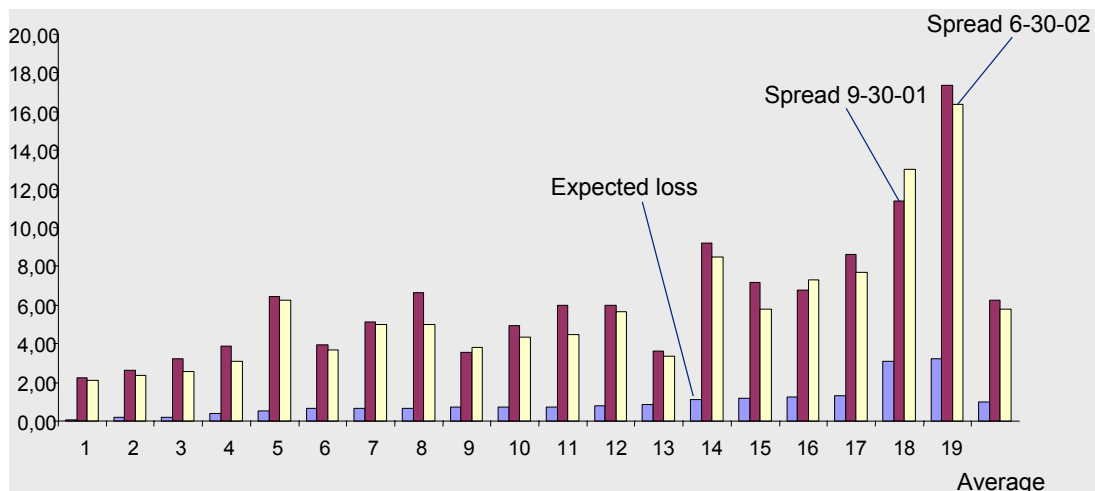
transfer. The consequence is that specific transactions like catastrophe bond issues may require a substantial minimum premium potential to be cost effective. This is typically explained with reference to the complexity of the contracts, the need for extensive information, and the substantial costs associated with monitoring risk management and mitigation.

**Figure 10. Observed Combinations of Expected Annual Loss in Percentage Points of Total Insured Value Per Year (Horizontally) and Price Spread in Base Points (Vertically)**



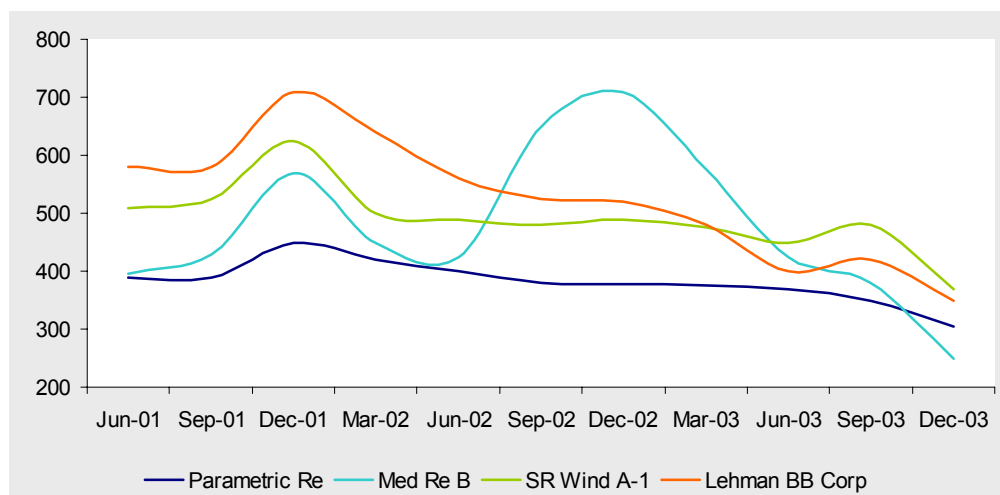
Note: The graph portrays cat bond issues since 1997, pricing at time of issue. Some selected issues are named. Price spread measures the difference between total yields and the sum of expected annual loss and the LIBOR interest rate. Source: Swiss Re (2004)

**Figure 11. Expected Loss Per Annum and Pricing of Cat Bonds (Spread in Percent of Bond Values) in Secondary Markets; September 2001 and June 2002. Figures across 19 cat bond issues and the unweighted average**



Source: Lane (2002), ECON Analysis

**Figure 12. Trend in Spreads. Four Selected Cat Bonds.  
June 2001 to December 2003. Base points**



Source: The graph reproduced from Swiss Re, 2004, Figure 12 using smoothed curves

Transaction costs are generally a key factor when explaining economic behavior. According to Williamson (1975 and 1985), transaction costs may determine whether to provide economic goods internally within the organization or in the marketplace. Internal provision of risk transfer may determine production through a vertically integrated captive unit instead of an external underwriter. In Williamson's terminology, this reflects the choice between hierarchy and market. When applied to the issue of transferring risk to international investors, transaction costs may play a key role in identifying to what extent risks should be retained, managed through pure risk finance or transferred to the international capital markets.

Carlton and Perloff (1994) review a list of factors relating to transaction costs, including asset specificity, information costs and costs of monitoring. They emphasize that the transaction-related uncertainties create a need for information and complex contract arrangements like canceling options, disclaimers of liability, insured's obligations, and so on. If, in addition, information is hardly obtainable, external sourcing may prove too costly and risky compared to self-insurance.

The general characteristics of risk transfers typically imply significant transaction costs. Risk transfer opportunities create incentives for moral hazard and adverse selection. Both types of conduct tend to transfer increased loss potential to the

underwriter beyond what is visible from the contract and the underlying statistically based risk descriptions. The underwriter has to implement strategies to reveal the true conduct of the insured, contract terms that discourage hidden actions and stimulate behavior in accordance with the interests of the underwriter.

There is no clear empirical evidence of transaction costs in natural hazard risk financing. Harrington and Niehaus (2003) found that the costs for loss adjustment comprise approximately 13 percent of actual losses for loss-based insurance. For developing countries, transaction costs may be significantly higher. Firstly, risk statistics and potential loss estimates may be difficult to obtain partly due to an incomplete institutional framework and evasive implementation of planning and building codes. Secondly, private sector insurance and long term financing is limited, implying the network needed to channel risk transfer instruments to individual households is underdeveloped or absent. As a consequence, the need to set up specialized arrangements to transfer risks increases the dependency between the insured and the insurer and thereby the risks attached to the particular relationship.

However, the most important factor driving cost levels is probably an inadequate description of risks. The attractiveness of risk-linked securities like cat bonds rests with the clarity of the underlying

ing risks. In some cases cat bonds cover a range of different risks. However, the majority of cat bond issues are only related to one specific risk factor in a well-defined geographical area. One challenge for less developed economies is to provide proper identification of risk and loss potentials. The pricing of well-defined risks may itself be a hindrance for risk transfer. When risks can hardly be defined, the pricing may be favorable to the insured.

### **Cost of Shifting the Timing of Consumption**

The costs of risk finance and transfer need to be compared to the costs for asset owners of highly volatile asset values and incomes. As shown by Freeman et al. (2003), natural hazard risk in Latin American countries is, to a large extent, both retained and underfinanced. This means that the effect of an incident will make its full potential impact on current and future consumption via lost real capital, reduced investments and reduced longer-term growth. The benefit of risk financing is not only to prevent suffering from the direct loss itself, but also to significantly strengthen the national capacity to recover from losses. Therefore, longer-term benefits may exceed the immediate benefits from reduced suffering.

People tend to be risk averse, that is, they are willing to accept some costs in order to achieve stability and resilience. However, the main argument for risk finance is not related to social risk preferences, but to the impact of risk financing on the real loss potential itself through reduced indirect losses.

The loss from a disastrous incident may be split into direct and indirect loss. The direct loss is the immediate loss of life, property and natural resources (e.g., marine biomass and forestry resources). Indirect losses arise from the consequential disruption of economic activity and uncertainty as regards the capacity for reconstruction and restoration. Indirect losses are primarily a consequence of insufficient risk financing. Therefore, the total loss potential from natural hazards may be significantly reduced through risk financing. The mitigation of the indirect loss potential can, in fact, be seen as an added benefit of the risk financing of the direct loss potential. Insufficient financing means increased likelihood of discontinuous

operations and uncertain reconstruction, two factors that form part of the aggregate underlying risks. These terms are explained in greater detail below and in table 7.

*Costs of Discontinuity:* A natural hazard interrupts industrial operations and deprives competent labor of its current occupation. Delayed rescue operations and planning for reconstruction cause further asset deterioration. Remaining values of physical assets normally needs to be secured immediately after the incident. Trained workers who have lost their previous occupation may search for other sources of income or remain unemployed, thereby losing production capacity.

*Costs of Increased Uncertainty:* Uncertainty raises the cost of financing and deters direct inward investments. Enterprises considering investments in countries with insufficient risk financing must be prepared to live with unpredictable interruptions and reconstruction works in case of an incident.

The indirect losses from natural hazards have, to our knowledge, not been subject to extensive research. Observations from the three Latin American countries indicate that the time elapsed from the incident to the restoration of public services and production capacity is excessive and generates substantial and unnecessary extra losses. In addition, the human suffering of the population is greatly exacerbated.

The mining sector in Peru is particularly exposed to the impact of El Niño phenomena. The damage is, however, generally indirect and largely a consequence of insufficient road reconstruction capacity in sparsely populated areas. The interruption of transportation and the uncertainty regarding reconstruction adds to the cost of capital and shortens the time horizon for investments. Proper risk financing might, in this situation, stimulate longer-term investment and sustain economic growth in risk-prone regions.

Therefore, underfinanced risks are likely to hold significantly higher loss potential than adequately financed risks. Yet, the difference does not depend on the particular instrument used for risk financing. To minimize indirect losses as defined above, only the degree of risk financing is important. The

essential function of risk financing is to avoid losses that may paralyze the economy by converting the sudden economic loss into predictable and tolerable regular longer-term financial commitments. Whether risk transfer reduces the actual costs of risk financing is an open question.

As mentioned, on a purely theoretical basis, it is quite obvious that the international transfer of nationwide risk factors will be beneficial to a risk prone country. The simple theoretical arguments mentioned, however, assume that there are no transaction costs and there is perfect distribution of information. In such theoretical cases, risks are priced according to the normal capital asset pricing model.

In addition to focusing on the benefits of pure risk financing as a first step toward improved management of natural hazard risks, it is also recommended to search for risk transfer options with low transactional costs (e.g., parametric risk transfer).

### Safeguarding Incentives

As discussed previously, the main explanation for the insufficient degree of risk mitigation relates to incentives. One complication arising from emergency relief is that it does not reward mitigation. In addition, positive incentives do not automatically follow from improved risk financing.

As pointed out by Kelly and Kleffner (2003), it would be naïve to assume that incentives will be perfect if left to private insurance. The insurance or reinsurance industry cannot be expected to provide the socially optimal amount of risk mitigation. Public programs for risk mitigation are un-

dertaken in most advanced economies, reflecting the fact social benefits from mitigation normally exceed private benefits both to the underwriters and to the insured. The challenge for the government and the regulatory authorities is to furnish risk-financing schemes with adequate incentives for risk mitigation.

A study of the Norwegian Natural Disaster risk pool, which provides mandatory reinsurance of real estate for primary insurers, reveals how risk transfer and national pooling schemes may weaken incentives for risk mitigation (ECON, 2001). Lax enforcement of necessary planning codes and zoning has, to some extent, contributed to unnecessary exposure (e.g., to flooding risks) in Norway. The responsibilities for risk mitigation have probably incorrectly been considered unclear. Unclear responsibilities are considered a reason for insufficient risk mitigation. The study concludes that while responsibilities are clear, incentives remain weak. Incentives impact behavior, whereas formal responsibilities with no incentives do not. The national reinsurance pool operated more like a social security institution than a rational reinsurance arm effectively reinforcing risk mitigation incentives. For example, the pool had not been allowed to vary premiums according to enforcement of good zoning practices or to seek legal remedy for agents failing to meet other obligations for risk mitigation.

To regard public reinsurance schemes more as social security rather than as ordinary risk transfer systems is rather common (see for example, the 2003 Minkowitz's study of the State Insurance Guarantee funds in the Untied States).

**Table 7. Direct Loss and Loss from Discontinuity and the Impact of Insufficient Risk Finance**

<b><i>Kind of loss</i></b>	<b><i>Cause of loss</i></b>	<b><i>Impact of insufficient finance</i></b>
<b>Direct loss</b>	Natural disaster and quality of mitigation	Weak motivation for risk surveillance and mitigation insufficient rescue capacity
<b>Loss from discontinuity</b>	Unused and unguarded assets and competence deteriorate over time	Prolonged period of discontinuity
<b>Loss from uncertainty</b>	Increased cost of capital and reduced investment incentives	Increased uncertainty as to when and how recovery will take place

Source: ECON Analysis

## Incentive Distortions

Individual asset owners normally welcome any reduction in their own risks even when the reduction may be at the expense of others. From a social point of view, the motivation to mitigate risks should reflect the value of mitigation to the society.

Moral hazard and adverse selection reflect hidden actions that may substitute socially efficient risk mitigation. Both insurance contracts and government relief assistance may stimulate moral hazard that hinders risk mitigation. Private incentives for risk mitigation rarely reflect its social value due to moral hazard, for example. Reduced risk mitigation may be induced by the availability of international relief assistance working as free risk financing. Similarly, individual firms count their private costs from risk exposure, but it is rather unlikely that they count indirect social effects (e.g. interrupted employment).

The likelihood of negative incentive effects is most important for risk transfer schemes. Asset owners have an incentive to transfer risks where risks are underestimated by the insurer or third party investors, for example, due to asymmetric information (adverse selection). The insured maximizes the private value of the insurance contract by selectively transferring the risks related to the most vulnerable assets and minimizing the mitigation costs to the lowest level consistent with the terms of the insurance contract (moral hazard). Both kinds of behavior result from information asymmetries and imply inefficient markets for risk transfer with excessive premiums and spreads and underutilization of insurance instruments.

There is little distortion of incentives from pure risk finance since it simply spreads an expected or realized loss over time, thereby leaving the full underwriting risk with the asset owner. The asset owner covers his own losses through savings or repayment of loss related loans as long as solidity is maintained in spite of a loss. As the asset owner's direct loss will not be changed, his moti-

vation to mitigate risks will basically remain unchanged.<sup>1</sup>

## Improved Incentives through Risk Finance and Risk Transfer Schemes

Risk financing normally requires, at least, extensive monitoring of risks, and often, also monitoring of mitigation and other aspects of risk management practices. The ex ante estimation of potential losses requires a valuation of assets. The information collected may itself correct commonly shared views on risk exposure and thereby correct existing incentives. If risk financing is done collectively for a group of asset owners (e.g., via a pool arrangement), incentives may be built into the pool agreement to avoid negative, hidden actions that tend to increase collective loss potentials. Even credit institutions offering contingent capital or loans for risk financing may have an incentive to mitigate credit risks by stimulating good risk management practices among their debtors. Accordingly, even pure risk financing schemes may give rise to or be equipped with improved incentive schemes.

If no particular measures are implemented, incentives for risk management will normally fail to reflect the social value of risk mitigation. However, incentives may both improve or deteriorate as a consequence of different risk and financing arrangements. The issue of incentive effects depends upon the relationship between the asset owner and the underwriter or the insured and the insurer, the degree of openness and trust and the specific terms in the contract for risk financing.

## Selection of Financing Structure

Rational financing combines a portfolio of risk financing instruments. The following illustration is based on an assumption that risks are financed on behalf of a very substantial share of the national loss potential either through a national pool or at least on behalf of the government sector as one single asset owner. Based on the descriptions above, the structure of risk financing may consist

---

<sup>1</sup> There are other risk elements involved in risk finance and transfer such as credit and timing risks. The latter may be transferred through pure risk financing.

of four elements: (i) retained risks, (ii) pure risk financing, (iii) ordinary reinsurance, and (iv) cat bond issues or other risk linked securities targeting investors outside traditional insurance and reinsurance.

Figure 13 illustrates the potential role of each risk financing option as a function of annual loss probability and potential percentage loss of GDP. It assumes that the nation establishes a capacity to manage variations in disposable national income of up to two percent with the flexibility of its own resource deployment and no other financing. Variations due to natural hazards between 2 and 4 percent of GDP are financed by pure risk finance (e.g., contingent capital, and savings and loan agreements, etc.). Risks above these layers are transferred into two tranches. The first tranche is transferred via ordinary reinsurance. The losses are considered moderate, but the probabilities are substantial.

The last tranche is covered by use of the cat bond market through an issue of bonds with an expected loss per year of less than one percent of the total asset value. According to international experience, this may seem a rational share of risks to be financed through this particular instrument, provided that the maximum loss insured is at least US\$0.2 billion (preferably closer to US\$1 billion).

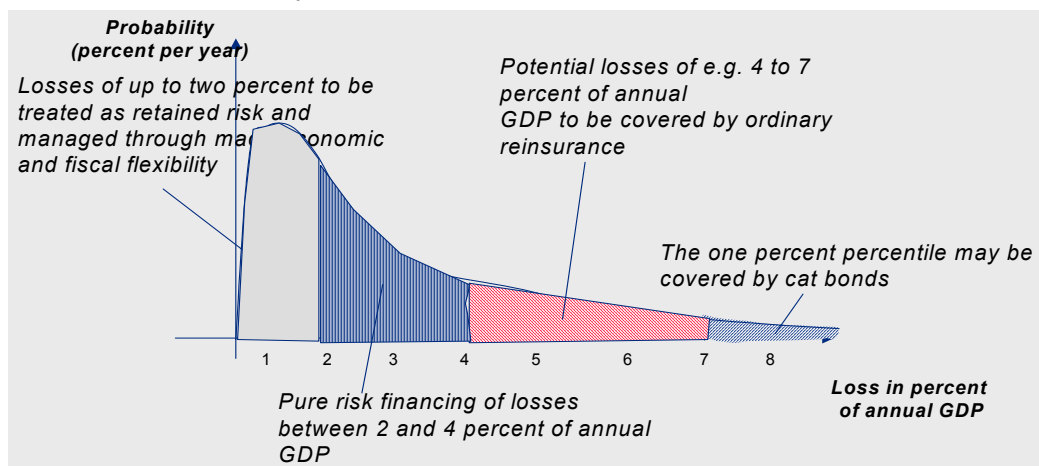
Retained risks, pure risk finance and risk transfer arrangements give rise to premiums, installments or regular deposits that need to be financed.

Retained risks, as illustrated in figure 13, are projected to constitute expected annual losses of up to approximately 0.5 percent of GDP. These may be covered by macroeconomic and fiscal flexibility. Although the amount to be reallocated (0.5 percent of GDP) may seem a small amount, it is significant given tight public budgets of 30 to 40 percent of GDP. The retained risks need to be included in national financial planning and fiscal budgeting. Insufficient financing means that an incident will impact living standards of the population directly and also cause excessive indirect losses.

Risk financing amounts to an annual expected loss of approximately at least two percent (adjusted for the effect of accruing interests). Amounts of this size will therefore have to be set aside annually in order to meet the obligations of potential pure risk financing agreements.

The two tranches of risk transfer will give rise to the payment of premiums that reflect the expected losses within each category, the risk premiums and interest rates.

**Figure 13. Structure of Risk Financing, Financial Instrument Used as a Function of Probability of Loss and Potential Loss as a Percent of GDP**



Source: ECON Analysis

# Risk Assessment and Risk Financing in Chile, El Salvador and Peru

The three countries surveyed for this report (Chile, El Salvador and Peru) need to improve the financial aspects of their risk management systems. This chapter summarizes findings from the three national studies performed by local consultants in Chile, El Salvador and Peru. The summary is structured under the following main observations: (i) the countries have a significant exposure to natural hazards; (ii) risk management is insufficient; (iii) the public sector and some housing segments are poorly covered; and (iv) the increased use of financial instruments is recommended.

- *Significant exposure to natural hazards:* Earthquakes seem the most important risk factor. In Peru, the relatively regularly occurring the El Niño phenomenon is an additional priority.
- *Insufficient risk management:* Risk management systems vary and are clearly insufficient, particularly in Peru and El Salvador. Risk financing schemes need to take into account potential affects on risk management in general.
- *The public sector and some housing segments are typically poorly covered.* The penetration of insurance is limited in all three countries. The lack of coverage against natural hazards is most severe in Peru, but all three countries have transferred an insignificant share of risk for public assets and private low value housing, both important segments to enhance economic progress.
- *Increased use of financial instruments is recommended:* All three countries need to apply risk finance to a greater extent. Risk transfer instruments could be applied more extensively in the public sector and, to some extent, in the private housing sector. The

study for Peru points to a general need to improve risk financing.

## Overview of Country Risk

Based on the frequency of occurrence and roughly estimated loss potentials, El Salvador seems the most severely exposed economy of the three. Earthquakes are the most important risk factors for El Salvador and Chile. Peru has good reasons to prioritize the management of risks associated with climatic factors like El Niño, a risk factor that is also a suitable case for cooperative risk management among adjacent countries.

## Earthquakes in El Salvador

El Salvador is relatively strongly exposed to natural hazards, particularly earthquakes. Frequent earthquakes may be expected to cause losses of around 5 to 12 percent of GDP. Experts expect that the country will suffer from earthquakes of this scale as often as every 5 years, with a potential for significantly higher losses every third time. The high frequency of disastrous events makes El Salvador the most exposed country of the three studied. In addition to earthquakes, floods and hurricanes also pose a significant risk (figure 14).

The relatively high frequency of substantial losses is a strong argument for establishing financial solutions. Compared to three other countries in the region, Freeman, et al. find that El Salvador is the most severely exposed (figure 15).

The loss potential from individual incidents is nevertheless limited compared to some other countries in the region. Hurricane Mitch caused losses of about 50 to 70 percent of annual GDP in neighboring Honduras, but limited damage to El Salvador when compared to the 1986 and 2001 earthquakes.



## The El Niño in Peru

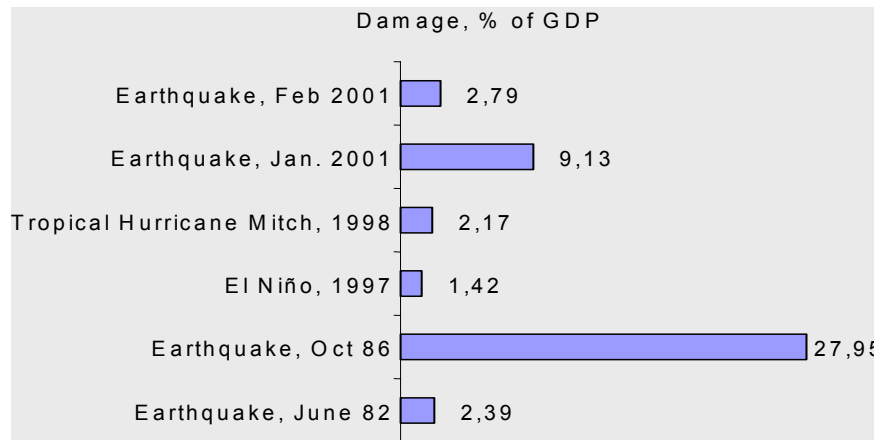
Damaging incidents from the El Niño phenomenon are rather frequent in Peru and result in losses that disrupt economic development.

*The total damage that may occur as often as every tenth year amounts to 4 to 8 percent of GDP.* The direct effects of El Niño are mainly related to physical capital onshore and fishing resources offshore. Public services normally suffer a large share of the losses (figure 16). Floods and landslides are often also related to El Niño.

*Efforts to research the management of El Niño-related risks have important implications for effective risk financing.* Research on the occurrences of El Niño is extensive and forecasting methods are being improved. Improved statistics and forecasting will support the development of financial instruments to manage risk.

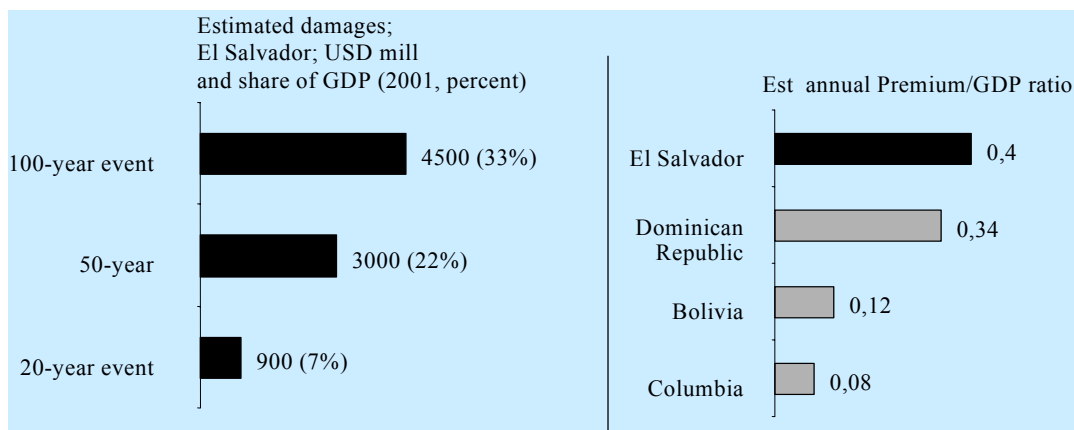
The case of El Niño is one where financial instruments may play an important role to improve risk management. The loss potential from relatively frequent events in Peru is lower than the loss potential of El Salvador.

**Figure 14. Major Natural Disasters in El Salvador over the past 20 years; losses, percent of GDP**



Source: National study performed by Escuela superior de economía y negocios (San Salvador) in cooperation with ECON Analysis

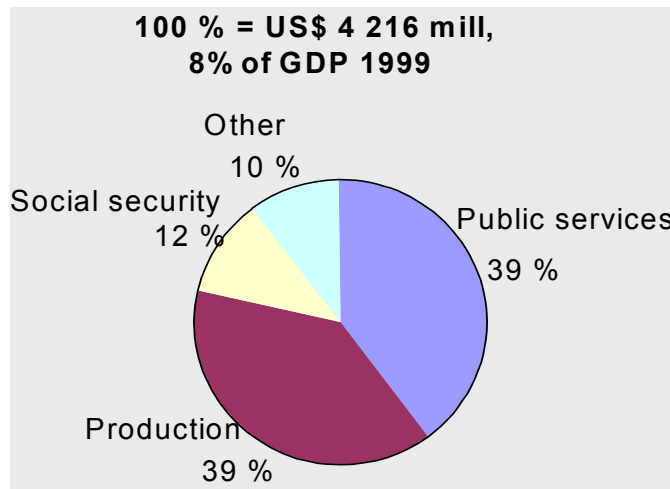
**Figure 15. Estimated Losses by Frequency of Incident for El Salvador, Comparison of Estimated Annual Premiums/GDP Losses for Four Latin American Countries**



Note: Annual premiums are estimated losses needing to be financed spread evenly over years. The need for financing is assumed equal to 50 percent of total losses; annual premiums are corrected for interests without risk premiums.

Source: Freeman et al. 2003

**Figure 16. Peru's Losses from El Niño, 1998-1999 by Sectors and in Percent of GDP 1999**



Source: World Bank, 2002.

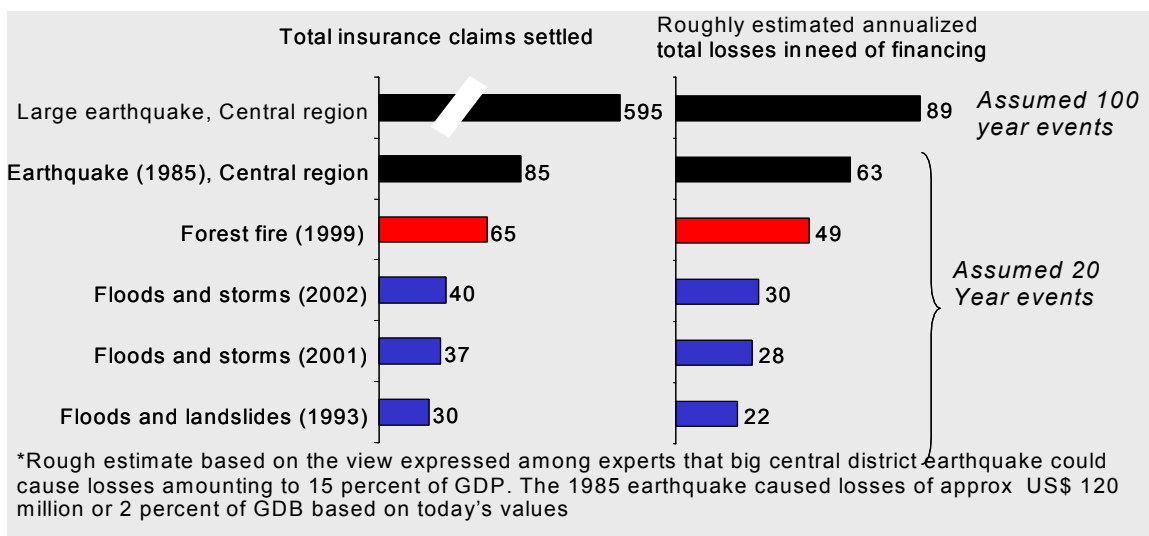
### Earthquakes and floods in Chile

As in El Salvador, earthquakes seem the most important natural hazard risk factor in Chile. Apart from the worst-case scenario, an earthquake with an epicenter in the central district (Santiago), the potential losses seem relatively modest (figure 17). The losses to insurance companies arising from the five incidents recorded are limited compared to the Santiago worst-case scenario, which has an estimated frequency of once every 80 to 100 years.

It is important to bear in mind, that the share of losses that gives rise to claim settlements may be only a fraction of total loss.

Severe earthquakes are rather frequent, recurring about every 5 years. However, they are regionally contained and may cause losses of 2 to 3 percent of GDP. The magnitude of the potential loss is relatively low thanks to Chile's geography and also to improved building standards and zoning. As illustrated in figure 17, only one earthquake is

**Figure 17. Claim Settlements by Chilean Insurance Companies, Five Main Incidents Over the Last 20 Years Compared to a Total Loss Estimate for an Earthquake in the Central Region. US\$ Million**



Note: Annualized total losses in need of financing are assumed to follow the same proportion (75 percent) of total claim settlements as in the earthquake of 1985.

Source: Report from national consultant, ECON Analysis

counted among the five major incidents over the past 20 years.

The risk of flooding could be relieved through improved water resource management. As noted in figure 17, flooding is also a very important source of natural hazard damage in Chile because a number of large urban areas are located at the foot of steep slopes. The current perception is that there is underinvestment in physical mitigation of central area flooding.

Chile is a relatively robust country and has established a basis of relatively sound macroeconomic policies. Aside from the Santiago region, population density is relatively low in risk prone areas. Figure 18 illustrates the urban population ratios in Latin America to emphasize the contained and specific risk to population in Chile.

### Risk Exposure

All three countries are susceptible to risks sufficient enough to cause large-scale discontinuity in economic development and activity. There is reason for concern about the ability to re-establish infrastructure and production capacity after a disastrous event. Figure 19 portrays the estimated loss profiles of Chile, Peru and El Salvador. Based on historic records, the chart illustrates the sequence of major disasters over the past 20 years (30 years for Peru), extrapolated in order to fill in a complete period of 100 years.

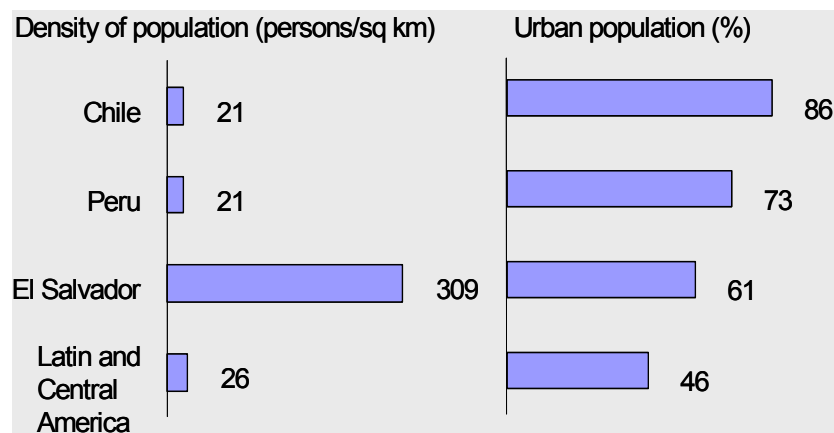
For Peru and El Salvador, it is assumed that the 20 or 30 years period described in the report are representative of the total loss potential. For Chile, it is assumed that a major earthquake in the central district will take place once during this period.

Risk is measured in terms of the likelihood of an occurrence and the physical and social level of preparedness in each country. Estimates indicate that El Salvador is the most vulnerable of the three countries and would likely sustain the greatest losses in the given time period. The average loss estimates based on records presented in the national case studies differ from the estimates provided by Freeman et al. (2003) (figure 20).

Variations in the expected annual losses of each country may occur due to the complexity of what is being measured and the assumptions that necessary. Furthermore, access to exact data is difficult to obtain because only reported losses are on record. Although estimates do not offer a precise evaluation of risk, the relative vulnerabilities are clear.

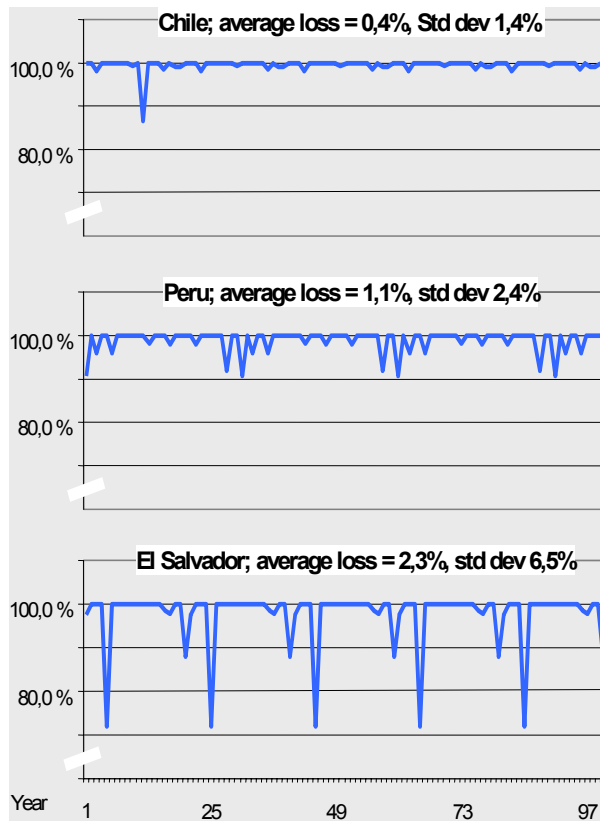
In all three countries, poverty, urbanization, population growth and environmental degradation have raised vulnerability and accentuated weaknesses in natural hazard risk management. These same variables may be a contributing factor to the frequency and severity of natural hazards that appear to be increasing regionally and globally (Andersen, 2002). Planning authorities have difficulties coping with the risk management challenge. Therefore, options for more effective risk management

**Figure 18. Population Density and Urbanization (2001).**



Source: World Bank, 2002.

**Figure 19 Potential Relative Loss Over Time; Chile, Peru and El Salvador.**



Note: Percent of GDP (2001), Average and Standard Deviation in Percent of Normal GDP. 100% equals GDP before loss from natural disaster

Source: Country studies, World Development Indicators, ECON Analysis.

(i.e., actions to reduce vulnerability, loss potential and costs of risk financing) need to be explored in order to maintain growth and alleviate poverty. In addition, the current trends seem to be broadly recognized as factors contributing to the need for an expansion of reinsurance capacity worldwide and supplementary financial instruments for effective risk transfer.

### Rapid Population Growth, in Risk-Prone Regions

The main driving forces behind the increased vulnerability to natural hazards are seen to be a further concentration of material wealth and the ef-

fects of climatic changes (Swiss Re, 2004). The rising severity of natural hazards, together with comprehensive terrorist attacks and industrial environmental catastrophes, has resulted in a substantial expansion of global reinsurance and markets for risk-linked-securities. The global trend of more severe natural hazards is creating significant pressure on the developing countries, which have traditionally been more exposed to natural hazards than industrialized countries.

High rates of increase in populations (up to 70 percent over the past thirty years) have placed pressure on urban areas, housing and public infrastructure. Most of the growth has taken place in vulnerable areas including coastal areas, under-regulated urban settlements and on marginal lands where natural hazards may cause severe consequences.

Cities are generally perceived to be more vulnerable than rural areas. In many countries, like Chile and El Salvador, capitals and mega cities are located in risk-prone areas and are particularly exposed to flooding and earthquakes. Andersen (2002) indicates that more and more people in Latin America have established themselves and built economic assets in areas of high relative natural hazard exposure.

### Environmental Threats

Environmental degradation, including deforestation and land erosion, has increased the vulnerability of urban and rural areas, especially with regard to flooding. Destruction of mangroves and coral reefs renders the coastal zone more vulnerable to heavy storms. Proper natural resource use and environmental protection would substantially reduce the potential impacts of hazards, such as flash floods, landslides, earthquakes and hurricanes.

### Perception of Risk Hazards

Several factors restrict rational risk management in Latin American countries. The loss potential is growing rapidly. Preferences among the population seem to provide little support for pre-disaster risk financing and important institutions are inadequate or missing.

Poverty means that meeting technical standards is a secondary concern relative to meeting basic needs for shelter and nutrition in order to survive. Weak institutions coincide with poverty problems and add to the difficulties of enforcing effective zoning practices and standards that may reduce the exposure of private housing to natural hazards. These two problems, concentration of poverty and lax enforcement of physical land use and building regulations, are typical in rapidly urbanizing developing economies.

The benefits arising from migrating into risk prone urban areas are often considered greater than the increased risk from natural hazards. Weak urban planning, both physical and regulatory, raises the potential social losses from natural hazards. Because they are unable to provide their own risk financing, poor households become even more reliant on public social care in case of natural hazards.

The preferences for disaster mitigation may also reflect the general risk perceptions of the society. Risk financing of natural hazard impacts may seem of little value when these are considered to constitute only one minor element of a very complex and risky environment.

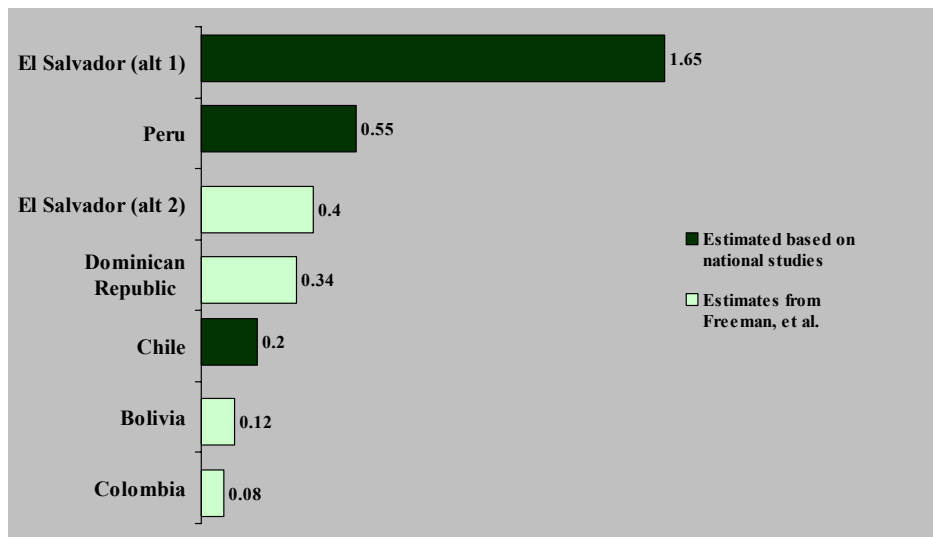
The risks experienced by the populations in all three countries represent a mix of several factors.

El Salvador experienced civil wars until the 1990s and its capital still bears traces of continued violence. Raw material prices, in particular coffee prices, fluctuate to an extent that makes stable economics unrealistic. Coffee growers see little reason to prioritize natural hazard risks when it is impossible to finance other risk factors.

Economic conditions in Peru and Chile are more diversified and stable. Chile, in particular, has developed rapidly in the last two decades. All three countries seem to be on their way to strongly improved currency stability. However, this may not result in citizens' increased focus on natural hazards. The memory of past economic and political developments maintain peoples' focus on risks other than natural hazards; risks that are not suitable for effective risk financing like excessive inflation or political instability.

Adequate physical planning and zoning require risk and vulnerability analysis, information that is also critical for rational risk financing and cost effective risk transfer. The development of adequate information (e.g., maps showing flood risks) is one opportunity for synergy between risk finance and mitigation. Improving the institutional capacity for risk mitigation will also contribute to more efficient solutions for risk finance.

**Figure 20. Comparison of Annual Premium. Estimates for Selected Latin American Countries. Percent of GDP. Private Sector Exposure: The Case of Housing**



Source: National studies (chapt. 3), Freeman, et al. (2003), ECON Analysis

## Insurance Coverage in the Public and Private Sectors

All three countries pursue policies of open financial markets. International insurers can access national insurance markets, and Chile in particular has well-developed insurance industries by international standards. In all three countries, home owners seem reluctant to buy private insurance. In the public sector, insufficient motivation is also arguably the main limiting factor. Although the Peruvian economy has improved strongly, the supply side may still be a limiting factor here, as demonstrated by the underdeveloped markets for mortgage financing.

### Public Sector Exposure

The public sector is responsible for the provision of important services like healthcare, education, infrastructure and social security. These are all goods of critical importance to the sustainability of economic development in case of natural hazards. Central and local governments lean unconsciously toward self-insurance and, thus, may contribute to extra variation and less predictable economic progress.

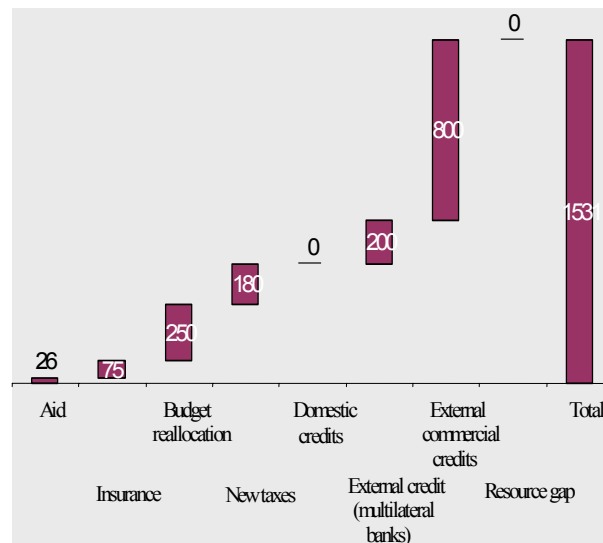
The public sector normally acts as self-insured in all three countries. Private-public partnerships, independent and semi-independent public enterprises and, to some extent, investments that are

financed by multilateral development banks are all insured to some extent. The use of private-public partnerships has greatly expanded during the last years, contributing to somewhat improved risk coverage, especially in Chile. But Chilean insurance experts still estimate that US\$85 billion of government assets remain uninsured.

Descriptions of the national emergency systems and discussions at regional workshops with managers of national emergency offices have confirmed that the coordination of financial and physical emergency planning is insufficient in all three countries.

Furthermore, self-insurance tends to lead to insufficient financing. Risk financing may be provided in several ways. Freeman et al. (2003) have reviewed financing options in El Salvador (see figure 21). The options correspond to instruments examined in the previous chapters. They have explored risk-financing options assuming that public authorities provide all risk financing. They find that in El Salvador, full financing of the 50-year event is realistic given current policies, but not a 100-year event. As shown above, there may, however, be reason to assume that total loss potentials are higher than estimated by Freeman et al. (2003). The results of the Chilean case study would indicate that Chile has sufficient financial and macro-economic flexibility to cope with hazards, particularly due to strong international credit ratings. In

**Figure 21. Financing El Salvador's Natural Hazard Risks; 50-year Loss**



Source: Freeman, et al. (2003)

Peru, fund allocation systems are used to satisfy extraordinary expenses associated with disasters. However, experience shows that it is difficult to prioritize an accumulation of reserves when confronted with a strained public budget and growing social challenges. The response time and recovery from a disaster has been uncertain and often inefficient in Peru due to a lack of available funds. Experience also has proven that severe indirect losses from disruption and unpredictable reconstruction may arise.

For all countries studied, the share of the loss potential currently covered by risk transfer instruments is limited. As mentioned above, the share of losses from the 1985 earthquake in Chile covered by insurance was approximately 7 percent. The share would probably be higher today, but only about one third of private houses are insured and public assets are mainly uninsured. According to the calculations of Freeman et al. (2003), the main share of potential losses needs to be financed by international credits. In addition, domestic macroeconomic flexibility may contribute significantly by enabling budget reallocation and extra taxes.

Both Chile and El Salvador may be able to meet their needs with moderate loss potential even with the increased frequency of natural hazards. However, estimated losses are uncertain. Public sectors and private housing seem important candidates for the use of new financial policies in order to improve the financing and transfer of economic risks.

### **Private Sector Exposure: The Case of Housing**

Private housing is both a sector of significant importance to social security, and at the same time, an important part of the national production capital. However, the majority of private houses are not covered against damage from natural hazards.

There are natural links between mortgage financing and insurance. To prevent losses from natural hazards, banks normally tend to require insurance coverage when financing private property. The existence of private, long-term financing is thus driving the demand for housing insurance.

In all three countries, long term financing and mortgage loans only cover a limited share of hous-

ing as a significant share of the population live in low value housing segments that are beyond the reach of commercial insurance. Twenty-one percent of Chile's population and 49 percent of Peru's population live below national poverty lines (World Development Indicators, 2003). Linking insurance to mortgage loans is normal, but homeowners often tend to let insurance run out as debts need to be repaid. Therefore, linking insurance to credit is often insufficient to provide more robust housing capital.

- The insurance of housing is particularly low in Peru, which seems to have the least developed mortgage finance sector. A public fund for financing private houses valued below US\$32,000 has been established.
- The national study estimates that insurance claims covered 33.5 percent of losses related to housing following the January 2001 earthquake in San Salvador.
- The share of insurance in the housing sector in Chile is thought to be equivalent to the level in El Salvador, and a scheme of mandatory housing insurance is being discussed, partly in order to finance fire brigades through a duty on the real estate insurance premiums.

Social security and labor productivity are also areas for concern. In a disaster situation, central and local governments have to deal with acute housing needs. Loss of housing capital results in both a direct loss of welfare and indirect losses in labor productivity (low-cost, labor-intensive manufacturing industries are common in all three countries). The capacity to finance reconstruction of low-value houses is an important challenge for the improvement of natural hazard risk management in all three countries. The lack of coverage for low-value houses adds to the exposure of the public sector.

### **Supply Versus Demand-Side Impediments**

Incomplete coverage of assets in El Salvador and Chile is primarily a demand-side issue, while important supply-side challenges remain in Peru.

*All three countries pursue relatively open market policies relative to insurance and finance.* The need for foreign insurance companies to have entities inside the country to be able to offer insurance is not seen as a significant obstacle to the widespread use of insurance. In Peru, life and pension funds must invest their funds domestically, which to some extent, may hinder expansion in these sectors. In general, openness contributes to the availability of insurance and enables protection against natural hazards for well-established entities with documented asset values and risk characteristics. However, openness alone is insufficient to ensure the presence of a competitive insurance sector. All three countries have a modern legal and institutional framework for the financial sector that includes supervisory bodies. Remaining obstacles for expanded supply of insurance and risk-related financial instruments may rest with the general economic climate, the limited size of the markets and immature financial sectors in general (Ma and Pope, 2003).

*Chile and El Salvador have well-developed national insurance industries.* National and international insurance companies operate in both countries in an environment of adequate regulation and competition. El Salvador's smaller market size may limit the degree of competition. There are only four main insurance companies in El Salvador and future structural shifts could emphasize this vulnerability.

*The supply of insurance against natural hazards is insufficient in Peru.* The national study and the experience of Peru cast doubt on the general sufficiency of the supply for insurance against natural hazards. In Peru, market shares seem rather unevenly distributed, with one major operator in each of the two markets. A Lima-based microfinance institution claims that it has been unable to obtain adequate offers for insurance of portfolios against natural hazard risks. Large international corporations get sufficient coverage from their international reinsurance providers. Options for risk transfer in other sectors such as agriculture and fishery are limited, especially with respect to natural hazards.

*Broad range of institutional issues in Peru.* According to the Peru study, impediments to an ef-

fective supply of natural hazard risk insurance are linked to the underdevelopment of mortgage financing. Adequate claim settlement procedures are necessary to instill confidence in a system of broadly distributed loss-based insurance. Further institutional development challenges are to avoid fraud and corruption, and establish appropriate housing and zoning regulations to address varying exposures to floods and the impacts of natural phenomena, such as El Niño.

In summary, all three countries must address demand-side deficiencies and establish the motivation for public authorities and property owners to improve the financial management of risks. Peru faces additional supply-side challenges that require further development of its financing system and the corresponding institutional capacity.

### **Preparing for Integrated Natural Hazard Risk Management**

Imperfections on the demand side restrict the penetration of proper risk financing. There is a need to motivate changes in the financial aspects of risk management in the public sector and in some areas of the private sectors (i.e., the housing sectors). The supply-side challenges in Peru imply a need for institutional development. This section summarizes the recommendations arising from the three country case studies, and also identifies issues to be further discussed in the final stage of this study.

### **The Need to Improve Risk Financing**

Weaknesses in the financial aspects of natural hazard risk management have been identified in all three countries. Chile seems to need some complementary solutions to an already quite efficient risk management system. The Peru country study recommends a captive pool solution. The El Salvador study devotes significant attention to the particular financial instruments and recommends applying risk transfer instruments to governmental assets and housing, especially for the poor population.



## **Risk Transfer for Public Assets Should be Considered for Chile**

Insurance industry experts claim that US\$85 billion of public assets have no insurance coverage. Local and central governments could sponsor catastrophe bond issues with potential annual losses amounting to 0.2 percent of asset values or US\$170 million annually. The theoretical maximum premium potential (assuming risk-free interest of about 4 percent and a spread of 5 percent) would be substantial. The study also supports the idea of compulsory housing insurance to improve coverage of the private sector. Some central institutional issues are briefly mentioned, such as the need for a unit to negotiate financial agreements and the supervision of various aspects of risk management that may impact the pricing of risk transfer instruments.

## **General Upgrading of Financial Risk Management Are Needed in El Salvador's Public and Housing Sectors**

The El Salvador study points to a general lack of policy guidelines for management of the financial aspects of natural hazards. As suggested by Freeman et al. (2003), some preparation for the application of financial instruments has already been made. One such step has been to develop a public asset inventory. Our observations of El Salvador point to the need for improved risk finance for central government assets and private housing of low-income families. Further evaluation of alternative financial options for financing public asset risks, including catastrophe bond issues is also recommended.

## **Steps toward Enhanced Institutional Capacities for Risk Financing in Peru**

The Peru study views the absence of satisfactory risk descriptions and public asset inventories, together with an immature financial market, as the primary obstacles to increased use of financial instruments for natural hazard risk management. The report recommends the establishment of a national natural hazard risk pool. The first stage would be to develop the pool for public sector assets, with a subsequent broadening into the private sector. This could be combined with mandatory insurance in

especially exposed regions. The pooling of risks into one underwriting pool would mean less risk to individual asset holders. In addition, the pool may develop the capacity needed to implement strategies for risk transfer both via effectively negotiated reinsurance contracts and through the use of new financial instruments like cat bonds and derivatives. It is estimated that US\$56 billion worth of public assets may be involved. With total annual loss estimates of 0.55 percent of asset values, total premiums may amount to more than US\$800 million.

To ensure efficient responses to future natural hazards, financial aspects must be an integrated part of the overall plan for risk management. As shown by Freeman, et al. (2003) and illustrated in the three country studies, risk finance is neither sufficient nor integrated into the general risk management framework. In the final section of this chapter, some issues are discussed regarding the development of integrated financial risk management policies.

## **Setting the Goal**

One major challenge uncovered in all three countries is demonstrating the value of improved risk finance. The barriers to appropriate risk financing are partly political. The ex ante financing of risks means that tomorrow's potential losses are included in current budget allocations.

As indicated earlier, setting the proper goal means addressing two distinct perspectives: macroeconomics and governance.

## **Macroeconomic Perspective**

None of the three country studies provides a basis for assessing the maximum acceptable level of macroeconomic volatility due to natural hazards. Natural hazard risks cannot be viewed in isolation from other risks. The level of macroeconomic stability must relate to relevant combinations of risks. The aggregate risk arising from a broad risk and asset portfolio is paramount. Examining individual risk factors in isolation provides limited value.

Historically, national income levels have varied widely as a consequence of political instability,

exchange rate fluctuations and terms of trade variations. There is no reason to assume a correlation between natural hazards, exchange rate fluctuations in a situation of sound financial policies, and terms of trade variations. Therefore, when factored into the aggregate risk level, the risk associated with natural hazards will be diluted.

Furthermore, dependence on external donors is still a viable strategy, especially in El Salvador. Loyal emigres abroad contribute nearly 10 percent of all workforce remittances going to Latin and Central American countries (Global Development Finance, The World Bank, 2003).

There is a clear need for further research regarding a socially attractive level of retained risk. The issue of national risk preferences is an empirical question. Preferences could be quantified through interviews with stakeholders and/or through the identification of implicit risk valuations from relevant examples of risk management behavior.

Based on subjective judgment and given the number of uncorrelated risk factors characterizing the Latin American economies, it seems likely that natural hazard risks having a loss potential in excess of 10 percent of GDP should be financed through macroeconomic and fiscal flexibility rather than specific risk financing arrangements. In addition to stimulating institutional development to ensure the necessary fiscal flexibility, a by-product of this approach would be a more robust macroeconomic policy.

### **Government Perspective**

The national studies assume that the government has two main responsibilities in the event that a natural hazard takes place: (i) to maintain public service levels and (ii) to protect minimum living standards for the poor. As noted, the government is also responsible for ensuring open and efficient financial markets.

In some cases, governments may entrust some areas of risk finance to wealthy segments of the private sector. However, the production capacity of the private sector, while a private good, has important positive externalities for the society at large. The government has good reasons to make the

robustness of private industry a concern of its own. Increased robustness reduces the risks of unemployment, underpins public budgets, and so on. In Peru, commentators pointed out that the ability of the marine and agricultural industries to access risk finance is limited due to insufficient markets. It is also often noted that losses to industries such as mining often arise from the breakdown of public infrastructure. The government is thus, to some extent, involved in private industry risk financing by financing its own risks and through the establishment of proper financial market institutions.

The positive external effects of private industry risk finance are relevant to arguments regarding whether the government should stimulate industrial risk financing. The instruments available include subsidized insurance and reinsurance and governmental natural hazard risk finance or underwriting. The latter case is well analyzed in Kelly and Kleffner (2003).

The discussion of the goal of risk financing also relates to concerns regarding the role of the government versus decentralized decision making in general. In some countries (e.g., Chile) there is a rather strong movement toward liberal market economics. It may be difficult to argue for public intervention into markets predominantly cared for by private companies. A general understanding of externalities, public goods and other forms of market imperfections in mature markets for risk mitigation, finance and transfer, is required.

The challenge of integrating financial and physical aspects of natural hazard risk management is central to broader development issues. Taking the long view means building the capacity to manage the risk of 20, 50 and 100-year events today. Representing the dispersed interests involves taking into account all parts of the population and the economy (rural and urban business, small municipal assets, and central public infrastructure). The commitment to allow assets to thrive requires the articulation of predictable frameworks and supportive legislation for financial services providers that can take a long-term perspective on natural resource protection.

As mentioned, the three countries differ strongly with respect to the status of economic develop-

ment. Chile has a rather advanced market economy. The current emphasis on a strong reliance on noninterference with private risk financing markets is, however, somewhat problematic given the existence of market imperfections. It is very difficult to prove that a simple, explicit policy at this stage of development should be replaced by a policy with more market intervention. Correcting market failures through governmental intervention, while straightforward in theory, is difficult to accomplish effectively in practice.

For Peru and El Salvador, the relationship between natural hazard risk management and the government perspective incorporates important institutional issues. The central recommendation here is that the development policies financial institutions must take precedence over technical solutions to risk financing.

### **Proper Institutional Framework**

The use of financial instruments for natural hazard risk management must not be regarded as a primarily technical issue.

The Peru case study includes a rather detailed discussion of potential natural hazard pool arrangements. More specific avenues for solving the institutional issues will have to be developed. It seems reasonable to assume that there is also a similar need for a public asset pool in Chile and El Salvador.

The lack of proper risk financing for the public sector is evident in both countries. One explanation is public authorities generally manage assets poorly. Although a growing share of the assets for the provision of public services will be privately owned and financed, there will still be a substantial share of assets belonging to the public sector. As a step toward improved asset management in general, the formation of a coordinated pool of public assets to take care of risk financing should be considered.

The purpose of the pool should be two-fold. Firstly, the pool should establish a mandate to improve risk management with allocated governmental assets. One operational objective should be to reduce the aggregate potential loss year by year.

The second objective should be to investigate and manage financial solutions. If the policy selected means risks are retained (i.e., financing depends on reallocation of public resources when needed), the pool management will have to ensure that risks are properly assessed and account for in public budgets. If risks are financed through financial markets, the task of the pool will be to manage and adjust portfolios of contracts and market instruments according to prevailing conditions.

Peru has the least developed system of distribution of financial services in general and risk financing instruments in particular. In Chile and El Salvador there seems to be little reason to focus on distribution networks as a governmental priority. Peru has several options. The banking sector, in spite of limited mortgage financing, is an important provider of finance to industrial enterprises. Additionally, there are several very active microfinance institutions. Both kinds of credit institutions may be appropriate vehicles for channeling natural hazard risk finance. By relieving the banks of the credit risks related to natural hazards, the microfinance institutions may be able to expand credits and charge lower credit margins.

### **Optimal Portfolios**

Increasing the use of financial instruments to cover disaster risk can improve macroeconomic performance over time. Issues regarding the specific goal for improved risk management and the selection of the proper institutional set-up have been discussed above. The third issue for implementation is the evaluation of alternative financial instruments.

The following three points may provide a useful basis for the selection of specific instruments and a rational portfolio of risk financing measures.

*There is a significant and growing capacity to retain risks.* The three countries have improved their macroeconomic situation strongly over recent years. Public finances are generally managed in a responsible manner. This means that the countries are also developing a capacity to better manage budgets, taxation and national reallocation of resources in a crisis situation. Chile is best positioned to manage risks through internal fiscal

flexibility, but all three countries have improved their performance in this respect over the past decade. Freeman et al. (2003) assume that El Salvador has a significant source of risk finance in the form of budget reallocations and extraordinary taxation. If supported by an effective governmental asset pool, increased capacity for risk retainment may prove a highly profitable option when strengthening the overall risk financing system.

*Creditworthiness in international markets contributes significantly to the financing of risks.* The three countries have, in parallel with improved macroeconomic performance, improved their standing in international markets and thereby their capacity to raise money through loans. Freeman et al. (2003). argue a significant share of El Salvador's need for extraordinary resources in a crisis situation may come from commercial international markets.

*Risk transfer appears to be expensive.* Rough indications show that premiums in the case countries may be based on a multiple of annual average loss estimates. Our estimates are far higher than what has been indicated in other studies (e.g., Freeman et al., 2003). If premiums are in line with risk premiums in ordinary equity markets, as follows from simple capital market theory, the costs of risk transfer would be competitive with pure risk financing. However, extra risk premiums may be expected in the case countries due to the lack of comprehensive statistical information, immature financial services networks and the still deficient functioning of markets for global risk transfer.

These three factors point to a situation where pure risk finance and the development of institutional capacity for enhanced and effective risk retainment at the national level may be good first level strategies. The issue of the extent to which risk transfer should be applied remains to be explored in greater detail.

# Conclusions

This chapter briefly formulates three broad conclusions and indicates some issues for further research. It is important to emphasize that the study performed, including the three national studies, only scratches the surface of a very broad topic covering a wide range of professional issues. The conclusions presented here should therefore be regarded as tentative. Based on what we have observed in this study, we conclude that:

- There is great value in improved risk financing in developing countries.
- There is, however, a limited need to apply new instruments for risk transfer. The benefits of improved macroeconomic and fiscal stability are more evident and should suffice to cover most of the risks. In any case, improved capacity for risk retainment should be the first priority.
- Donors need to take a long-term perspective for risk financing. The development of public policies and financial institutions to manage risks should take precedence over technical solutions to improved financing.

## **Proper Risk Financing Means Loss Reduction**

The main finding of this report is that the benefits of risk financing far exceed those of ex post responses to direct damages of natural hazard incidents. The crucial importance of adequate risk financing arises from its ability to curb unnecessary indirect losses by providing resources for more rapid reconstruction and recovery, and more robust longer-term growth.

Steps toward improved risk finance and management must begin with an established goal and secure commitment to improve risk management. Insufficient risk finance is primarily a demand side problem. Less developed countries may form pools to provide a basis for rational risk financing on behalf of a significant share of the national economy. Joint coverage of public assets of vari-

ous ministries is a natural first step for the public sector.

Achieving the requisite commitment from developing country stakeholders poses a significant challenge. The behavior of bilateral and multilateral donors has thus far been counter-productive to stimulating incentive. Donations shape organizations and governments. The excessive emphasis on financing response rather than prevention is well recognized by development economists. Longer-term commitments to proactive disaster risk management probably have to be initiated by a clear shift in donor behavior, thereby motivating recipient countries to revise current practices.

Donors and risk-prone recipient countries have a common interest in improving risk management and finance. Some risk financing options might, as shown in the report, reduce motivation for rational risk reduction and institution building. Emergency relief has typically received more attention from donors than disaster prevention. There is substantial potential for more effective development assistance and more rational interaction between donors and recipients.

## **Limited Need for New Risk Transfer Instruments**

Risk-prone countries have several options for implementing rational risk finance. Most of the steps required complement sound economic policies for longer-term growth. Building domestic macroeconomic robustness and fiscal budget flexibility is clearly more attractive than engaging in complex risk transfer operations. Risk transfer is costly, in particular where risk statistics are unreliable and distribution networks are weak.

A robust economy may tolerate hazards without suffering unnecessary indirect losses. Risk pricing and transaction costs indicate that transferring risks may be more costly than increased savings ratios, more fiscal flexibility or increased future debt repayments in public budgets. Sound macro-

economic policies provide a double dividend; firstly, economic stability and credibility and secondly, more cost effective options to establish the optimal portfolio of instruments for risk financing.

Developed and capable institutions lower the cost of risk finance. The quality and capacity of institutions are important for the management of risks and risk finance. Risk financing at the government level requires budget discipline. Claim settlements may be extremely inefficient if corruption is widespread. Lack of statistics describing potential losses due to natural phenomena will complicate risk modeling and raise the costs of any risk transfer. Loss-based risk transfer is confronted with moral hazard problems that necessitate effective monitoring of risk management behavior. When monitoring is difficult, the perceived risk increases and the costs of illegitimate risk management behavior are spread over all insured parties. Severe moral hazard problems are therefore detrimental to any loss-based risk transfer scheme.

Parametric insurance does not itself weaken the incentives for risk mitigation. In the event of a disaster, payment is parametrically based and thus independent of the size of the loss. Therefore, there is no remuneration for moral hazard.

Regional cooperation may improve the options for risk finance. However, the costs of risk financing are highly dependent on scale, not least because transaction costs are substantial. The need to perform research on underlying risk characteristics may also add substantial costs. Cat bond issues are now dominated by more cost-effective parametric and index-based settlement arrangements. The transaction costs associated with such instruments are low when there is large underlying loss and premium potential. Cat bonds benefit from being single purpose oriented, while bundling of risks, according to Marsh and McLennan (2003), tends to raise costs. Regional cooperation between countries offers clear benefits. Some promising signs of cooperation are seen in the Pacific coast areas that suffer from El Niño-related impacts. Donors and multilateral banks can foster even more cooperation through selectively adapted programs and incentives. As the geographic scope and time horizon may be expanded, the expected difference be-

tween index or parametric compensation and actual accumulated loss will diminish.

The three countries evaluated differ with regard to risk factors, relative risk exposure and level of development of their national capital markets. The observations on the potential for application of risk financing in the three countries nevertheless seem to confirm the validity of the steps suggested toward improved risk finance and management.

### **Development Financing and Natural Hazard Risk**

The study conclusions suggest that natural hazard risks may strongly impede growth potential in developing countries. Firstly, underfinanced risks create unpredictability with respect to infrastructure, public services and restoration capacity. Predictability is an important prerequisite for attracting foreign direct investment. Secondly, underfinancing of risks tends to be reinforced by the behavior of donors volunteering to underwrite risks implicitly as part of empathetic emergency assistance policies after an incident. The fact that such donors may coordinate their underwriting through multilateral banks does not alter this effect. Thirdly, large and sudden inflows of emergency assistance in the absence of sound institutional capacity leave very limited room for longer-term institutional development.

The presumption that reliance on emergency transfers hampers economic growth is well acknowledged in development economics. The study of risk financing for developing countries illustrates how emergency assistance can be detrimental. Trusting in spontaneous emergency assistance is system where the insurer is unaware of his role, and there are no requirements on the behavior of the insured. A vicious circle is created. Hazards give rise to emergency aid that weakens institutions. Weakened institutions pay less attention to adequate risk management and mitigation, further enhancing the loss potential, and so on. Effective risk management, on the other hand, implies positive contributions to economic development.

Some important implications arise from the relationship between risk financing and institutional development. Recommendations of risk financing

that do not consider the institutional challenges of the country, may cause as much harm to development as unconscious donor behavior. The positive institutional effects only arise if the financing agent provides incentives for rational risk management. A simple recommendation, for example, for the introduction of parametric insurance or cat bonds to finance natural hazard risks may do more harm than good if institutional capacity is not addressed.

The sudden inflow of very large sums of money that will result from a risk transfer scheme may be detrimental to weak public institutions. Institutions that are more familiar with the management of tied emergency aid cannot be expected to cope with the challenge of fair and effective distribution of compensations to a multitude of stakeholders. Both individual donor countries and multilateral banks looking for financial solutions to manage natural hazard risks, therefore, need to prioritize institutions before finance.

### **The Need for Further Research**

The conclusions in this report are based on limited theoretical and empirical research. Initially, a sub-

stantial share of research effort was devoted to the financial instruments for risk financing. The conclusions of the study, however, reflect an understanding that the political aspects, the donor-recipient country partnerships, and political economy, are more important considerations than the financial instrumentation.

The study has uncovered a set of unresolved issues that deserve further attention. First, there is a need to investigate more closely the social preferences for macroeconomic stability in developing countries. This could be achieved by applying methods for testing preferences that influence the level of risk financing at the national level.

There is also a need to further investigate alternative institutional frameworks. The relationship between institutional solutions for risk management and finance, on the one hand, and general economic development, on the other, is crucial and deserves further attention. There is also a need to model and verify the value of alternative pool arrangements, especially for the public sector.

## References

- Andersen, Torben J. 2002. *Innovative Financial Instruments for Natural Disaster Risk Management*. Sustainable Development Department Technical Papers Series, ENV-140. Washington, D.C.: Inter-American Development Bank.
- Brealey, Richard A. and Stewart C. Myers. 2003. *Principles of Corporate Finance*. McGraw-Hill/Irwin.
- Carlton, Dennis W. and Jeffrey M. Perloff. 1994. *Modern Industrial Organization*. Harper Collins.
- Copeland, Thomas E. and J. Fred Weston. 1988. *Financial Theory and Corporate Policy*. Addison-Wesley.
- Cummins, J. David, David Lalonde and Richard D. Phillips. 2004. The Basis Risk of Catastrophic-loss Index Securities. *Journal of Financial Economics*, Jan 2004, Vol. 71 Issue 1, p. 77.
- Doherty, Neil A. and Andreas Richter. 2002. Moral Hazard, Basis Risk and Gap Insurance. *Journal of Risk & Insurance*, Mar 2002, vol 69, issue 1, p 9-25.
- ECON. 2001. *Sikring mot naturskader* (Natural Disaster Risk Mitigation in Norway). ECON-report 95/01, in Norwegian only). ECON Analysis, Oslo.
- \_\_\_\_\_. 2003. *Mecanismos financieros para el manejo de los riesgos provientes de los desastres naturales*. ECON report 06/03.
- Freeman, Paul K, Leslie A. Martin, Joanne Linnerooth-Bayer, Koko Warner, Reinhard Mechler and Georg Pflug. 2003. *Disaster Risk Management: National Systems for the Comprehensive Management of Disaster Risk and Financial Strategies for Natural Disaster Reconstruction*. Washington, D.C.: Inter-American Development Bank.
- Harrington, Scott E. and Greg Niehaus. 2003. Capital, Corporate Income Taxes, and Catastrophe Insurance. *Journal of Financial Intermediation*, Vol 12, no 4, ct 2003: pages 365-389.
- Keipi, Kari and Justin Tyson. 2003. *Planning and Financial Protection to Survive Disasters*. Sustainable Development Technical Papers Series, ENV-139. Washington, D.C.: Inter-American Development Bank.
- Kelly, Mary and Anne E. Kleffner. 2003. Optimal Loss Mitigation and Contract Design. *The Journal of Risk & Insurance*, June 2003, vol 70 no 1, pp 53-72.
- Lane, Morton N. 2002. Meanwhile Back at the Price Drawing Board. *Lane Financial L.L.C. Trade Notes*. August 23, 2002.
- Lowell, Stephanie, Les Silverman and Lynn Taliento. 2001. Not-for-profit Management: The Gift that Keeps on Giving. *The McKinsey Quarterly*, 2001 Number 1.
- Ma, Yu-Luen and Nat Pope. 2003. Determinants of International Insurers' Participation in Foreign Non-life Markets. *The Journal of Risk & Insurance*: June 2003, vol 70 issue 2.



- Marsh & McLennan Securities. 2003. Market Update. *The Catastrophe Bond Market at Year-end 2002*.
- Mey, Jozef De. 2003. The Aftermath of September 11: The Impact on and Systemic Risk to the Insurance Industry. *The Geneva Papers on Risk and Insurance*, 2003 Vol 28, No 1, 65-70.
- Miller, Stuart and Kari Keipi. 2005. *Strategies and Financial Instruments for Disaster Risk Management in Latin America and the Caribbean*. Sustainable Development Technical Papers Series, ENV-145. Washington, D.C.: Inter-American Development Bank.
- Minkowitz, Martin. 2003. State Insurance Guaranty Funds. A Precarious Safety Net for Commercial Insurance Consumers. *Insurance Advocate*, Nov 10, 2003: pp 30-44.
- Ozimir, Dan. 2002. *The Risk-linked Securities Market*. Testimony before the House Financial Services Committee, Subcommittee on Oversight and Investigations. House of Representatives. October 8, 2002.
- Swiss Re. 2004. *Insurance-linked Securities Quarterly*. January.
- Williamson, Oliver E. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: The Free Press.
- \_\_\_\_\_. 1985. *The Economic Institutions of Capitalism*. New York: The Free Press.
- World Bank. 2002. *World Development Report, 2002*.