

FINANCING CATASTROPHE RISK IN THE CAPITAL MARKETS

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Abstract

This article provides an overview of the methodology that insurance and reinsurance companies can use to finance extraordinary or catastrophe risk in the capital markets as well as to split or swap it. Those mechanism can be divided into two groups: the risk finance instruments and the risk transfer instruments, focused on the issue of new assets by securitization or the derivatives structured products.

Catastrophe or "act of God" bonds, contingent surplus notes, exchange-traded catastrophe options, catastrophe equity puts, or catastrophe swap, are useful tool instruments for insurers and for investors. From the insurers' point of view, those financial instruments allow to supplement traditional reinsurance, they are not used to replace it. From the investors' perspective those tool instruments permit that investors use catastrophe models and exposure data to determine the rates of return they could expect from buying or selling catastrophe instruments to insurers at the same time that get a new means of reducing portfolio risk through diversification.

1. Introduction

In a general sense, the financial system of a country is a group of institutions coupled to methods and markets with the principal aim of conducting savings generated by those institutions "...with surpluses" into those institutions "...with deficits" (Calvo, A., Rodriguez-Saiz, L., Parejo, J.A., Cuervo, A., 2002). In other words, the principal aim of a financial system is to channel funds from those who have excess money to those in need of it. The institutions in a position to lend money are called lenders³ and the ones who need to borrow money are called borrowers⁴.

The main aim of financial intermediaries is to attract funds from lenders and channel them to those in need of money. This function is important because the borrowers and lenders are different institutions, and also because desires about liquidity, risk, and profitability of financial

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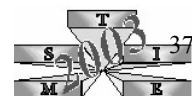
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³ Lenders are usually those who prefer to spend on consumer goods and capital goods MORE than their final revenues at a current interest rate of market.

⁴ Borrowers are usually those who prefer to spend in consumer consume goods and capital goods LESS than their final revenues at a current interest rate of market.



assets are not the same for the many market participants. This circumstances allows the markets to deal with a huge range of assets that adapt to those preferences. For this and other reasons such as the market globalization or their liberalization, the financial intermediaries channel savings by the "transforming" assets, from primary⁵ to secondary⁶ financial assets (Palomo, R. and Mateu J. L., 2000). Financial intermediaries can be classified as banking or non-banking intermediaries. Insurance and reinsurance institutions and companies are in the group of non-banking financial intermediaries. These institutions have a dealer activity apart from their principal activity, which is risk insurance. Insurance is a subset of the overall financial market. All these institutions accumulate very large reserves from policyholder premiums and investors in bonds, shares, investment funds, pension funds, etc. Through these investments the insurance and reinsurance⁷ institutions are channeling investment money from the lenders to borrowers. At the same time, their activities transfer the risks in the financial markets.

This article provides an overview of how insurance and reinsurance companies and institutions can use financial markets as an additional source of capacity and financing to complement traditional reinsurance products. These new tool techniques are divided into two groups: products to finance risk and products to transfer risk.

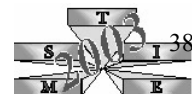
2. Catastrophe risk and insurance problems

The market that traditionally deals with catastrophe risk is the insurance market. Participants in an insurance contract exchange the risk and uncertainty of a potential large loss for a relatively small and certain insurance premium. Under normal conditions, insurance companies use markets to establish efficient and equitable pooling arrangements for commonplace risks such as house fires or car accidents. Problems can arise with other risks like earthquakes or hurricanes that are considered to be extraordinary or catastrophe risks because they differ in several ways from the risks insurance companies normally assume.

The risk of natural disasters has increased significantly in recent years all over the world for several reasons. On one side, there are ongoing climate and other terrestrial changes that have increased the severity and frequency not only of earthquakes and hurricanes, but also of floods, landslides, droughts, etc. In addition, there has been enormous population growth with urban development in high-risk areas during the last decade. Some manifestations are: floods in Central Europe in 2002 (\$18,5 billion total losses with \$3 billion in insured losses), hurricane Georges in the Caribbean in 1998 (\$3.4 billion), the Northridge Earthquake in the USA in 1994 (\$12 billion), hurricane Andrew in the USA in 1992 (\$14 billion), typhoon Mireille in Japan in 1991 (\$5.2 billion), winter storms in Central Europe in 1990 (\$10.2 billion), hurricane Hugo in 1989 (\$3 billion in insured losses), and more (Munich Re Group, 2002).

Insurers are trying to accommodate their business to this new situation of growth and development by expanding insurance coverage in high-risk areas. The direct consequence is that insurers have increased their exposure to catastrophic losses, and in some extraordinary events this new situation can overwhelm the financial resources of the communities and their insurers. There are many reasons why insurance markets have not financed and diversified catastrophe risk sufficiently to secure their financial viability and to protect policyholders, but we will underline two: first is the increase in the "actuarial cost"⁸ of catastrophe risk; second is the much greater potential severity of a particular disaster for the reasons we have indicated above (Laye, J.E. and Martínez Torre-Enciso, M^a I., 2001).

⁵ A primary financial asset is the one that is issued by the borrowers such as shares, bonds, etc.
⁶ The secondary financial asset is the asset issued by the intermediaries such as banking account, deposits, etc.
⁷ Reinsurance is the insurance of a risk taken on by another insurer.
⁸ "The actuarial cost" is the estimated annual average loss from catastrophes.



An insurer facing such a situation usually looks at two options. It can reduce insurance policies in force within a high-risk area and / or increase its reinsurance to cover a greater portion of its losses. For the second option, reinsurers no longer have enough financial resources to cover the losses from a major catastrophe and must charge a relatively high price for the coverage they do offer. Consequently, many insurers face a socially unacceptable risk of insolvency or severe financial problems from catastrophes at the present time. Financial markets could be the solution to cover catastrophe losses although there are not yet well developed for that function.

3. Catastrophe risk and financial markets

Given this situation of climate and geological changes with population and building development increases, experts have expressed concern that insurance and reinsurance companies no longer have the resources to respond to the losses from a major catastrophe (Levin, A., Mcweeney, P. and Gugliada, R., 1999). Insurance and reinsurance companies had began to look for solutions to provide the capacity necessary to finance very large catastrophe risks. As an starting point those companies studied two possibilities: the government's tax power and the capital market monetary capacity. For political and social reasons the first alternative was promptly eliminated. On the other hand, the total estimated value of the capital markets is \$19 trillion dollars, and the average daily standard deviation is approximately \$133 billion dollars. In capital markets, however, a loss approaching \$50 billion is almost routine. (Insurance Service Office, Inc., 1999). The second alternative offers insurance and reinsurance companies the possibility to use \$26 billion dollar to finance potential losses, so this was the elected alternative.

What is needed is the convergence of insurers and capital markets to provide an array of innovative concepts to integrate financial risk into reinsurance covers and to access capital markets for the transfer or financing insurance risk. Since mid 1990s those mechanism has been developed and aggregated in two groups (Munich Re ART Solutions, 2001 (2)):

- + Risk financing instruments:
 - Contingent capital (contingent liquidity)
- + Risk transfer instruments:
 - The securitization (catastrophe or "act of God" bonds, etc.)
 - Financial derivatives (exchange-traded catastrophe options, catastrophe swap, etc.)

The risk securitization and the use of financial derivatives are mechanisms to transfer risk to financial markets mainly developed and used since 1997. Those mechanism bridge the gap between insurer markets and capital markets by turning reinsurance contracts into securities and derivatives structures that investors understand and can therefore include in an investment portfolio (Súarez Suárez, A.S., 2000). These assets or instruments are vehicles used to transfer risk and channel funds.

4.- Catastrophe risk' financial instruments

Following the previous classification, the paper will begin the analysis of the catastrophe risk' financial products with the first group, those that finance risk, studying after those that transfer risk to the capital markets: risk securitization and financial derivatives. Within the whole group the most important ones are: *contingency surplus notes*, *catastrophe equity puts*, *cat-bonds*, *exchange-traded catastrophe options* or the *catastrophe swaps*.

4.1.- Risk finance instruments

After a mayor catastrophe with loss of equity or surplus, capital markets can provide insurance companies with capital via so-called **contingency capital or liquidity programs**. Those programs offer insurance companies capital support in form of surplus notes or preference shares in a period of time where financing will be difficult or impossible. This process merely



involves providing capital which is repaid to creditors or investors after expiry of the contingency capital transaction. It is only a financing transaction, not a transfer of the insurance risk.

This has been the traditional technique used by insurance companies to provide an additional source of risk financing in case of natural catastrophe, and to mitigate the impact of such catastrophes on their capital.

a. – Contingency surplus notes (CSNs)

Contingent surplus notes (CSN) are based on an insurer's right to issue CSNs in the future to investors at preset terms in exchange for cash or liquid assets. The right to issue the surplus notes may be contingent on specified events taking place, or it may be unconditional. Usually there is an specified event.

Within this structure, the cedant or CSN'buyer pays a premium to acquire the right to sell surplus notes or preferences shares to investors if the predefined event occur and the loss of equity capital arise. Investors purchase the shares or the surplus notes with a cash payment.

b. –Catastrophe equity puts

The traditional definition of "put options" indicates they are financial products that give the buyer the right, but not the obligation, to sell a certain amount of a specified asset to the seller for a predetermined price and for a specified period. Within this structure of contingency program, which incorporates an equity put or surplus put option, the cedant (option buyer) pays a premium to acquire the right to sell surplus notes or preferences shares to investors in the event of specifically pre-defined natural catastrophe and the loss of equity capital. Catastrophe equity puts are put options that enable insurers to sell shares of their stock to investors at prenegotiated prices (exercise price) when catastrophe losses exceed the levels specified in the options. The option can be exercised after the occurrence of a natural catastrophe.

Investors purchase the shares or the surplus notes with a cash payment. Catastrophe equity puts thus provide insurers with access to additional equity in the wake of catastrophe losses. These instruments are traded on the Chicago Board of Trade (CBOT) and the Bermuda Commodities Exchange⁹.

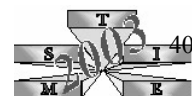
4.2.- Risk transfer instruments

The use of alternative risk transfer structures as insurance securitization and derivatives enables insurance companies to access the capital markets as additional capacity providers. In the case of insurance securitization, the capital is made available up-front before the loss event. Insurance derivatives enable investors to assume insurance risk by way of an unfunded capital market instruments in the format of options or swaps.

4.2.A.-Insurance securitization

The most common definition of securitization is, "it consists of the pooling of assets and the issuing of securities to finance the carrying of the pooled assets" (Martinez Torre-Enciso, M^{AI}. and Laye, J.E., 2001). When circumstances are favorable, securitization can be one of the most efficient forms of financing, due to a combination of two emerging trends in capital markets: first, this method incorporates the growing importance of using information to create wealth; second, it used the increasing sophistication of computers and the ways they are used. At least one expert has said, "...a securitization, when structured correctly, may entail less risk than the financing of the entity that originated the securitized assets" (Kravitt, J.H.P., 1997). When we speak of securitized insurance risk we are actually speaking of securitizing the cash flows associated with insurance risk: premiums and losses. Premiums represent a cash flow from the insured to the insurer while losses represent a cash flow from the insurer to the insured.

⁹ See, <<http://www.bsx.com>>



The evolving concept of securitization appears to be developing into an innovative risk management product that insurance (and reinsurance) institutions can use to transfer their risk to capital markets and also use as a new additional source of capacity to supplement traditional reinsurance (Grandi, M. And Müller, A., 2000).

c. – Catastrophe (Cat) bonds or "act of God" bonds

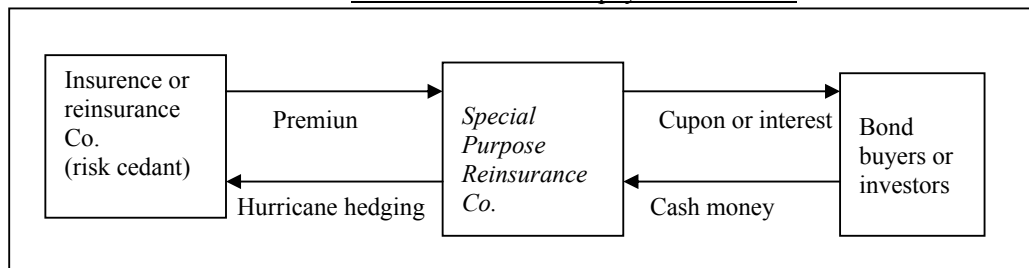
The issue of Catastrophe (Cat) bonds or "act of God" bonds is the most used securitization tool. Cat bonds are corporate bonds that constitute an exchange of principal for periodic coupon payments. The main difference with traditional corporate bonds is that the payment of the coupon and/or the return of the principal of the cat bond is linked to the occurrence of a specified catastrophic event.

With the most common insurance securitization model via an insurance risk bond, the insurer, acting as the sponsor of the transaction, concludes a reinsurance agreement with the reinsurer, who then cedes the risk to Special Purpose Reinsurance Company (SPC) under a retrocession agreement. This SPC covers any liabilities from the retrocession agreement by issuing bond. The SPCs are independent companies with reinsuring capacity, located in far areas such as Bermudas. Their task is to serve as a transfer risk vehicle in securitization deals.

Cat bonds require that bondholders forgive or defer some or all payments of interest or principal if actual catastrophe losses exceed a specified amount. When specified catastrophic event occur, an insurer or reinsurer that issued catastrophe bonds can pay claims with the funds that would otherwise have gone to the bondholders. And, to the extent that bondholders forgive repayment of principal, the insurer or reinsurer can write down its liability for the bonds, boosting surplus and potentially staving off insolvency. Cat bonds are also defined as "investment instruments based on a quantifiable risk that has been analyzed by one or more research firms, such as Property Claim Services (PCS) in New York City" (Hodges, S., 1997).

Let illustrate an example of how to issue cat bonds to transfer risk to capital market and to finance the potential losses in the event of an hurricane (figure 1). The transaction illustrated in figure 1 have three different components: investors, insurance or reinsurance companies that are the risk cedant and the Special Purpose Reinsurance Company (SPC). Insurance or reinsurance companies cede the risk to a SPC throughout an insurance (retrocession) agreement and the payment of the premium. The SPC covers any liabilities from the retrocession agreement by issuing bonds that investors buy received interests for the temporal cesion of money and the temporal risk assumption.

FIGURE 1: Cat Bond payment structure



If there is no loss event, an hurricane in this example, cat bonds will operate as any other corporate bond, i.e., principal and interest will be paid at it was stipulated in the bond contract. If a loss occurs during the cat bond life, investors will no receive their money at the expitiation. The nominal value and/or the interest of the bond is repaid to the investors five to ten years after the loss event (develop lossess period) and the SPC could face their cash needs with this money.

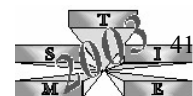


Figure 2 shows the cash flow evolution in a securitization structure. The proceeds from the bond issue are invested in top-quality bonds through a collateral trust. Management of the collateral trust is in the hands of a trustee whose task is to ensure the proper administration and the use of the trust assets. The investment income from the collateral trust should be based on a reference interest rate and should be paid to investors throughout the periodic coupon (Canter, M.S. and Cole, J.B., 1997)

FIGURE 2: Cat Bond cash-flow esturcture

CONTRACT DATE	PLUS 6 MONTH	EXPIRATION DATE	DEVELOP LOSSES PERIOD (if necessary)
* Investor buy cat bonds * Reinsurance process begining	* 6 month'cupon payment	* 6 month'cupon payment * If hurracane, expiration delay * If no hurracane, principal payment	* Periodic coupon payment * Principal payment * Payment from SPC to insurance company

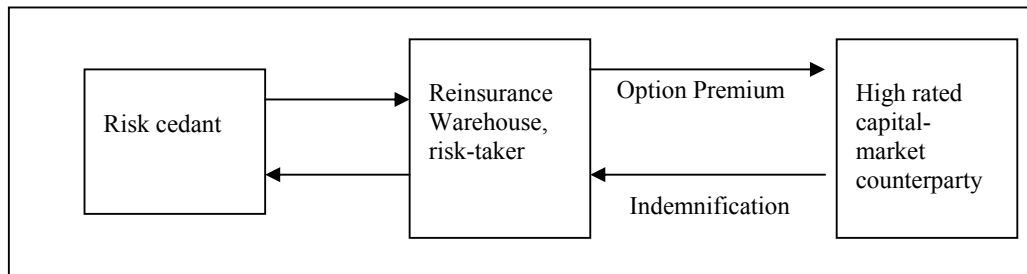
4.2.B.-Insurance derivatives

Insurance derivatives are mechanism to transfer insurance risk to the capital markets. Those tool instruments in contrast to insurance risk bonds, do not provide prior liquidity to safeguard the maximum liability, can be structured as swaps or options.

d. – Exchange-traded catastrophe options

Traditionally "call options" are financial instruments that give the buyer the right, but not the obligation, to buy a certain amount of a specified asset from the seller of the option for a predetermined price and for a specified period (Diez de Castro, L.T. and Mascareñas, J., 1994). The specified asset can range from commodities to interest rates, notional bonds, or a catastrophe index. In such transactions there are usually intermediaries, so buyers and sellers often don't know each other's identities. Figure 3 illustrates the catastrophe option payments.

FIGURE 3: Exchange-traded catastrophe options payments



Exchange-traded catastrophe options are standardized contracts that give the purchaser the right to a cash payment if a specified index of catastrophe losses for a specific period reaches a specified level – the strike price. An insurer or reinsurer that wants to use this form of securitization to hedge catastrophe risk can buy catastrophe options from investors. If catastrophe losses cause the index used in settling a catastrophe option to equal or exceed the strike price of the option, the investors must pay the insurer an amount based on the terms of the contract.

Insurers, reinsurers and investors can trade catastrophe options on the Chicago Board of Trade (CBOT) and the Bermuda Commodities Exchange¹⁰. The Chicago Board of Trade has been trading in standardized option contracts on the basis of market loss indices since the 1980s.

¹⁰ See, : <<http://www.bsx.com>>



Outside commodity exchanges, derivatives are negotiated and agreed upon between the parties on a case-by-case basis. These are referred to as over-the-counter derivatives.

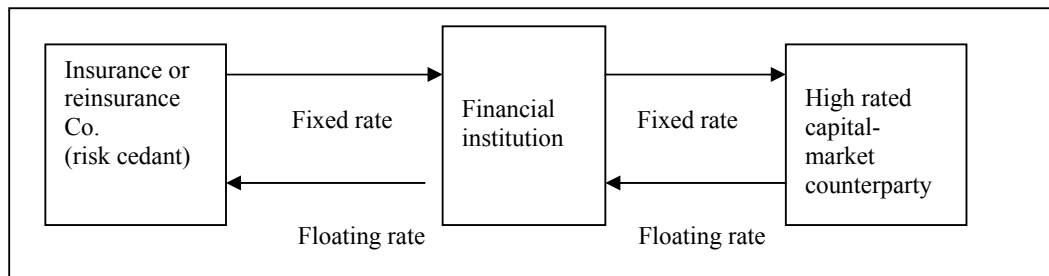
e. –Catastrophe swaps

An alternative structure to transfer catastrophe risk through the capital markets is a "cat swap". Swaps are contracts whereby parties agree to exchange assets or cash flows. In a catastrophe swap, an insurer agrees to make periodic payments to another party, and the other party agrees to make payments to the insurer which are based on a measure of catastrophe losses. The over exposure of one party in a risk class can be ceded or swapped for another risk class that is underrepresented in the traditional insurance portfolio.

In this financial instrument the returns are linked to the occurrence of an insured event, but there is no exchange of principal. Instead, the investor receives his or her premium up front and, depending on his or her credit rating, may use a letter of credit to guarantee his obligation. This structure enables the investor to invest the notional of the swap in a manner of his own choosing throughout the term of the swap, he or she may instead invest this money, for example, in LIBOR or any other interest rate reference.

These instruments can be used in the Catastrophe Risk Exchange (Catex) in New York¹¹. Catex is a "new computerized risk exchange that will allow property casualty insurers a cyberspace marketplace to swap blocks of insurance policies and reduce their exposure from over concentration in a geographic area or line of business" (Kretzler, C. and Wagner, F., 2000). This market permits splitting the catastrophe risk that would be exchanged amongst another; for example, storm risks in Japan against California earthquake risks, assuming that these have the same probability of loss and identical exposure (nominal value).

FIGURE 4: Cat Swap payments

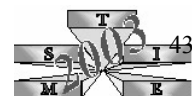


5.- Conclusion

The transfer of insurance risk to capital markets and the financing of insurance risks through the capital markets is still a very young field of business. The volume of all capital market transaction carried out since 1994 to 2001 exceeds US\$ 13bn (Munich Re ART Solutions, 2001(1)). In any case, natural catastrophes will continue to be the focus of finance and transfer of insurance risk in the future thought their actual tool instruments and other that would arise.

Contingency surplus notes, catastrophe equity puts, cat bonds, exchange-traded catastrophe options or cat swaps are financial instruments very useful for insurers and investors for several reasons. From the insurers' point of view, those financial instruments are not used to replace traditional reinsurance, but to supplement it. All forms of financing catastrophe risk should be used in different percentages of each form to get enough finance if needed as well as to transfer their risks to the capital markets. In the process to choose the correct financial structure, the insurer can use computer models and information about the business they have written to determine its potential catastrophe losses and how much capital the insurer would need to finance that risk on its own; after, the insurer can then compare the cost of using its own capital

¹¹ The address is : <<http://www.Catex.com>>



with the cost of reinsurance and the cost of securitizing risk; finally, with optimization algorithms, the insurer can determine the combination of capital, reinsurance, and securitization that minimizes its overall cost of financing catastrophe risk.

From the investors' perspective those financial instruments permits some advantages: On one hand, investors can use catastrophe models and exposure data to determine the rates of return they could expect from selling catastrophe options to insurers. With models and data, an investor can determine the probability that the actual value for a catastrophe index will surpass the strike price for a given catastrophe option. With knowledge of that probability and information about the prices for catastrophe options, an investor can calculate the rate of return he could expect from selling catastrophe options to insurers; on the other hand, Catastrophe options, catastrophe bonds, and other forms of securitization also offer investors a new means of reducing portfolio risk through diversification. The results from investments securitizing catastrophe risk depend on catastrophe loss experience, while bankruptcy and default rates for most other investments generally depend on economic conditions. Therefore, the results of investments securitizing catastrophe risk do not correlate with the results of other investments. And, as a result, adding catastrophe bonds or catastrophe options to an investment portfolio can improve the performance of the portfolio, making it more profitable, less risky, or both.

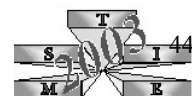
7.- Biographies

Isabel Martínez Torre-Enciso, is an Assistant professor in the Business and Management Department at the Universidad San Pablo CEU, Madrid and the R.C.U. Escorial-M^a Cristina del Escorial (UCM) where she has been teaching management and finance for the past 11 years. She received her Ph.D in 1996 from the Universidad Complutense de Madrid. She has attended to several conferences and has published more than 20 papers in emergency management, financial markets, corporate finance and other fields in national and international reviews. She is member of different professional associations and working groups. Her research interest is crisis and emergency management, business continuity, risk analysis and management, corporate finance and financial markets. She works also as a free consultant.

John E. Laye is the Managing Partner of Contingency Management Consultants. As a U.S. Navy officer, he was involved in analysis and planning for operational disruptions without formal preparation. After his naval career, more experience, research and study led to instructing at the university level and for the U.S. Federal Emergency Management Agency's Emergency Management Institute, where he joined the development team for the Integrated Emergency Management Course. He now teaches public policy there, and strategy and the practicum for emergency program managers at University of California (Berkeley's) Extension, where he is Director Emeritus. He presents research done with Professor I. Martínez Torre-Enciso at conferences in the US, Europe, and Asia, looking at policy's broad perspectives and the extended time lines of senior management. John Laye's principal efforts are as Managing Partner and Principal Consultant of Contingency Management Consultants, who advise corporations and governments on disaster avoidance. Eight of his clients' programs have received awards. His colleagues voted him a Fellow of the Business Continuity Institute in 1997, and he was elected a Certified Management Consultant in 1990. He has an Associate of Arts concentrated in Police Science, a Bachelor of Arts in Political Science from the U.S. Naval Postgraduate School, and an MS in Management from the University of Southern California. John is listed in Who's Who in America, is a Past President of the California Emergency Services Association, Chaired the International Association of Emergency Managers' *Business and Industry Committee*, and does penance on related boards and advisory groups.

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