

**Study on the Interactive Approach
between Insurance and Capital Markets
for Catastrophe Risks**

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ABSTRACT

Following the shortage of capacity in the reinsurance market after the disaster of Hurricane Andrew, the interactive approach between insurance and capital markets was started. This means the indication of liquidity of catastrophe exposure and possibility of arbitrage between both markets. In order to accelerate this movement we need to establish a common, standard practical base between both markets. However there are differences in pricing mechanisms and risk management techniques between both markets. Therefore this new development seems to take a complementary role, not a substitutional one.

1. INTRODUCTION

Franklin R. Edwards in his recent book The New Finance summarizes the recent major changes of U.S. financial markets into the following three factors and two effects.¹ Significant macroeconomic changes have occurred over the past three decades. The long period of price and interest rate stability that followed the Great Depression and later World War II ended in the 1960s. The result was higher and more volatile inflation rates, which led to higher and more volatile interest rates. Savers became sensitized to yield differences and aggressively sought higher yields wherever they could find them. As a result, banks and other financial intermediaries were forced to pay higher yields to retain funds and to attract new funds.

Second, innovations in both information and communications technologies began to break down what were heretofore natural barriers to competition. The ability to retrieve, store, process, manipulate, and transmit large masses of data at low cost made it easier for financial institutions to offer new products and enter new markets to compete for customers. Also, the increased speed and lower cost of communicating and transmitting data over large geographical areas eliminated geographical distances as an obstacle to competition.

Third, the growing internationalization or globalization of markets (both financial and nonfinancial) that accompanied the end of capital controls and the institution of flexible exchange rates further increased competition. With globalization came not only head-to-head competition between U.S. and foreign financial institutions but direct competition between U.S. and foreign regulatory systems.

Those economic changes had two key effects: "they intensified competition among financial intermediaries

¹ Franklin R. Edwards, The New Finance, The AEI Press, 1996, pp. 8-9.

and between financial intermediaries and primary security markets, and they undercut the effectiveness of traditional regulation."

In this same line we find the interactive approach between capital markets and property and casualty (PC) insurance markets. Driven from both sides, this new development is intended to cope with managing catastrophe risk exposure.

The purpose of this paper is to review the current market movement in this area and its functional meaning. The author also attempts to predict changes in the future PC insurance market.

2. SUMMARY OF BASIC CONCEPT

A. The role of insurance in the financial sector

Insurance is one of the methods of handling risk for individuals and corporations. The Commission on Insurance Terminology of the American Risk and Insurance Association defines insurance as "the pooling of fortuitous losses by transfer of such risks to insurers who agree to indemnify insureds for such losses, to provide other pecuniary benefits on their occurrence, or to render services connected with the risk. The actuarial risk pooling is established by major product line basis.

Contributions are made by each insured to the fund in relation to the level of risk brought to the pool and the insurer undertakes to settle claims out of the pool as they arise. At the same time, insurers provide funds to the capital market -- particularly to the fixed income sectors. As such, they use their own balance sheet to facilitate the transactions and to absorb the risk associated with them. The benefits of insurance are explained as follows: indemnification against unexpected loss; reduction in uncertainty; release of funds for more productive use; and access to specialist risk management services provided by insurers.²

B. The role of insurance in risk management

Risk management is defined as the executive decisions surrounding the management of pure risks. As such, risk management is a much broader concept than insurance management because insurance is only one of several methods for dealing with risk. Risk management attempts to identify the pure risks faced by the firm or organization, and uses a wide variety of methods, including insurance, for handling these risks.

The objectives of risk management may be divided into two distinct sets. The first set includes, prior to the occurrence of a loss, evaluation of potential losses for financial analysis, reduction of anxiety, and meeting externally imposed obligations. The second set of objectives concerns post-loss matters such as survival of the firm, continued operation, stability of earnings, continued growth and social responsibility.

Typically risk management has four basic functions: identifying and evaluating potential losses, selecting the appropriate technique or combination of techniques for handling losses, and administering those techniques. Nonfinancial firms usually handle loss by relying on techniques such as avoidance, retention, noninsurance

² Alan Gordon, Risk Financing, Witherby, 1992, pp. 157-158.

transfers, loss control, and insurance. Insurance is a contractual transfer of risk and is the most widely used risk financing tool.

C. Management of financial sectors and risk-based capital

Financial sectors themselves engage in risk management internally for achieving their objectives. Risk measurement and management are substantively important for all financial firms. They must seek out and evaluate risks, set capital requirements to cover the risks taken and wring profits from them. In contrast, consumers and industrial companies try to minimize risks and focus on mastering different skills to earn profit.

In the insurance industry there are several concepts related with risk which can be defined as follows: risk is the relative variation of actual loss from expected loss or future volatility of changes from the expected return from asset management or loss arising from the insured perils; chance of loss is the probability that an event will occur; peril is the cause of loss; and hazard is a condition that creates or increases the chance of loss.

D. Uniqueness of insurance in pricing

Insurance pricing differs considerably from the pricing of other products. When other products are sold, the company knows in advance what its costs of production are, so that a price can be established to cover all costs and yield a profit. However, for insurance it is not known in advance what the actual costs are going to be. In general, the rates charged by insurers are said to be adequate, not excessive and not unfairly discriminatory. These are interpreted as follows: adequate means the rate should be high enough to pay all losses and expenses; not excessive means the rate should not be so high that policyholders are paying more than the actual value of their protection; and not unfairly discriminatory means exposures that are similar with respect to losses and expenses should be charged the same rates, and dissimilar exposures should be charged different rates.³

In order to satisfy the above three requirements, generally the premium is determined subject to the actuarial fair price through an appropriate statistical approach. Insurance premiums comprise two parts: the pure-risk premium and an expense loading. These are reflected in the following three factors.

- 1) Risk-pooling and risk absorbing: Insurance provides a mechanism for risk reduction by diversification through pooling. The actuarial, underwriting, and related expenses of operating the pooling system are the major part of the premium. The pure risk premium is calculated from a probability distribution of expected total loss. However, since there is variability between expected loss and actual loss, the insurers have to consider this as a cost of capital which works as a risk buffer in their operation.
- 2) Financial service: This includes risk survey, coverage design, loss prevention, and loss settlement services.
- 3) Intermediation: Insurers collect premiums in advance of loss payments and hold the funds in reserve until claims are paid. Policy holders receive a discount in their premiums to compensate for the opportunity cost of the funds held by the insurer.

E. Risks facing PC insurance companies

³ George E. Rejda, Principles of Risk Management and Insurance, 4th edition, p. 560.

Risks facing all financial institutions can be segmented from a management perspective into three types.⁴ These are: a) risks that can be eliminated or avoided by standard business practices; b) risks that can be transferred to other participants, and c) risks that must be actively managed at the firm level.

There are also some risks that can be eliminated, or at least substantially reduced, through the technique of risk transfer. Markets exist for many risks borne by the insurance firm. Actuarial risk can be transferred to reinsurers. Catastrophe risk can be offset somewhat by undertaking a position in catastrophe futures and perhaps even in catastrophe bonds. Interest risk can be hedged or transferred through interest rate products such as swaps, caps, floors, futures, or other derivative products. Insurance policies and lending documents can be altered to effect a change in the duration and convexity of risks. After eliminating and/or transferring the risks, the remaining risks are absorbed at the insurance firm level by using firm resources and risk management tools and procedures.⁵

But in reality, given that the fat-tail nature of catastrophe risk is very dangerous for property and casualty insurers' management, more effective and beneficial treatment is expected.

F. Similarities and differences in risk management techniques between insurance and derivatives

There is similarity between the capital market and the insurance market. The essence of an insurance transaction seems to be similar to an option contract: in return for a fixed consideration (i.e., the premium), one party makes available to another party a larger sum (i.e., the amount insured) contingent upon the occurrence of an event (i.e., an insured loss).

However there are differences in the form of risk management. Insurance is a statistics-based, pooling instrument for risk management based on the law of large numbers. If risks are reasonably independent across individuals or groups, and the sample mean is predictable, they work well. If the numbers are not large enough, it is standard to spread risk through time.

On the other hand, derivatives are securities whose prices are determined by, or derived from, the prices of other securities. These assets are also called contingent claims because their payoffs are contingent on the prices of other securities. In relation with risk management, they are used as hedging instruments by taking a position which is highly correlated with the risk, but with negative correlation. This is an economic approach, not a statistical approach. Therefore it does not require a large number of samples nor does it require knowing the frequency of the event or the actuarial table.

3. CURRENT ISSUES CONCERNING THE TREATMENT OF CATASTROPHE EXPOSURES

⁴ Oldfield, G. and A. Santomero, "The Place of Risk Management in Financial Institutions," Working Paper, Wharton Financial Institutions Center, 1995.

⁵ David F. Babbel and Anthony M. Santomero, "Risk Management by Insurers: An Analysis of the Process," Working Paper, Wharton Financial Institutions Center, 1996.

A. Nature of catastrophe risks

Insurers normally insure only pure risks. However, not all pure risks are insurable. Certain requirements usually must be fulfilled before a pure risk can be privately insured. From the viewpoint of the insurer, there are ideally six requirements for a risk to be insurable:⁶

- 1) There must be a large number of homogeneous exposure units.
- 2) The loss must be accidental and unintentional.
- 3) The loss must be determinable and measurable.
- 4) The loss should not be catastrophic.
- 5) The chance of loss must be calculable.
- 6) The premium must be economically feasible.

Usually losses can be classified into three layers according to the size and frequency of individual losses during a specified period, normally a year.⁷ The lowest layer represents losses which are small in size but frequent in occurrence. This pattern means that they are relatively predictable. The middle layer represents those losses which are less frequent in occurrence but greater in severity. The level of severity is determined by the degree to which a loss will interrupt operations and place a strain on both cash flow and the ability of the business to meet its commitments. The upper layer is that of catastrophic loss. These losses occur relatively rarely but the severity is of such a scale that the viability of the enterprise is threatened.

The reason why catastrophe risks are considered to be avoidable insurable risks lies in their nature, which tends to make the pooling technique break down and become unworkable. Catastrophe risks, such as hurricanes or earthquakes, are classified as unknown risks and are characterized by a fundamentally non-linear phenomenon in which chaotic patterns emerge easily, and it is also very hard to predict the probability of the expected loss.

These characteristics are evidenced with regard to the premium schemes used for catastrophe risks in comparison with other lines of business.⁸ For most lines of insurance, the value of loss per dollar of insurance varies little from year to year. For that reason, a dynamic strategy in which premiums are set so that the loss ratio (based on say the average of the last three years of loss) attains some target level, will produce a time path of premiums which is reasonably smooth. In this case, it is both possible and appropriate for the company to plan to pay today's losses out of today's premiums. Of course, some capital surplus is necessary to cover unexpected losses, but the quantity of surplus is small if the loss pattern is smooth, and in this case no reserve fund is needed to cover future losses.

In contrast, in the case of catastrophe insurance, the annual pattern of losses is highly non-smooth and dynamic premium strategies based on a few years of experience will lead to loss ratios which are far from the target in some years. In particular, in bad years these loss ratios could require a large stock of surplus capital.

B. Problems facing the insurance industry for catastrophe exposure

⁶ George E. Rejda, Principles of Risk Management and Insurance.

⁷ Alan Gordon, Risk Financing, Witherby, 1992.

⁸ Dwight M. Jaffee and Thomas Russell, "Catastrophe Insurance, Capital Markets and Uninsurable Risks," Working Paper, Wharton Financial Institutions Center, 1996, p. 3.

Today the U.S. PC insurance industry faces challenges presented by the difficulties of catastrophe exposure for two main reasons. First is the size of capacity of the exposure. Losses from potential earthquakes or hurricanes have increased dramatically over the past ten years (from \$50 to \$100 billion) largely because of greater concentrations of people and developed property than before, as well as higher exposed values.

The increased frequency and size of catastrophes have fueled the 1989-1995 upsurge: over the entire 1950-1988 period, catastrophes averaged 35 per year, as opposed to only 25 per year, while the average insured loss per catastrophe reached \$302 million, up from \$56 million.⁹ In contrast the entire capital and surplus of the U.S. PC insurance industry is approximately \$190 billion, to which can be added some \$20 billion of capital and surplus for the U.S. reinsurance industry -- a total of just \$210 billion (annual premiums totaled \$264 billion in 1994, the catastrophe exposure of which is anywhere from \$10 to \$20 billion), while the corresponding amount in U.S. capital markets is estimated to be in excess of \$13,000 billion (i.e., over 60 times the capital and surplus of the entire U.S. insurance industry). In addition, U.S. capital markets have a daily standard deviation (due to interest rate and equity/bond price changes) on the order of \$133 billion, which the markets accept with aplomb, whereas a \$133 billion loss overnight in the insurance industry would certainly receive much greater attention.

Second, economic inefficiencies are surfacing in some areas of the insurance/reinsurance infrastructure for the following reasons:

- 1) A paucity of risk takers implies poor diversification, resulting in high costs of insurance capital.
- 2) Innovators attempting to capture profit associated with new forms of risk distribution will have a window of opportunity to earn large returns, and, at the same time, substantially reduce system-wide costs.
- 3) The information and analysis used to identify and price risk, particularly catastrophe risk, has lacked sophistication.
- 4) Widely accepted, standardized packages of aggregated risks are just beginning to become accepted and used.¹⁰

To address these criticisms, careful study which considers the different mechanisms and practices between both markets is needed. Other interpretations also exist.¹¹ For example, one criticism is the high level of transaction costs in the insurance industry -- commission rates for intermediaries of 10 to 20 percent -- which are sometimes compared with margins of 10 to 20 basis points (i.e., 0.1 to 0.2 percent) in the financial markets. However this criticism misses the mark on two key points. First, insurance commissions are applied to the premium (not the policy limit), whereas financial market margins are applied to the nominal value of the contract (which corresponds more closely in insurance terms to the policy limit than to the premium). Second, there is an entirely different and far more important economic dynamic underlying the insurance industry than the issue of cost levels. This is the use of capital and the way that the insurance industry actually leverages it. For the above reasons, catastrophe exposure requires innovative financial treatment which crosses over insurance and capital markets.

⁹ Sara Borden and Asani Sarkar, "Securitizing Property Catastrophe Risk," in Current Issues in Economics and Finance, Federal Reserve Bank of New York, August 1996.

¹⁰ Kenneth A. Froot, Brian S. Murphy, Aaron B. Stern, and Stephen E. Usher, "The Emerging Asset Class: Insurance Risk," Guy Carpenter & Co., July 1995, pp. 2-3.

¹¹ "An Engagement is Announced," in Reinsurance, April 1996.

C. Traditional treatment for catastrophe risk

a. Historical treatment

Marine insurance, one of the oldest lines of business, is a traditional example of catastrophe exposure. A market for marine insurance operated among the ancient Greeks and Phoenicians, and flourished in London from as early as the 17th century.

The oldest form of treatment for ocean disaster was called "contract of bottomry," in which a lender advanced the ship-owning merchant the full cost of the voyage as a loan. If the voyage was successful, the ship-owner repaid the bank at an interest rate with a risk premium. If the ship was lost, the loan was forgiven. In other words there was no separation of insurance and loan. The more modern form, known as syndicate insurance, was developed as a practice at Lloyd's. However even this system with its unlimited liability and three-year, open-book accounting system was unable to cope properly with catastrophe exposures.

b. Reinsurance treaty (insurance for insurance companies)

The traditional approach is to use reinsurance structures to transfer and or diversify catastrophe risk. If the risks are too large for a single insurer, the reinsurance market allows the risks to be shared by a number of others as a means of further spreading risk. Reinsurance is a risk-sharing agreement among insurers which helps an insurance scheme to work well. That is, the function of reinsurance is simply the diversification of the risk portfolio by pooling a larger number of mutually independent risks. In a sense, reinsurance functions as a bank-like business for the insurance industry. For example, a quota share treaty is nothing more than a means of substituting capital.

The reinsurance catastrophe excess loss (catXL) treaty is designed to protect the reinsured against an accumulation of losses stemming from one event. Such losses would be beyond what an insurance company would expect in a normal year. The property catXL product is written on an excess of loss basis: the ceding company assumes all losses arising from an event up to a fixed amount (the retention or deductible), at which point the property catXL cover is triggered. The cost of catXL protection, or price, is usually expressed as the rate-on-line or ROL, which is the ratio of premium to the extent of catXL cover.

The reinsurance market is a wholesale market for insurance and it is arranged either directly between the reinsurer (seller) and cedant (buyer) or through an intermediary -- the reinsurance broker.

c. Enhancement of reinsurance structure

To cope with the limited capacity of the reinsurance market, each insurance market has tried to establish various other devices for raising capital. For example, the State of California set up the California Earthquake Authority (CEA) as a collaborative effort between the private insurance industry and the public sector for solving the residential property market crisis in California. In this case, the insurance industry provides the majority of the CEA's claim-paying capacity, and the State serves as the vehicle to manage and pool the risk and raise additional capital from the capital market in the form of a portfolio-linked security structure, which is explained later as one of the new devices.

In Japan the special Earthquake Reinsurance Program for home and furniture loss is underwritten by a government structure which operates under the no-profit rule. Private insurance companies alone cannot

provide enough capacity to cover catastrophic disasters that heavily impact the national economy and the lives of Japanese citizens. This program was established in 1966 following the massive Niigata earthquake in 1964.

D. Newly-developed, risk-management instruments for catastrophe risk

Recently we can observe the use of a three-way approach for managing catastrophe risk:

- 1) attempts at more effective diversification among the insurance industry;
- 2) obtaining capacity from the capital market; and
- 3) a combination of insurance and security techniques.

a. Attempts at more effective diversification among the insurance industry

***The Catastrophe Risk Exchange (CATEX)**

CATEX in Princeton, New Jersey is a computerized trading floor (exchange) licensed in New York as a neutral reinsurance intermediary where primary insurers, reinsurers, intermediaries, and self-insureds can trade types of insurance risks, such as a book of property business exchanged for a book of auto liability risk. CATEX was founded by former New Jersey Insurance Commissioner Samuel Fortunato and developed by Science Applications International Corporation(SAIC) and Sun Microsystems,Inc. About two dozen companies have signed on to the electronic trading floor, including CIGNA Corp., Travelers/Aetna Property Casualty Corp., Swiss Re America , Aon, Everest Re (recently spun off by its parent, Prudential Insurance Company of America), Enron International, PXRE and Employers Reinsurance Corp., although only a handful of risks have been posted so far, and none have been traded.

CATEX has announced that its electronic commerce system currently has over \$1.3 billion in risk and coverage posted for cession or assumption. An electronic exchange is a facility in which insurance companies, self-insureds and reinsurers can trade or swap risk exposures with others and also a facility to enter into the capital market. CATEX started operation of this system in October 1996 but actual transactions will begin in 1997. In addition to straight risk-for-risk swaps, CATEX has received approval from New York regulators to allow swaps to be sweetened with cash or straight cash-for-risk swaps. Self-insured companies also will be allowed to swap their risks with other self-insured companies through a reinsurance intermediary.

CATEX is also trying to expand this class of business to other types of insurance besides catastrophe insurance. It has scheduled expansions in Bermuda, London, Germany, Japan and several other countries. It has also created an additional classification of CATEX membership, called a signatory class, which is available to risk bearers with less than \$1 billion in net admitted assets who choose to access CATEX through their intermediary. Once trading becomes active, real time indexes will be available on a minute-by-minute basis, which will be helpful to capital markets which have been reluctant to enter into insurance deals because the pricing is unknown. A subscription to CATEX costs about \$75,000 a year. For that cost, subscribers can post risks for swapping or requests for reinsurance coverage. CATEX receives fees of \$150 per \$1 million of coverage swapped from each party. For reinsurance transactions, CATEX receives a commission equal to 75 basis points of the reinsurance premium, a figure substantially less than commissions from traditional reinsurance intermediaries, which are normally 5~10% on premium.

b. Obtaining capacity from the capital market

***An insurance-linked security (or disaster/Act of God bond)**

These securities are sometimes considered the modern version of bottomry, because they provide capital

to an insurance company in advance of a catastrophe, and they are only exercised in the event of a catastrophe. This would link an investor's returns to the size of an insurer's losses: the bigger the losses, the smaller the returns. Two types of securities are involved, a portfolio-linked security (sometimes called liability-backed security) and an index-linked security.

The former structure is one in which an insurance company cedes its portfolio to a special purpose reinsurance company which in turn issues a bond-collateralized reinsurance obligation. Part of the proceeds of this reinsurance obligation are deposited in a collateral account and loss payments disbursed therefrom are subject to the reinsurance conditions. That is, the ceding insurer's portfolio exposure is transferred to the investor's exposure in a capital market. The return on this security is linked with the result of the underlying insurance portfolio. If a catastrophe occurs and the associated insured losses reach a specified amount, the coupon rate will decline to a new fixed rate for the remaining period. Repayment of principal can also be linked to the catastrophic occurrence. Thus, the price of a security is related to its reinsurance portfolio. In other words, the nature of this risk-management technique and pricing scheme is simply the transference of risk from insurer to investors.

A similar scheme is used for the capital market funding portion of the California Earthquake Authority (CEA) Program. According to industry information, a bid by CEA for a \$1.5 billion bond offer marketed by Morgan Stanley fell by the wayside because CEA received better terms from a traditional reinsurer. This is due to the recent soft market in reinsurance caused by a number of catastrophe losses, increased capital from the Bermuda and London markets, and possibly more precise pricing through an improved catastrophe analysis model.

Index-linked securities, on the other hand, are designed by replacing a portfolio with an insurance market claim index.

There are several differences between an insurance-linked security and a reinsurance treaty:

- An index-linked security is an investment product and increased capacity appears on the insurance company's balance sheet.
- There is no credit risk as with a reinsurance treaty, since proceeds are deposited at the outset.
- A security is typically valid longer than the 12-month period a reinsurance is valid.
- There is no reinstatement cover for a security like there is for a reinsurance.
- A security contract is not one of indemnification, so there is no need to prove a loss in order to obtain the benefits.
- An index-linked security brings a basis risk, since the cover paid for is not an exact match to the cedent's exposure.

Average returns would be higher on these bonds than on the ordinary sort partly because investors would be acting as insurers as well as lenders, and so need to be rewarded for the extra risk. In theory, returns will also be attractive for another reason. As the risk of natural disasters is only slightly related to risks on other investments, such securities should help investors to diversify their portfolios, thus improving their risk-adjusted returns. Indeed, a study by Goldman Sachs estimates the yield on a hypothetical ten-year disaster bond, based on past catastrophes, to be about as risky as a B-grade corporate bond, offering loss-adjusted returns of 7 to 8 percent compared with the 5.5 percent returns of a B-bond.¹²

¹² "Disastrous Bonds," The Economist, August 31, 1996, p. 60.

But there are several problems. Set aside, for the moment, the fact that it is much harder to predict future hurricane losses than to gauge firms' default risks. Disaster bonds still suffer from another huge handicap: there are not many of them about. As a result, they are not very liquid, forcing sellers to pay huge premiums to tempt investors.

***CBOT PCS Catastrophe Insurance Options**

Exchange-traded insurance options and futures began in 1992. Over-the-counter insurance products were first issued in 1994, and insurance swaps are expected to begin in the near future. The Chicago Board of Trade (CBOT) first introduced Property Catastrophe Options as American options which can be exercised before or on their expiration date and which use an index based on insurance industry loss ratios provided by the Insurance Service Office, Inc., of New York City (ISO). These were terminated at the end of 1995. The current PCS catastrophe option, named after the Property Claim Service (PCS), a division of the American Insurance Services Group, Inc. which provides the index, was then introduced. This option is a European option, which can be exercised only on its expiration date.

PCS options are standardized instruments based on a benchmark index of catastrophe estimates provided by PCS, and their public option premiums are the same for all users. With catastrophe options, an underlying asset does not exist, so an index is used in lieu of an asset price. The index is an estimate of industry's total claim payments for catastrophe occurring within the contract period and specified region. The difference between the strike price and the index at the option's expiration determines the option's value. PCS options are primarily traded as call spreads, which are similar to layers of reinsurance or aggregate excess of loss reinsurance agreements. Layers are formed by choosing appropriate strike prices which are associated with industry loss estimates that underline each PCS contract. Each PCS loss index represents the sum of then-current PCS estimates for insured catastrophic losses in the area and loss period covered, divided by \$100 million. Each index is quoted in points and tenths of a point.

Several differences can be pointed out between reinsurance and call spread:

- There is no need to have an insurable interest to buy or sell reinsurance options.
- They are traded and settled through an exchange (rather than principal to principal).
- Prices are publicly disseminated, and the final settlement value is linked to an underlying index of losses (rather than any one insured's particular loss experience).

However the difficulties should also be pointed out.¹³ Reinsurance options are traded with low volumes since market participants can not easily find counterparts to their trades. For example, between October 1995 and April 1996, the average monthly volume of catastrophe options traded was approximately 450, compared with 167,000 per instrument for all future options traded on CBOT. Also insurance companies face basis risk, since an option payoff is based on the aggregate industry claim payments and is unlikely to offset an individual company's claim payments.

Another drawback of industry indexes is their lack of definition. As losses stemming from megacatastrophes can take years to develop, concerns have been expressed about the possibility of manipulation by insurance companies. In other words, the current situation of CBOT Cat leaves only speculative capital as a source of risk-bearing supply. In order to be successful, the pricing of these contracts should be reasonably understandable in comparison with the success of stock and interest rate option

¹³ Economics and Finance (current issue)

contracts.¹⁴

The major reasons for the success of stock and interest rate option contracts was the simultaneous development of the Black/Scholes option-pricing model, which allowed market participants to detect under- and over-pricing and trade accordingly. At the present time no such tool exists for pricing catastrophe options.

***Bermuda Catastrophe risk market**

The opening of the Bermuda Commodities Exchange in April this year was approved by a private act of the Bermuda parliament last year. The exchange is owned by its members, currently AIG, Chase Manhattan and Guy Carpenter. The contracts in weather-related catastrophe risks will follow a catastrophe index developed by Guy Carpenter, which collates detailed information on loss experiences by zip-code areas.¹⁵ Comparing the characteristics of the Guy index with the PCS index, the former is specific to the particular line of business, home-owners' insurance, and also considers matching with the insurance practice on a zip code basis. In this treatment we presume the possible reduction of basis risk, however it should also be pointed out that such risk cannot be extinguished completely.

*** Contingent surplus note or subordinated convertible bonds with a cat coupon, or equity put**

This approach is different from the fore-mentioned devices because it pays attention to increase of capital itself as a risk buffer in the case of financial distress due to catastrophe loss. The contingent surplus note transaction has been completed by the Nationwide Mutual Insurance Company, and explained as follows:¹⁶

Nationwide retained the option to issue up to \$400 million in surplus notes to a guaranteed buyer, a Nationwide trust. Thus, investors did not buy surplus notes; they purchased bonds issued by the trust. These Nationwide trust bonds are backed by U.S. Treasury securities. However, if Nationwide exercises its option to issue surplus notes to the trust, the collateral backing the Nationwide trust bonds held by investors would change from U.S. Treasury securities to Nationwide surplus notes. In this case, the trust would sell its holdings of U.S. Treasury securities to finance the purchase of Nationwide's surplus notes. Whether or not Nationwide issues surplus notes, investors receive the same coupon payments. Although the Nationwide trust bonds provide a higher coupon rate than U.S. Treasury securities, investors bear the risk that the collateral on their investment may change from U.S. Treasury securities to Nationwide surplus notes.

A similar approach was taken in the Winterthur case, which was reported as follows:¹⁷

Winterthur recently took the cat bond concept forward with its issue of subordinated convertible bonds with a cat coupon attached. The cat coupon is triggered by an explicit event index which is based on numbers of vehicles damaged, rather than one based on actual claims volume.

¹⁴ The Journal of Commerce. March 12, 1997, pp. 6A, 12A.

¹⁵ Jaffee, Dwight M. and Thomas Russell, "Catastrophe Insurance, Capital Markets and Uninsurable Risks," Working Paper, Wharton Financial Center, 1996, p.12.

¹⁶ Risk Financing Newsletter, Vol. 13, No. 2, June 1996.

¹⁷ Garry Booth, "Managing Catastrophe Risk," FT Financial Publishing, 1997, p. 49.

An arrangement where investment and reinsurance is linked is used to help a cedant finance expansion. But the technique can also be applied to catastrophe situations. Such an arrangement is often called an equity put. The standby credit is triggered when losses exceed an agreed threshold or a market benchmark. The cedant issues the reinsurer with equity or equity-related instruments in exchange for new capital, and pays an annual commitment fee, based on the size of the facility. A contingency bond is different from other devices in that the investors never take the underwriting risk. This is very similar to bank loans which fluctuate according to the debtor's net value.

c. The idea of combining insurance and security techniques

The idea of combining risk-bearing across insurance and securities to achieve a more efficient allocation of catastrophe risk is presented below. It involves a modified insurance instrument, which provides insurance contingent on the frequency as observed after the fact, and of a derivative security for betting on the frequency itself.¹⁸

The concept is illustrated as follows:¹⁹

A catastrophe bundle is a two-part contract which combines a catastrophe future with a mutual reinsurance portfolio. Catastrophe bundles permit reinsurers to provide full, customized coverage to an insurer without having it assume unreasonable risk. The first component of a catastrophe bundle treats the actuarial table as the risk, (i.e., the risk of using the wrong actuarial table for predicting the frequency of property catastrophes.) Securities similar to those suggested in 1992 are now traded on both the Chicago Board of Trade (CBOT) under the name of CAT (catastrophe) futures, as well as in private sale. A CAT future entitles the reinsurer to an agreed dollar amount that increases as the frequency of catastrophe claims in a given region increases. Since the value of CAT contracts rises as losses increase, reinsurers decrease their exposures by buying such instruments. On the other side of the equation, speculators can trade CAT contracts to make a profit, in effect providing them with a means of betting on the weather. In addition to the protection provided by catastrophe futures if catastrophe frequency rises, reinsurers also require additional protection if the severity of catastrophes exceeds their predictions. This, in turn, is afforded by the second part of the catastrophe bundle: a mutual reinsurance portfolio.

The mutual reinsurance portfolio provides shares in a CAT pool and is designed to cover deviations from the average severity exposure posed by catastrophes. This combination of catastrophe futures and a mutual reinsurance portfolio can be meshed to provide reinsurers with a very effective means of hedging property catastrophe risks, ultimately producing an optimal allocation of risk bearing between reinsurers seeking to hedge their risks, and speculators who seek a profit from the transaction.

¹⁸ Chichilnisky, Graciela, "The Future of Global Reinsurance," presented at the NBER Workshop Public Policy and the Environment," July 31, 1996.

¹⁹ Chichilnisky, Graciela, "Financial Innovation in Property Catastrophe Reinsurance: The Convergence of Insurance and Capital Markets," Risk Financing Newsletter, Vol. 13, No. 2, June 1996.

Insurance swap instruments will enable primary insurers, reinsurers, and self-insurers to diversify their risks by trading blocks of insurance policies in different regions of the United States. Each swap will be a bilateral agreement, creating reciprocal reinsurance between two insuring entities.

4. FACTORS ACCELERATING THE CONVERGENCE OF FINANCIAL AND INSURANCE MARKETS

A. Overview of problem

The negative perceptions and features associated with insurance risk for investors are pointed out below:²⁰

Perception of risk: In the case of insurance, even if the statistics indicate that an investment should achieve a stated level of profitability over time, investors tend to feel that the erratic occurrence of insured events puts them into a lottery and exposes them to a level of volatility which they would not accept in another class of investment.

Securitizing risks: There is also some concern that insurance risk is, to some extent, under the control of the insurance sector. The financial result of insurance can be manipulated potentially to the detriment of investors. However, the experience of Securitizing other financial business risks, such as bank loans, has demonstrated that such risks may be transferred from their natural owners to investors with absolute fair dealing.

Lack of liquidity: Capital market investors prefer the ability to sell an investment should their view of it change. However, the lack of willing buyers and sellers of insurance-related investments make this risk relatively illiquid, leaving investors uncomfortable.

No natural hedging mechanisms: Investors who become nervous about the direction of the stock market can hedge their market risk by selling (or buying) stock index futures, but there is no such hedge for insurance risk.

Insurance losses are seldom clear cut: Insurance claims are subject to argument. Both the amount of the claim and the policy wording covering the claim may be disputed. Settlement of agreed claims is often slow. This is in contrast with the speedy settlement of securities transactions for known amounts on fixed dates.

Regulatory barriers: Regulators are often suspicious of change in established market practice.

Kenneth A. Froot of Harvard Business School reviews the possible reasons for problems in current reinsurance schemes and provides possible solutions.²¹

He states that if the problem is that catastrophe-risk-taking capital is insufficient, then the capital markets clearly represent a potential solution. He points out the necessity of standardizing risk. Because reinsurance contracts have tailor-made features and cover company-specific exposures, the simple securitization of existing reinsurance contracts is unlikely to lower costs or increase capacity. He suggests that catastrophe indexes are one way to accomplish this. Indexes help avoid the redundant analysis of distinct risks and also help promote

²⁰ Emap Finance and Swiss Re, "The Convergence of the Financial and Insurance Markets," 1996, p.14.

²¹ Kenneth A. Froot, "The Limited Financing of Catastrophe Risk: An Overview," Paper for the NBER's Insurance Program.

liquidity.

B. Practical suggestions for improving on current circumstances

There are two ways to improve current trading circumstances. The first is to determine what standard practices are suitable to both the insurance and financial markets. Many of the differences in practical value and transaction style between the two markets stem from the afore-mentioned differences in risk management techniques and pricing mechanisms. Therefore comparative study in these areas is necessary if insurance risk is to be transferred to the capital market and a secondary insurance market is to emerge.

Second, it is clear that current securities market institutions and commercial banks have developed as a way of sharing and making use of each other's risk, liquidity, and information services. Examples of the convergence of securities and banking markets are evidenced in securitization and hedging tools. The contributions of brokers, dealers, and organized exchanges help to provide liquidity in financial secondary markets, which provide more information to savers and borrowers.

Transactions between insurance markets and security markets, on the other hand, have just started. Basic differences in concept and gaps between users' needs and suppliers' benefits still exist. For example, when we compared portfolio-linked securities and index-linked securities, the former had the advantage of direct risk transfer for insurers but there were transaction costs and information costs for creating the structure, that is the reinsurance transaction, and running the special purpose vehicle, and these are a disadvantage for investors. Also, when we consider the necessary return level of the insurance companies which use this scheme, it is important to select a better than average risk portfolio in order to compensate the company for maintaining the above operation costs as well as enable it to realize a suitable level of return. Otherwise an inefficient cost situation will be created, resulting in the reduced attractiveness of the scheme.

On the other hand, index-linked securities are cost effective and easily understood by investors. But if primary insurers wish to use such securities for risk management, they should be prepared to cope with the basis risk between their own portfolio risk exposures and the industry risk on which the index is based. However, it is difficult to measure basis risk appropriately.

In addition, there is the non-harmonious situation between financial and insurance pricing schemes, as indicated by the following:

Homeowners' insurance is, in effect, a put option. The policyholder pays a premium for an option to put his home to a counter party when its market value has declined and the insurance company will assume the liability of fire-damaged houses. There are, however, difficulties in applying option theory to insurance. First, insurance loss distributions are not log-normal (i.e., they are not evenly distributed around the premium price), undermining conventional pricing models. More importantly, the underlying asset (i.e., the profit stream generated by the insurance risk) is not actively traded. Furthermore, options theory is based on instantaneous measures of marginal changes,

not aggregate measures based on the law of large numbers.²²

The dynamics of catastrophe losses (these losses being the primary asset in the catastrophe options market) differ completely from the dynamics of stock prices. Catastrophe losses have sample paths which are usually zero but which are sometimes very large. This creates a jump process with a very skewed distribution, even in a short period of time, so this risk cannot be fully hedged with only two assets. It would seem that a new and potentially far more complex option pricing theory needs to be developed for catastrophe options, and until this theory is established it is unlikely that trading capital will flow into this market in any sizable amount.²³

***Creation of a new scheme for global welfare**

A second suggestion for accelerating this movement is to create a global indemnifying scheme for catastrophe losses from the viewpoint of global welfare. This idea is an extended version of the Japanese earthquake re-insurance scheme or the California Earthquake Authority Program, the Hawaii Hurricane Relief Fund and/or the Florida Hurricane Fund. It considers the argument that an optimal economic solution for the future costs associated with common problems such as air pollution should take into account other environmental hazards. There is also a strong belief that environmental solutions and business principles cannot work together. If they could, one idea would be to create a global catastrophe reimbursement scheme with an internationally agreed upon premium paid for by the industries concerned. This premium could be considered a global tax, the risk-sharing structure of which comes from a catastrophe bundle.

There are several challenges to the industry with this line of thinking. First, as part of a market-oriented approach for reducing air pollution, the Clean Air Act of 1990 gave polluters the right to buy and sell rights to emit sulfur dioxide, which are now traded at CBOT as the EPA's Acid Rain Program. Several environmental derivatives transactions have also taken place. For example, there is the swap contract between the pharmaceutical company and INBIO, a Costa Rican government. In the swap the pharmaceutical company receives a portion of the property rights of Costa Rican forests and pays INBIO U.S. \$1 million. It also guarantees that a portion of the profit the company will receive from developing and marketing medicine derived from the genetic codes in the country's forests will be delivered to INBIO. Developments in these areas should be closely observed when considering this subject.

***Necessity of further study on the property of catastrophe exposures**

Finally, I would like to point out the necessity of the continuous study of natural hazards which are still one of life's greatest mysteries. The science of catastrophe prediction is not well developed, in the sense that the size, frequency, and location of catastrophes continue to surprise most experts. Improved understanding of exposures in this area will result in the reduction of uncertainty for the parties involved in catastrophe-related financial trade. Also it will provide a useful starting point for developing effective financial solutions.

²² Emap Finance and Swiss Re, "The Convergence of the Financial and Insurance Markets," 1996, pp. 7-8.

²³ Dwight M. Jaffee and Thomas Russell, "Catastrophe Insurance, Capital Markets and Uninsurable Risks," Working Paper, Wharton Financial Center, 1996, p. 13.

5. CONCLUSIONS - PREDICTIONS CONCERNING THE FUTURE OF THE INSURANCE MARKET

In conclusion, I characterize current developments in alternative risk-transferring methods as follows:

The risk management technique and pricing system for each instrument are different. Therefore the merits and demerits are also different, and there is no common scheme for evaluating them. The merits of one instrument do not necessarily offset the drawbacks of another. For example, insurance works based on pooling and the advantages are relatively long-term stability of pricing and providing continuity of coverage. The disadvantages, however, are lack of capacity against catastrophe exposures. Capital market-related insurance products, on the other hand, have potentially huge capacity but are unstable in terms of their reliance on investors' speculative attitude. Of course, the merits of the pricing system depend on the combination of volume of capital supply and expected return of speculators.

One recent transaction serves as an instructive case in point. A principal motivator for capital market-related products was the price of catastrophe reinsurance following the losses of Hurricane Andrew. However this effect has been ameliorated following successive rate reductions at the time of annual policy renewal. In addition, reinsurance capacity available through the Bermuda marketplace and elsewhere has expanded so there are just not the same pressures in 1997 as there were in 1992.

Based on the above, I conclude as follows: Given the relative merits of each product, the best treatment of risk management for users is the extent to which their needs are satisfied in an optimally efficient combination of both techniques. In other words the products are not substitutes for each other, but complements of each other. In consequence, the convergence of insurance and financial techniques will occur to the extent that effective common practical standards and arbitrage opportunities bridging both markets can be created. Certainly, further study in these areas will prove generally beneficial to mankind.

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