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CAT Bonds and Other Risk-Linked Securities: State of the Market and Recent Developments

J. David Cummins

Abstract

This article reviews the current status of the market for catastrophic risk (CAT) bonds and other risk-linked securities. CAT bonds and other risk-linked securities are innovative financial vehicles that have an important role to play in financing mega-catastrophes and other types of losses. The vehicles are especially important because they access capital markets directly, exponentially expanding risk-bearing capacity beyond the limited capital held by insurers and reinsurers. The CAT bond market has been growing steadily, with record amounts of risk capital raised in 2005, 2006, and 2007. CAT bond premia relative to expected losses covered by the bonds have declined by more than one-third since 2001. CAT bonds now appear to be priced competitively with conventional catastrophe reinsurance and comparably rated corporate bonds. CAT bonds have grown to the extent that they now play a major role in completing the market for catastrophic-risk finance and are spreading to other lines such as automobile insurance, life insurance, and annuities. CAT bonds are not expected to replace reinsurance but to complement the reinsurance market by providing additional risk-bearing capacity. Other innovative financing mechanisms such as risk swaps, industry loss warranties, and sidecars also are expected to continue to play an important role in financing catastrophic risk.

Introduction

This article analyzes risk-linked securities as sources of risk capital for the insurance and reinsurance industries. Risk-linked securities are innovative financing devices that enable insurance risk to be sold in capital markets, raising funds that insurers and reinsurers can use to pay claims arising from mega-catastrophes and other loss events. The most prominent type of risk-linked security is the catastrophic risk (CAT) bond, which is a fully collateralized instrument that pays off on the occurrence of a defined catastrophic

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event. CAT bonds and other risk-linked securities are potentially quite important because they have the ability to access the capital markets to provide capacity for insurance and reinsurance markets. The CAT bond market has expanded significantly in recent years and now seems to have reached critical mass. Although the CAT bond market is small in comparison with the overall nonlife reinsurance market, it is of significant size in comparison with the property-catastrophe reinsurance market. Some industry experts observe that nontraditional risk financing instruments, including CAT bonds, industry loss warranties (ILWs), and sidecars, now represent the majority of the property-catastrophe retrocession market.

This article begins by discussing the design of CAT bonds and other risk-linked securities. The discussion then turns to the evolution of the risk-linked securities market and an evaluation of the current state of the market. The scope of the article is limited primarily to securitization of catastrophic property-casualty risks. However, there also are rapidly developing markets in automobile and other types of noncatastrophe insurance securitizations as well as life insurance securitizations, which are discussed in Cowley and Cummins (2005).

THE STRUCTURE OF RISK-LINKED SECURITIES

This section considers the structure of CAT bonds and other risk-linked securities that have been used to raise risk capital for property-casualty risks. The discussion focuses primarily on CAT bonds but also considers other innovative risk financing solutions. Included in the latter category are some investment structures that are not necessarily securities in the sense of being tradable financial instruments but are innovative approaches whereby insurers and reinsurers can either access capital markets to supplement traditional reinsurance.

Risk-Linked Securities: Early Developments

Following Hurricane Andrew in 1992, efforts began to access securities markets directly as a mechanism for financing future catastrophic events. The first contracts were launched by the Chicago Board of Trade (CBOT), which introduced catastrophe futures in 1992 and later introduced catastrophe put and call options. The options were based on aggregate catastrophe loss indices compiled by Property Claims Services (PCS), an insurance industry statistical agent.[1] The contracts were later withdrawn due to lack of trading volume. In 1997, the Bermuda Commodities Exchange (BCE) also attempted to develop a market in catastrophe options, but the contracts were withdrawn within 2 years as a result of lack of trading.

Insurers had little interest in the CBOT and BCE contracts for various reasons, including the thinness of the market, possible counterparty risk on the occurrence of a major catastrophe, and the potential for disrupting long-term relationships with reinsurers. Another concern with the option contracts was the possibility of excessive basis risk, i.e., the risk that payoffs under the contracts would be insufficiently correlated with insurer losses. A study by Cummins et al. (2004) confirms that basis risk was a legitimate concern.

[1] Contracts were available based on a national index, five regional indices, and three state indices, for California, Florida, and Texas. For further discussion, see Cummins (2005).

Interestingly, in 2007 two separate exchanges, the Chicago Mercantile Exchange (CME) and the New York Mercantile Exchange (NYMEX) introduced futures and options contracts on U.S. hurricane risk. Both exchanges indicate in their distributional materials on the contracts that their introduction was motivated by the 2005 U.S. hurricane season, which revealed the limitations on the capacity of insurance and reinsurance markets. CME currently lists contracts on hurricanes in six U.S. regions: the Gulf Coast, Florida, Southern Atlantic Coast, Northern Atlantic Coast, Eastern United States, and Galveston-Mobile. CME contracts settle on the Carvill Hurricane Indices created by Carvill, a reinsurance intermediary. NYMEX initial listings were a U.S. national contract, a Florida contract, and a Texas-to-Maine contract. The NYMEX contracts will settle on catastrophe loss indices. The NYMEX indices are calculated by Gallagher Re based on data provided by Property Claims Services, the same data source utilized for the earlier CBOT options. Given that both the CME and NYMEX contracts are based on broadly defined geographical areas, they will be subject to significant basis risk. Thus, it remains to be seen whether these contracts will succeed where the similar CBOT contracts failed. However, given the existence of a secondary market as well as dedicated CAT bond mutual funds, it is possible that the CME or NYMEX contracts could be used for hedging purposes by investors with broadly diversified portfolios of CAT bonds.

Another early attempt at securitization involved contingent notes known as "Act of God" bonds. In 1995, Nationwide issued $400 million in contingent notes through a special trust—Nationwide Contingent Surplus Note (CSN) Trust. Proceeds from the sale of the bonds were invested in 10-year Treasury securities, and investors were provided with a coupon payment equal to 220 basis points over Treasuries. Embedded in these contingent capital notes was a "substitutability" option for Nationwide. Given a prespecified event that depleted Nationwide's equity capital, Nationwide could substitute up to $400 million of surplus notes for the Treasuries in the Trust at any time during a 10-year period for any "business reason," with the surplus notes carrying a coupon of 9.22 percent.[2] Although two other insurers issued similar notes, this type of structure did not achieve a significant segregation of Nationwide's liabilities, leaving investors exposed to the general business risk of the insurer and to the risk that Nationwide might default on the notes. In addition, unlike CAT bonds, the withdrawal of funds from the trust would create the obligation for Nationwide eventually to repay the Trust. Consequently, contingent notes have not emerged as a major solution to the risk-financing problem.

CAT Bonds

The securitized structure that has achieved the greatest degree of success is the CAT bond. CAT bonds were modeled on asset-backed-security transactions that have been executed for a wide variety of financial assets including mortgage loans, automobile loans, aircraft leases, and student loans. CAT bonds are part of a broader class of assets known as *event-linked bonds*, which pay off on the occurrence of a specified event. Most event-linked bonds issued to date have been linked to catastrophes such as hurricanes and earthquakes, although bonds also have been issued that respond to mortality events.

[2] Surplus notes are debt securities issued by mutual insurance companies that regulators treat as equity capital for statutory accounting purposes. The issuance of such notes requires regulatory approval.

The first successful CAT bond was an $85 million issue by Hannover Re in 1994 (Swiss Re, 2001). The first CAT bond issued by a nonfinancial firm, occurring in 1999, covered earthquake losses in the Tokyo region for Oriental Land Company, the owner of Tokyo Disneyland. Although various design features were tested in the early stages of the CAT bond market, more recently CAT bonds have become more standardized. The standardization has been driven by the need for bonds to respond to the requirements of the principal stakeholders including sponsors, investors, rating agencies, and regulators.

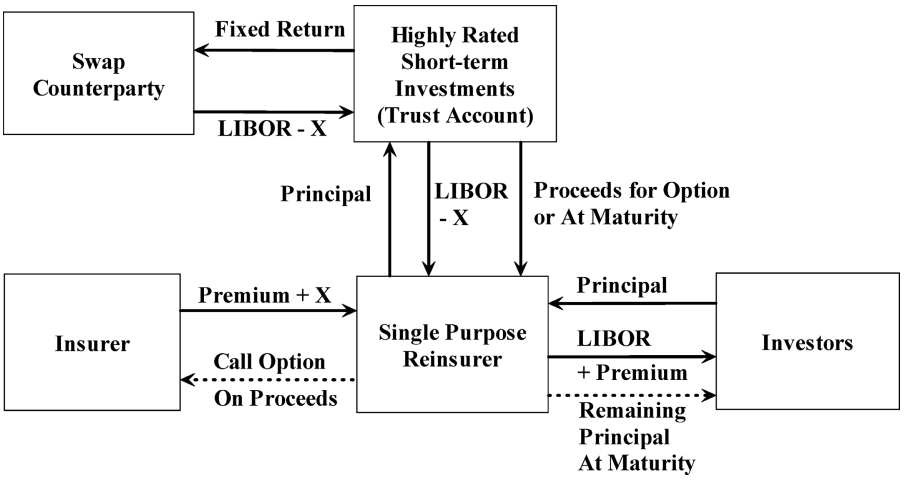
CAT bonds often are issued to cover the so-called *high layers* of reinsurance protection, e.g., protection against events that have a probability of occurrence of 0.01 or less (i.e., a *return period* of at least 100 years). The higher layers of protection often go unreinsured by ceding companies for two primary reasons—for events of this magnitude, ceding insurers are more concerned about the credit risk of the reinsurer, and high layers tend to have the highest reinsurance margins or pricing spreads above the expected loss (Cummins, 2007). Because CAT bonds are fully collateralized, they eliminate concerns about credit risk, and because catastrophic events have low correlations with investment returns, CAT bonds may provide lower spreads than high-layer reinsurance because they are attractive to investors for diversification.

CAT bonds also can lock in multi-year protection, unlike traditional reinsurance, which usually is for a 1-year period, and shelter the sponsor from cyclical price fluctuations in the reinsurance market. The multi-year terms (or *tenors*) of most CAT bonds also allow sponsors to spread the fixed costs of issuing the bonds over a multi-year period, reducing costs on an annualized basis.

A typical CAT bond structure is diagrammed in Figure 1. The transaction begins with the formation of a single purpose reinsurer (SPR). The SPR issues bonds to investors and invests the proceeds in safe, short-term securities such as government bonds or AAA corporates, which are held in a trust account. Embedded in the bonds is a call option that is triggered by a defined catastrophic event. On the occurrence of the event, proceeds are released from the SPR to help the insurer pay claims arising from the event. In most CAT bonds, the principal is fully at risk, i.e., if the contingent event is sufficiently large, the investors could lose the entire principal in the SPR. In return for the option, the insurer pays a premium to the investors. The fixed returns on the securities held in the trust are usually swapped for floating returns based on London interbank offered rate (LIBOR) or some other widely accepted index. The reason for the swap is to immunize the insurer and the investors from interest rate (mark-to-market) risk and also default risk. The investors receive LIBOR plus the risk premium in return for providing capital to the trust. If no contingent event occurs during the term of the bonds, the principal is returned to the investors upon the expiration of the bonds.

Some CAT bond issues have included *principal protected tranches*, where the return of principal is guaranteed. In this tranche, the triggering event would affect the interest and spread payments and the timing of the repayment of principal. For example, a 2-year CAT bond subject to the payment of interest and a spread premium might convert into a 10-year zero-coupon bond that would return only the principal. Principal-protected tranches have become relatively rare, primarily because they do not provide as much risk capital to the sponsor as a principal-at-risk bond.

Figure 1
CAT Bond With Single-Purpose Reinsurer



Insurers prefer to use a SPR to capture the tax and accounting benefits associated with traditional reinsurance.[3] Investors prefer SPRs to isolate the risk of their investment from the general business and insolvency risks of the insurer, thus creating an investment that is a "pure play" in catastrophic risk. In addition, the bonds are fully collateralized, with the collateral held in trust, insulating the investors from credit risk. As a result, the issuer of the securitization can realize lower financing costs through segregation. The transaction also is more transparent than a debt issue by the insurer, because the funds are held in trust and are released according to carefully defined criteria.

The bonds are attractive to investors because catastrophic events have low correlations with returns from securities markets and hence are valuable for diversification purposes (Litzenberger et al., 1996). Although the $100 billion-plus "Big One" hurricane or earthquake could drive down securities prices, creating systematic risk for CAT securities, systematic risk is considerably lower than for most other types of assets, especially during more normal periods.

In the absence of a traded underlying asset, CAT bonds and other insurance-linked securities have been structured to pay off on three types of triggering variables: (1) *indemnity triggers*, where payouts are based on the size of the sponsoring insurer's actual losses; (2) *index triggers*, where payouts are based on an index not directly tied to the sponsoring firm's losses; or (3) *hybrid triggers*, which blend more than one trigger in a single bond.

There are three broad types indices that can be used as CAT bond triggers—industry loss indices, modeled loss indices, and parametric indices. With industry loss indices, the

[3] Harrington and Niehaus (2003) argue that one important advantage of CAT bonds as a financing mechanism is that corporate tax costs are lower than for financing through equity and that the bond poses less risk in terms of potential future degradations of insurer financial ratings and capital structure than financing through subordinated debt.

payoff on the bond is triggered when estimated industry-wide losses from an event exceed a specified threshold. For example, the payoff could be based on estimated catastrophe losses in a specified geographical area provided by Property Claims Services (PCS), the same organization that provided the indices for the CBOT options. A modeled-loss index is calculated using a model provided by one of the major catastrophe-modeling firms—Applied Insurance Research Worldwide, EQECAT, or Risk Management Solutions. The index could be generated by running the model on industry-wide exposures for a specified geographical area. Alternatively, the model could be run on a representative sample of the sponsoring insurer's own exposures. In each case, an actual event's physical parameters are used in running the simulations. Finally, with a parametric trigger, the bond payoff is triggered by specified physical measures of the catastrophic event such as the wind speed and location of a hurricane or the magnitude and location of an earthquake.

There are a number of factors to consider in the choice of a trigger when designing a CAT bond (Guy Carpenter, 2005a; Mocklow et al., 2002). The choice of a trigger involves a trade-off between moral hazard; (transparency to investors) and basis risk. Indemnity triggers are often favored by insurers and reinsurers because they minimize basis risk, i.e., the risk that the loss payout of the bond will be greater or less than the sponsoring firm's actual losses. However, indemnity triggers require investors to obtain information on the risk exposure of the sponsor's underwriting portfolio. This can be difficult, especially for complex commercial risks. In addition, indemnity triggers have the disadvantage to the sponsor that they require disclosure of confidential information on the sponsor's policy portfolio. Contracts based on indemnity triggers may require more time than nonindemnity triggers to reach final settlement because of the length of the loss adjustment process.

Index triggers tend to be favored by investors because they minimize the problem of moral hazard; i.e., they maximize the transparency of the transaction. Moral hazard can occur if the issuing insurer fails to settle catastrophe losses carefully and appropriately (i.e., overpays) because of the correlation of the bond payout with its realized losses. The insurer might also excessively expand its premium writings in geographical areas covered by the bond. Although CAT bonds almost always contain copayment provisions to control moral hazard, moral hazard remains a residual concern for some investors. Indices also have the advantage of being measurable more quickly after the event than indemnity triggers, so that the sponsor receives payment under the bond more quickly.

The principal disadvantage of index triggers is that they expose the sponsor to a higher degree of basis risk than indemnity triggers. The degree of basis risk varies depending upon several factors. Parametric triggers tend to have the lowest exposure to moral hazard but may have the highest exposure to basis risk. However, even with a parametric trigger, basis risk can be often be reduced substantially by appropriately defining the location where the event severity is measured. Similarly, industry loss indices based on narrowly defined geographical areas tend to have less basis risk than those based on wider areas (Cummins et al., 2004). Modeled-loss indices may become the favored mechanism for obtaining the benefits of an index trigger without incurring significant basis risk. However, modeled-loss indices are subject to "model risk," i.e., the risk that the model will over- or underestimate the losses from an event. This risk is diminishing over time as the modeling firms continue to refine their models.

Sidecars

An innovative financing vehicle with some similarities to both conventional reinsurance and CAT bonds is the *sidecar.* Sidecars date back to at least 2002 but became much more prominent following the 2005 hurricane season (A.M. Best Company, 2006). Sidecars are special purpose vehicles formed by insurance and reinsurance companies to provide additional capacity to write reinsurance, usually for property catastrophes and marine risks, and typically serve to accept retrocessions exclusively from a single reinsurer. Sidecars are typically off-balance sheet, formed to write specific types of reinsurance such as property-catastrophe quota share or excess of loss, and generally have limited lifetimes. Sidecars and excess of loss CAT bonds can work together as complementary instruments in much the same way as quota share and excess of loss complement each other in a traditional reinsurance program.

Reinsurers receive override commissions for premiums ceded to sidecars. Most sidecars are capitalized by private investors such as hedge funds, but insurers and reinsurers also participate in this financing device. Sidecars receive premiums for the reinsurance underwritten and are liable to pay claims under the terms of the reinsurance contracts. In addition to providing capacity, sidecars also enable the sponsoring reinsurer to move some of its risks off-balance sheet, thus improving leverage. Sidecars can also be formed quickly and with minimal documentation and administrative costs.[4]

Catastrophic Equity Puts (Cat-E-Puts)

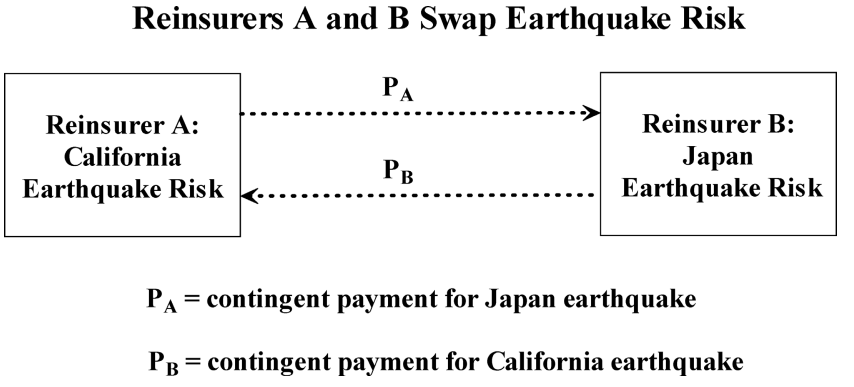
Another capital market solution to the catastrophic loss financing problem is catastrophic equity puts (Cat-E-Puts). Unlike CAT bonds, Cat-E-Puts are not asset-backed securities but options. In return for a premium paid to the writer of the option, the insurer obtains the option to issue preferred stock at a preagreed price on the occurrence of a contingent event. This enables the insurer to raise equity capital at a favorable price after a catastrophe, when its stock price is likely to be depressed. Cat-E-Puts tend to have lower transactions costs than CAT bonds because there is no need to set up an SPR. However, because they are not collateralized, these securities expose the insurer to counterparty performance risk. In addition, issuing the preferred stock can dilute the value of the firm's existing shares. Thus, although Cat-E-Puts have been issued, they have not become nearly as important as CAT bonds.

Catastrophe Risk Swaps

Like Cat-E-Puts, catastrophe risk swaps generally are not prefunded but rely only an agreement between two counterparties. Catastrophe swaps can be executed between two firms with exposure to different types of catastrophic risk. An example of a catastrophic-risk swap is provided in Figure 2. In the example, a reinsurer with exposure to California earthquake risk agrees to swap its risk with another reinsurer with exposure to Japanese earthquake risk. Another example is the swap executed by Mitsui Sumitomo Insurance and Swiss Re in 2003, which swapped $50 million of Japanese typhoon risk against $50 million of North Atlantic hurricane risk and $50 million of Japanese typhoon risk against $50 million of European windstorm risk. In some instances, a reinsurer may serve as an intermediary between the swap partners, but in most instances CAT swaps

[4] For further discussion, see Cummins (2007) and Lane (2007).

FIGURE 2
Catastrophe Risk Swap



are done directly between two (re)insurers. Swaps are facilitated by the Catastrophic Risk Exchange (CATEX), a web-based exchange where insurers and reinsurers can arrange reinsurance contracts and swap transactions.

The event or events that trigger payment under the swap are carefully defined in the swap agreement. For example, a parametric trigger could be used such as an earthquake of a specified magnitude in Tokyo for the Japanese side of the swap and a comparable earthquake in San Francisco for the U.S. side. The swap can be designed such that the two sides of the risk achieve *parity*, i.e., such that the expected losses under the two sides of the swap are equivalent. This obviously requires an extensive modeling exercise, which would be conducted using one of the models developed by catastrophe-modeling firms or internally. With parity, there is no exchange of money at the inception of the contract, only on the occurrence of one of the triggering events. The swap also defines a specified amount of money to be paid if an event occurs, such as $200 million. Some contracts have sliding scale payoff functions, which specify full payout for the severest events and partial payout for smaller events. Swaps can be annual or can span several years. Swaps also can be executed that fund multiple risks simultaneously such as also swapping North Atlantic hurricane risk for Japanese typhoon risk in the same contract as the earthquake swap.

Swaps may be attractive substitutes for reinsurance, CAT bonds, and other risk financing devices. They have the advantage that the reinsurer simultaneously lays of some of its core risk and obtains a new source of diversification by exchanging uncorrelated risks with the counterparty (Takeda, 2002). Thus, swaps may enable reinsurers to operate with less equity capital. Swaps also are characterized by low transactions costs and reduce current expenses because no money changes hands until the occurrence of a triggering event. The potential disadvantages of swaps are that modeling the risks to achieve parity can be challenging and is not necessarily completely accurate. Swaps also may create more exposure to basis risk than some other types of contracts and also create exposure to counter-party nonperformance risk. The possibility of nonperformance risk provides another potential role for an investment bank or specialized reinsurer to execute hedges to enhance the credit quality of the swap. However, such hedging would add to the transactions costs of the deal. Systematic data on the magnitude of the risk swaps

market presently are not available. However, industry experts interviewed by the author indicate that the swaps market is "quite substantial."

ILW

As explained further below, a possible impediment to the growth of the CAT securitization market has to do with whether the securities are treated as reinsurance by regulators, and hence given favorable regulatory accounting treatment. It seems clear that properly structured *indemnity* CAT securities (those that pay off based on the losses of the issuing insurer) will be treated as reinsurance. Nevertheless, regulation does not seem to have impeded the strong growth of the CAT bond market during the past several years because sponsors and their bankers have found various ways to finesse potential regulatory problems. For example, even if the SPV is an offshore vehicle, the trust holding the assets can be onshore, mitigating regulatory concerns regarding credit risk of offshore entities.

Dual-trigger contracts known as *industry loss warranties* (ILW) also overcome regulatory objections to nonindemnity bonds (McDonnell, 2002). ILWs are dual-trigger reinsurance contracts that have a *retention trigger* based on the incurred losses of the insurer buying the contract and also a *warranty trigger* based on an industry-wide loss index. That is, the contracts pay off on the dual event that a specified industry-wide loss index exceeds a particular threshold at the same time that the issuing insurer's losses from the event equal or exceed a specified amount. Both triggers have to be hit in order for the buyer of the contract to receive a payoff. The issuing insurer thus is covered in states of the world when its own losses are high and the reinsurance market is likely to enter a hard-market phase. ILWs cover events from specified catastrophe perils in a defined geographical region. For example, an ILW might cover losses from hurricanes in the Southeastern United States. The term of the contact is typically 1 year. ILWs may have *binary triggers*, where the full amount of the contract pays off once the two triggers are satisfied or *pro rata triggers* where the payoff depends upon how much the loss exceeds the warranty.

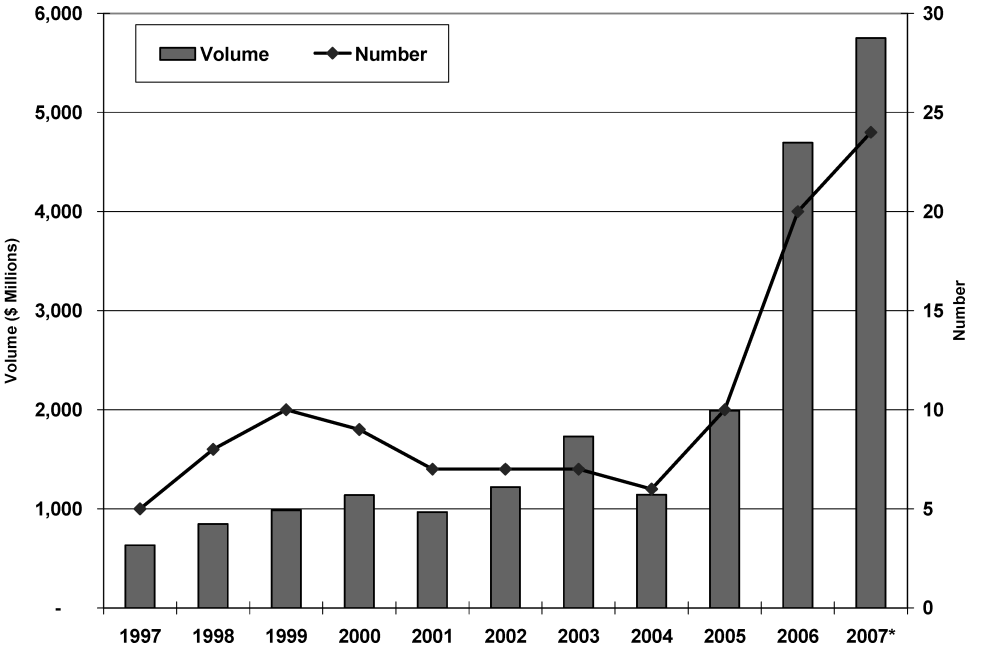
The principal advantages of ILWs are that they are treated as reinsurance for regulatory purposes, and that they can be used to plug gaps in reinsurance programs. They also represent an efficient use of funds in that they pay off in states of the world where both the insurer's losses and industry-wide losses are high.

Systematic data on the size of the ILW market are presently not available. However, reinsurance experts interviewed by the author believe that the ILW market is roughly of the same order of magnitude as the CAT bond market. Experts also comment that capital market participants provide the majority of risk capital in the ILW market, just as they do in the CAT bond market. ILWs can be packaged and securitized, broadening the investor base.

THE RISK-LINKED SECURITIES MARKET

This section reviews the recent history and current status of the risk-linked securities market. The focus is primarily on CAT bonds, which are the most commonly used securitized structure used in financing catastrophic risk.

FIGURE 3
Nonlife CAT Bonds: New Issues



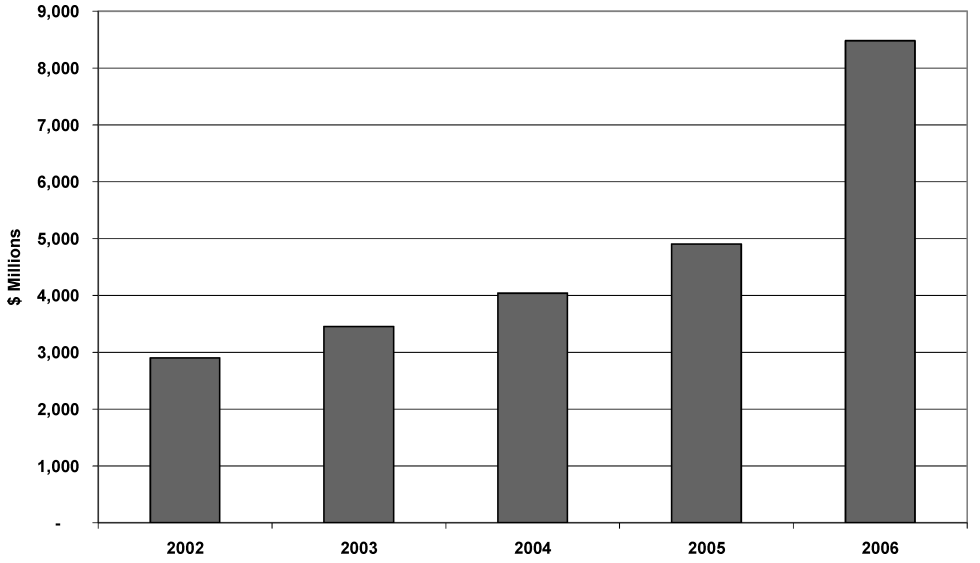
*Through July 31, 2007.
Source: MMC Securities (2007) and Swiss Re (2007b).

The CAT Bond Market: Size and Bond Characteristics

Although the CAT bond market seemed to get off to a slow start in the late 1990s, the market has matured and now has become a steady source of capacity for both primary insurers and reinsurers. The market is growing steadily and set new records for market issuance volume in 2005, 2006, and 2007. CAT bonds make sound economic sense as a mechanism for funding mega-catastrophes. Catastrophes such as Hurricane Katrina and the fabled and yet to be realized $100 billion-plus "Big One" in California, Tokyo, or Florida are large relative to the resources of the insurance and reinsurance industries but are small relative to the size of capital markets (Cummins, 2006). A $100 billion loss would represent less than 0.5 of 1 percent of the value of U.S. securities markets and could easily be absorbed through securitized transactions. Securities markets also are more efficient than insurance markets in reducing information asymmetries and facilitating price discovery. Thus, it makes sense to predict that the CAT bond market will continue to grow and that CAT bonds will eventually be issued in the public securities markets, rather than being confined primarily to private placements as at present.

The new issue volume in the CAT bond market from 1997 through July 2007 is shown in Figure 3. The data in the figure apply only to nonlife CAT bonds. Recently, event-linked bonds have also been issued to cover third-party commercial liability, automobile quota share, and indemnity-based trade credit reinsurance. There is also a growing market in life insurance securitizations of various types.

Figure 4
CAT Bonds: Risk Capital Outstanding



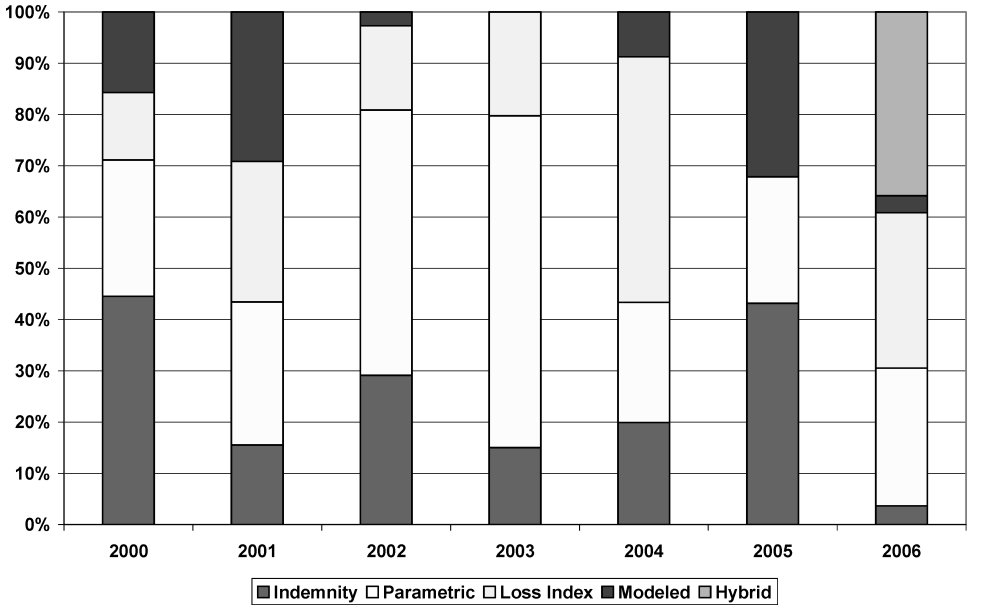
Source: Guy Carpenter (2006a) and MMC Securities (2007).

Figure 3 shows that the market has grown from less than $1 billion per year in 1997 to more than $2 billion per year in the first half of 2005, and then accelerated to nearly $5 billion in 2006 and nearly $6 billion in the first 7 months of 2007. The number of transactions also has been increasing, to 24 in the first 7 months of 2007. A substantial number of the issuers in 2005–2007 were first-time sponsors of CAT bonds, although established players such as Swiss Re continue to play a major role (Guy Carpenter, 2007). Figure 4 shows that the amount of risk capital outstanding in CAT bond markets has also grown steadily. Risk-capital outstanding represents the face value of all bonds still in effect in each year shown in the figure. Nearly $9 billion of risk capital was outstanding by the end of 2006, and nearly $14 billion by mid 2007 (Swiss Re, 2007b).

The characteristics of CAT bonds continue to evolve, but the overall trend is toward a higher degree of standardization. The issue volume by trigger type between 2000 and 2006 is shown in Figure 5. For the period as a whole, index or hybrid bonds accounted for 80 percent of total issue volume. The leading type of index by issue volume is the parametric index, accounting for 34 percent of total issuance. Indemnity bonds made a come-back in 2005 but fell off again in 2006.

The trends in bond tenor are shown in Figure 6. Even though there were some 10-year bonds issued during the 1990s, the market seems to have converged on shorter-term issues, with 3-year bonds constituting the majority of issues in 2005 and 2006. Maturities greater than 1 year tend to be favored because they provide a steady source of risk capital that is insulated from year-to-year swings in reinsurance prices and because they permit issuers to amortize costs of issuance over a longer period, reducing per period transactions costs. Bonds longer than 5 years are not favored by the market

FIGURE 5
CAT Bond Issues by Trigger Type



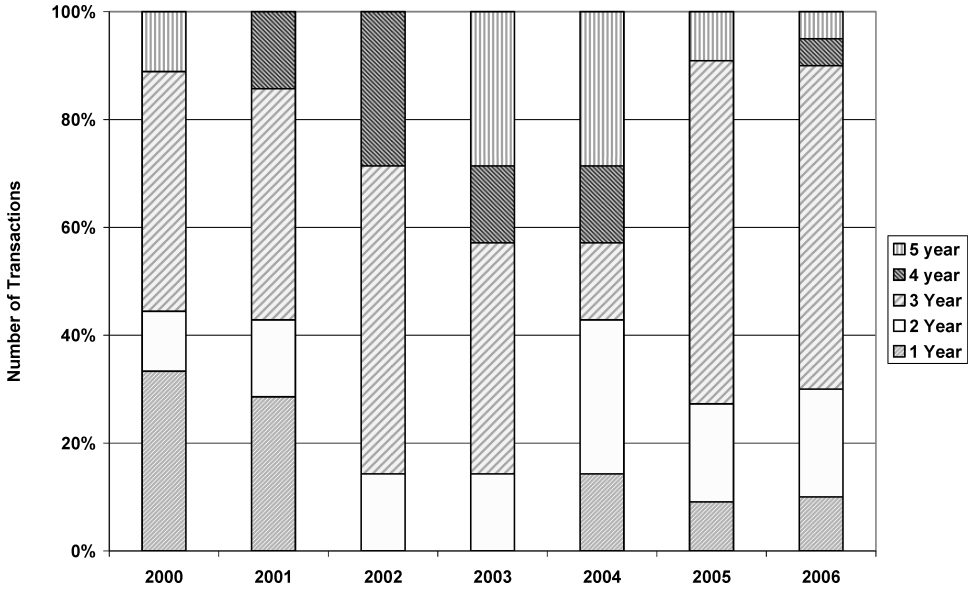
Source: Guy Carpenter (2006a) and MMC Securities (2007).

because market participants would like to reprice the risk periodically to reflect new information on the frequency and severity of catastrophes and to recognize changes in the underwriting risk profile of the sponsor.

For the period as a whole, insurers accounted for 47.9 percent of bonds by issue volume, reinsurers accounted for 47.5 percent, and corporate/government issues accounted for 4.7 percent. In 2006, the first government issued disaster-relief bond placement was executed to provide funds to the government of Mexico to defray costs of disaster recovery.

Specifically, the Mexican bonds would pay off to the benefit of the Mexican Natural Disaster Fund (FONDEN). The CAT bonds are limited to Mexican earthquake risk, but future bonds may be issued that cover Mexican hurricane risk. The bonds were part of a $450 million reinsurance transaction with European Finance Reinsurance, a wholly owned subsidiary of Swiss Re. Swiss Re retained $290 million of the contract exposure and issued $160 million in CAT bonds (notes) with a 3-year bond tenor through a special purpose vehicle, CAT-Mex Ltd. The bonds are binary and parametric, triggered by earthquake physical parameters, including Richter scale readings. Two tranches were issues covering different Mexican earthquake zones. The larger tranche ($150 million) has an expected annual loss of 0.96 percent and a spread over LIBOR of 235 basis points, whereas the smaller tranche ($10 million) has an expected annual loss of 0.93 percent and a spread of 230 basis points. The Mexican bonds provide another indication that the spreads on CAT bonds are declining and show that opportunities exist for securitization

Figure 6
CAT Bond Transactions by Bond Tenor



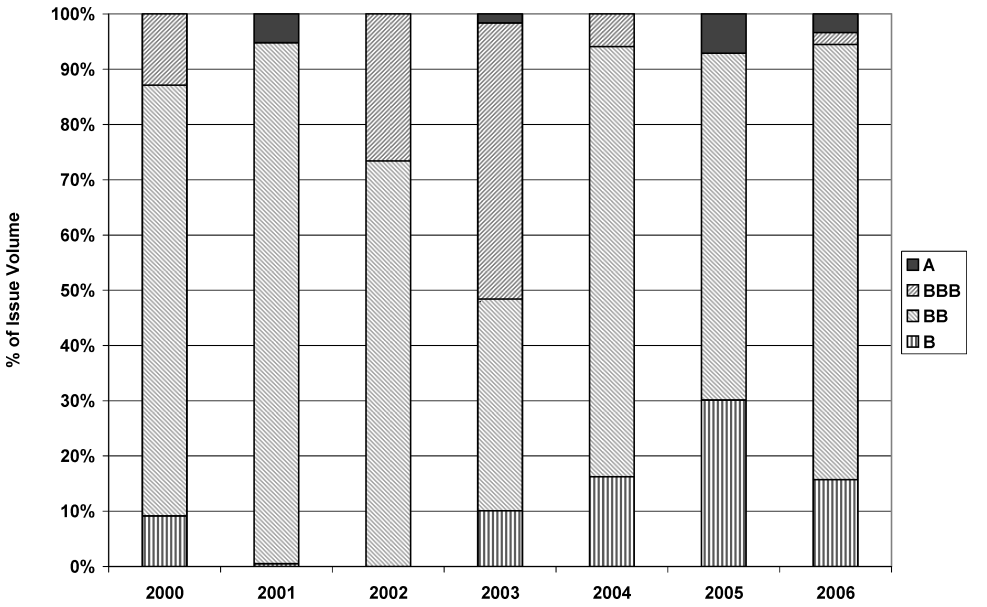
Source: Guy Carpenter (2006a) and MMC Securities (2007).

elsewhere in the world.[5] The bonds are also important because they illustrate how securitization can be used by governments to prefund disaster relief programs, rather than waiting for disaster relief from donor countries and international financial organizations *ex post*.

Obtaining a financial rating is a critical step in issuing a CAT bond because buyers use ratings to compare yields on CAT bonds with other corporate securities. Consequently, almost all bonds are issued with financial ratings. The ratings by bond issue volume from 2000 through 2006 are shown in Figure 7. The vast majority of CAT bonds issued in 2005 and 2006 have been below investment grade (ratings below BBB); i.e., 93 percent of the 2005 issuance volume and 94.5 percent of the 2006 volume were rated BB or B. In 2007, there has been a resurgence in investment-grade bonds (Swiss Re, 2007b), although the majority of CAT bonds are below investment grade in 2007 as well. Although lower than investment grade bond ratings are generally bad news for insurers, reinsurers, and other corporate bond issuers, they are not necessarily adverse in the CAT bond market. Because CAT bonds are fully collateralized, CAT bond ratings tend to be determined by the probability that the bond principal will be hit by a triggering event. Thus, the bond ratings merely indicate the layer of catastrophic-risk coverage that is being provided by the bonds. Although it is important for CAT bonds to be issued with financial ratings, the modeling firm's analysis drives the price more than the actual rating.

[5] For further discussion of the Mexican bonds, see Cardenas et al. (Forthcoming).

FIGURE 7
CAT Bond Issue Volume by Financial Rating

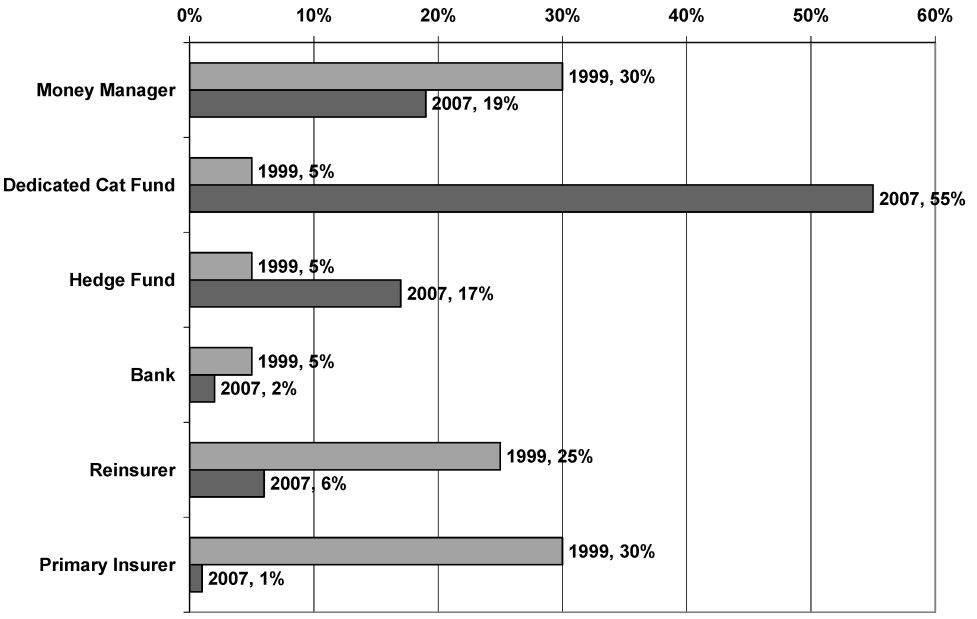


Source: Guy Carpenter (2006a) and MMC Securities (2007).

In the past, the CAT bond market has been criticized for lack of investor interest. However, that critique of the market is now out of date—recent data suggest that there is broad market interest in CAT bonds among institutional investors. Figure 8 shows the percentage of new issue volume by investor type in 1999 and 2007. In 1999, insurers and reinsurers were among the leading investors in the bonds, accounting for 55 percent of the market; i.e., insurers were very prominent on both the supply and demand sides of the market. If insurers and reinsurers are on both sides of the market, the market cannot be said to have attracted very much new capital into the financing of catastrophic risk. However, by 2007, insurers and reinsurers accounted for only 7 percent of demand, suggesting that substantial external capital has been attracted to the market. Dedicated CAT funds accounted for 55 percent of the market in 2007, and money managers and hedge funds accounted for 36 percent. The declining spreads and increasingly broad market interest in the bonds suggest that the bonds are attractive to investors and are playing an increasingly important role relative to conventional reinsurance.

In addition to CAT bonds, a significant amount of new capital was raised through sidecars in 2005 and 2006. The new capital raised through Bermuda sidecars in 2006 is shown in Table 1. Eleven sidecar transactions took place in 2006, totaling $2.9 billion in risk capital. In 2005, there were eight transactions, which raised a total of $2.5 billion. There was some indication that sidecars were competing with CAT bonds for risk capital of interested investors in 2005, leading to rising prices and tightening capacity in the CAT bond market (Guy Carpenter, 2006a). However, the CAT bond market clearly rebounded in 2006 and 2007.

Figure 8
CAT Bonds: New Issue Volume Purchased by Investor Type



Source: Swiss Re.

The first publicly acknowledged total loss of principal for a CAT bond took place in 2005, although there apparently have been earlier wipeouts that were not publicly announced (Lane and Beckwith, 2006). KAMP Re 2005 Ltd., a $190 million bond issued in July 2005 under the sponsorship of Zurich Financial, apparently paid out its entire principal to the sponsor as a result of Hurricane Katrina claims (Guy Carpenter, 2006a). KAMP Re had an indemnity trigger, and the short-term impact of the wipeout was to increase investor wariness of indemnity-based transactions. However, indemnity transactions rebounded in 2007 due to a surge of primary insurer CAT bond issues (Swiss Re, 2007b).

The longer-term impact of the KAMP Re wipeout on the CAT bond market is likely to be favorable. The smooth settlement of the KAMP Re bond established an important precedent in the market, showing that CAT bonds function as designed, with minimal confusion and controversy between the sponsor and investors. Thus, the wipeout served to "reduce the overall uncertainty associated with this marketplace and therefore increase both investor and sponsor demand for these instruments" (Guy Carpenter, 2006a, p. 4).

CAT Bond Prices

CAT bonds are priced at spreads over LIBOR, meaning that investors receive floating interest plus a spread or premium over the floating rate. In the past, CAT bonds have been somewhat notorious for having high spreads, and much has been written trying to explain the magnitude of the spreads (e.g., Froot, 2001). However, there are now significant indications that the spreads are not as high as they might seem relative to the cost of reinsurance, such that CAT bonds are more competitive with conventional reinsurance than earlier analyses may have suggested.

TABLE 1
New Capital Raised Through Sidecars in 2006 (US$ Millions)

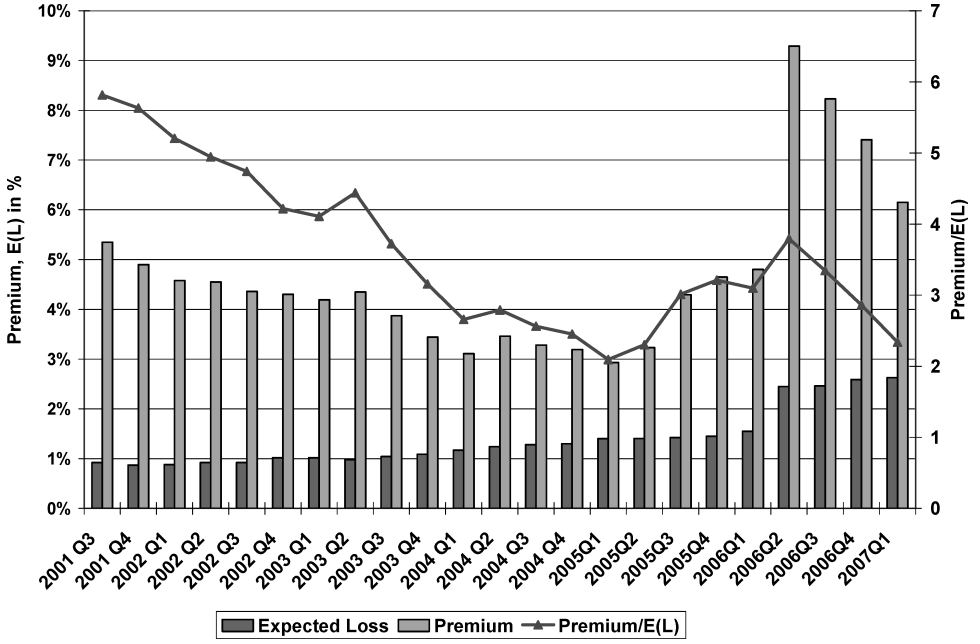
Vehicle Name	Sponsor	Equity	Debt	Total
Bay Point Re	Harborpoint	125	125	250
Concord Re	Lexington Insurance	375	375	750
Helicon Re	White Mountains	145	185	330
Monte Forte Re	Flagstone Re	60		60
Panther Re	Hiscox	144	216	360
Petrel Re	Validus Re	200		200
Sirocco Re	Lancashire Re	95		95
Starbound Re	Rennaissance Re	127	184	311
Stoneheath Re	XL Re	300		300
Timicuan Re	Rennaissance Re	50	20	70
Triomphe Re	Paris Re	121	64	185
Total		1,742	1,169	2,911

Source: MMC Securities (2007).

Because CAT bonds are not publicly traded, it is difficult to obtain data on CAT bond yields. However, there is an active, though nonpublic, secondary market that provides some guidance on yields. The secondary market yields on CAT bonds are shown quarterly from the third quarter of 2001 through the first quarter of 2007 in Figure 9. The numbers in the figure reflect investment yields over LIBOR. The figure shows the absolute yields and also an estimate of the expected loss. The data are from Lane and Beckwith (2005, 2006, 2007a, 2007b). Figure 9 shows the expected loss, the premium, and the bond spread (ratio of premium to expected loss), based on averages of secondary market transactions.

Prior to Katrina, there was a more or less steady decline in yields and a slight increase in the expected loss, implying a general decline in the cost of financing through CAT bonds. The ratio of the premium to expected loss was about six in early 2001, and prior research covering periods before 2001, showed median ratios of yields to expected loss of about 6.5 for CAT bonds (Cummins et al., 2004). However, the ratio of premium to expected loss began a more or less steady decline between 2001 and 2005 and stood at 2.1 in the first quarter of 2005. Not surprisingly, yields and spreads increased following Katrina as the market tightened and investors had opportunities to place capital in other catastrophic-risk vehicles such as sidecars. The spread peaked at 3.7 in the second quarter of 2006 but declined again to 2.3 by the first quarter of 2007. Thus, the CAT bond market was able to withstand the post-Katrina competition for capital without returning to the high relative spreads of earlier periods. Consequently, it seems that the earlier critique of CAT bonds, i.e., excessive spreads, no longer applies. This is the expected result in a market where there is growing investor interest and expertise as well as growing volume, which adds to market liquidity.

Figure 9
CAT Bond Premia and Expected Loss



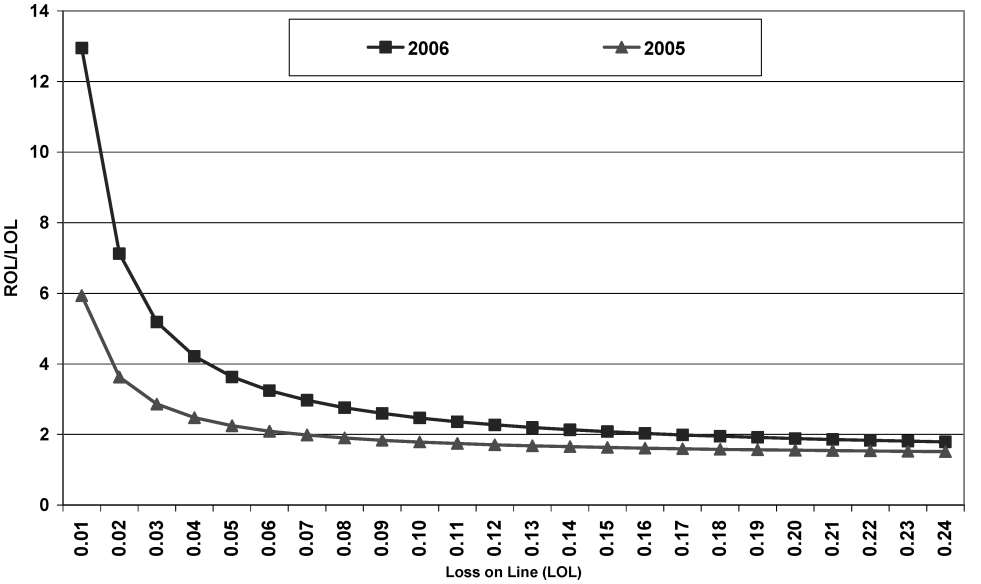
Source: Lane Financial LLC.

Comparison of CAT bond and catastrophe reinsurance pricing is difficult because of the general lack of systematic data on reinsurance prices. However, based on some unpublished data from Guy Carpenter, it is possible to provide a general indication of the comparative prices of CAT bonds and reinsurance. Guy Carpenter provided data on the relationship between the rate on line and the loss on line for catastrophe reinsurance. The rate on line (ROL) is defined as the reinsurance premium divided by the policy limit, and the loss on line (LOL) is the expected loss on the contract divided by the policy limit. The ratio of the ROL to the LOL is somewhat analogous to the ratio of the yield to expected loss on CAT bonds shown in Figure 9. The Guy Carpenter ROL and LOL data are based on average figures for Guy Carpenter clients buying reinsurance in 2005 and 2006 and are given separately for national primary insurers and regional primary insurers.

Like the CAT bond yield to expected loss ratios, the ratios of rates on line to expected loss on line for Guy Carpenter clients are significantly higher in 2006 than in 2005, reflecting the effects of Hurricanes Katrina, Rita, and Wilma. In addition, the ROL-to-LOL ratios are significantly larger for national insurers than for regional insurers. Finally, the ratios are lower for contracts with higher expected losses on line, reflecting the fact that policies with low expected LOL are covering the more risky upper tails of the loss distribution.

The ratios of ROL-to-LOL for national insurers in 2005 and 2006 are shown in Figure 10. The figure focuses on national insurers because the issuers of CAT bonds tend to be

FIGURE 10
Catastrophe Reinsurance Ratio of Rate on Line to Loss on Line, National Companies



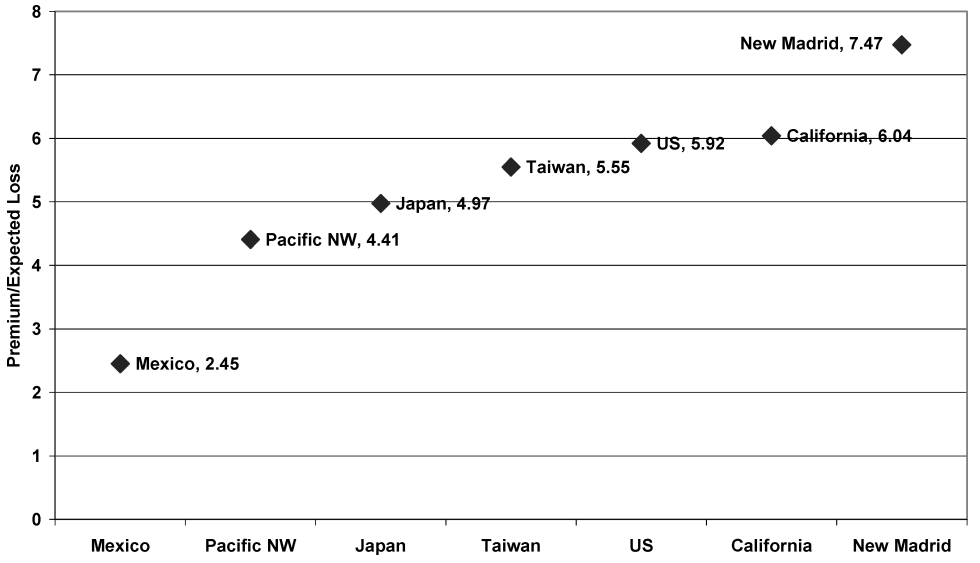
Source: Guy Carpenter.

large national and international firms. Thus, the most relevant comparison of CAT bond premia is with reinsurance prices for national insurers.

As shown in Figure 9, CAT bonds on average tend to have expected losses of between 1 and 3 percent of principal, and thus are most comparable to catastrophe reinsurance contracts with relatively low LOLs. As shown in Figure 10, the ROL-to-LOL ratios for LOLs of 1 percent, 2 percent, and 3 percent were 12.9, 7.1, and 5.2, respectively for national companies in 2006, and 5.9, 3.6, and 2.9, respectively for national companies in 2005. These compare with bond premium to expected loss ratios of around 3.3 in 2006 and 2.7 in 2005, based on averages of the four quarterly numbers for these years from Figure 9. Hence, even with the more normal pricing of 2005, CAT bonds clearly are "in the ballpark" in terms of pricing for national companies and also seem attractive relative to reinsurance in 2006. Hence, CAT bonds do not appear to be expensive relative to catastrophe reinsurance. Moreover, investment banks have succeeded in reducing transactions costs and speeding the time to market as they have gained experience with insurance-linked securitizations, also making the bonds more attractive to insurers and reinsurers.

For regional companies, at the 1 percent, 2 percent, and 3 percent LOL levels, the ROL-to-LOL ratios were 2.9, 2.5, and 2.3, respectively in 2006, and 2.4, 2.0, and 1.9, respectively in 2005. Thus, CAT bond prices look less attractive relative to reinsurance for regional companies. However, because regional firms have not been active in the CAT bond market, it is not clear what the bond premia would be for these firms.

FIGURE 11
Spreads on Selected Earthquake Bonds



Source: Cardenas (2006).

Another comparative indication of trends in CAT bond spreads is provided by a comparison of the Mexican CAT bonds with previously issued earthquake bonds. This comparison is provided in Figure 11, which shows the spreads on the Mexican bonds along with spreads on a representative selection of prior earthquake bonds. It is clear that the spreads on the Mexican bonds are very low in comparison to the prior bonds. This illustrates two phenomena, which cannot be precisely separated in terms of their influence on the spreads: (1) The Mexican bonds are more recent than the other bonds shown in the table, and, as indicated above, CAT bond spreads have been declining. (2) The Mexican bonds are valuable to CAT bond investors for diversification purposes because they cover a previously unsecuritized area of the world and permit investors to diversify their current large proportionate exposure to U.S. hurricane risk.

It is also relevant to compare CAT bond yields relative to yields on comparably rated corporate bonds. This comparison has been performed in MMC Securities (2007). The results show that BB CAT bond yields were comparable to yields on BB corporate bond yields from 2001 up until the time of Hurricane Katrina in 2005. Yields on CAT bonds exceeded yields on BB corporates during most of the period from the September of 2005 through February of 2007, although the gap had narrowed considerably by the end of the period. At the peak, yields on CAT bonds were 2 to 3 percent higher than the yields on BB corporates. Nevertheless, considering the magnitude of reinsurance prices in 2006 and the uncertainty created by Katrina and other recent catastrophes, the CAT bond market seems to have weathered the storms in very good shape.

REGULATORY, ACCOUNTING, TAX (RAT), AND RATING ISSUES

Prior discussions of alternative risk finance have indicated that regulatory and accounting treatment of CAT bonds and other risk financing solutions pose impediments to the growth of the market. However, industry experts interviewed by the author indicate that regulatory and accounting issues do not pose a material impediment to the growth of the market at the present time, and the statistics on market size and growth clearly seem to bear this out. Although a complete treatment of the regulatory, tax, and accounting issues are beyond the scope of this article, this section provides a few observations on the relevant issues, primarily to provide suggestions for future research that might be conducted on these topics.

Regulatory Issues

Some prior commentators have argued that CAT bonds have mostly been issued offshore for regulatory reasons and that the lack of onshore issuance represents a barrier to market developments. The argument is that encouraging onshore issuance might reduce transactions costs and facilitate market growth. However, industry experts interviewed by the author disagree with this point of view. They argue that the offshore jurisdictions, including Bermuda, the Cayman Islands, and Dublin, provide low issuance costs and high levels of expertise in the issuance of insurance-linked securities. Transactions costs for the onshore CAT bonds that have been issued generally have been higher than for offshore issues. Thus, whereas issuance of securities onshore (e.g., in the United States) probably would be a favorable development in the long run, the off-shore jurisdictions perform very effectively and efficiently in handling the issuance and settlement of insurance-linked securities.

Prior commentators have argued that nonindemnity CAT bonds currently face uncertain prospects with respect to regulatory treatment. The argument was that regulators are concerned about basis risk and the potential use of securitized risk instruments as speculative investments. As a result, it was argued that regulators may deny reinsurance accounting treatment for nonindemnity CAT bonds, impeding the development of the market. However, industry experts interviewed by the author indicate that regulatory treatment does not presently pose a significant obstacle to market development. Market participants have found a variety of structuring mechanisms to blunt regulatory concerns about alternative risk financing with respect to nonindemnity CAT bonds. For example, contracts can be structured to pay off on narrowly defined geographical indices or combinations of indices that are highly correlated with the insurer's losses. Concerns about speculative investing can be addressed through dual-trigger contracts that pay off on an index but where the insurer cannot collect more than its *ultimate net loss*, a familiar reinsurance concept equal to the insurer's total loss from an event less collections under reinsurance contracts.[6]

Even though regulation does not seem to pose a significant barrier to the development of the market at the present time, it remains true that the United States generally takes a heavy-handed, intrusive, and inflexible approach to insurance regulation. U.S. insurance

[6] This dual-trigger approach was developed in the market for *industry loss warranties*, which is a segment of the reinsurance market offering this type of contract (McDonnell, 2002).

regulation does not place sufficient reliance on the market as self-regulator of insurers and reinsurers. Regulation should primarily be designed to ensure transparency of insurance and reinsurance transactions, relying on the market to enforce appropriate behavior by insurers. Instead, U.S. regulation takes a "we must approve or disapprove everything" approach. It would be helpful to the efficiency of insurance markets in general if regulators were to adopt a more flexible regulatory approach. In the area of risk-linked securities, it would be helpful if regulators were to codify the rules and regulations relating to the statutory accounting treatment of various types of risk-linked securities and avoid imposing any unnecessary regulatory impediments in the future.[7]

Tax Issues

According to industry experts, offshore CAT bonds do not create taxation problems for sponsors. There generally are no income, corporate, withholding, or other significant taxes in offshore jurisdictions that apply to CAT bonds. The bond's SPRs are also not taxable for U.S. federal income tax purposes, provided that they are not held to be "engaged in a U.S. trade or business." Although no systematic information is available, anecdotal information suggests that so far offshore CAT bond SPRs have not been held to be engaged in a U.S. trade or business.

Consequently, the main tax issue involving CAT bonds for U.S. investors is the treatment of the bond premia under U.S. income tax law. The tax status is currently somewhat ambiguous given that neither the Tax Code nor the Internal Revenue Service addresses the tax treatment of income received from CAT bonds. Reportedly, bonds are presently being treated by many U.S. taxpayers who invest in the bonds as passive foreign investment companies (PFICs). Accordingly, income from CAT bonds is currently being included in taxable income as dividends rather than interest. U.S. sponsors also reportedly have been deducting premium payments on offshore bonds for income tax purposes, i.e., bond interest is currently treated in the same way as reinsurance premiums.

Dissemination of Information on Bonds

Although the ultimate objective should be the development of a public market for CAT bonds, privately placed bonds are likely to continue to play an important role. However, current securities regulations discourage the dissemination of information about private placements. Hence, market development is being impeded to the extent that information on existing bonds is not generally available. This discourages research by potential bond sponsors and by third parties such as academicians who might add significant value to the discussion.

Under current securities regulations, bond prospectuses for privately placed bonds can be distributed only to investors falling under the definition of accredited investors (or qualified investors) under Securities and Exchange Commission Regulation D. This class consists mainly of institutional investors and high net worth individuals. The rules are designed to prevent the sale of securities to the general public that have not gone through the Securities and Exchange Commission (SEC) registration process for public securities

[7] The NAIC has a model law on SPVs. For discussion of some of the issues, see Grace, Klein, and Phillips (2001).

issuance. However, the rules also have the unintended consequence of inhibiting research on CAT bonds.

The SEC rules should be changed to allow sponsors to distribute bond prospectuses to researchers who are not necessarily accredited investors. This could be done by posting the prospectuses on a repository maintained by an appropriate governmental entity. The repository could clearly indicate that the posting of the prospectuses on the site does not constitute an offer to sell and could require researchers downloading documents from the site to sign a strict users agreement. It still would not be possible for sponsors to sell bonds to the general public without appropriate registration with the SEC, but this change would make the bond prospectuses available for researchers.

Issues to Be Explored

What actions could be taken that would facilitate the further expansion of the market for insurance-linked securities? Although most of the regulatory issues mentioned in earlier discussions of CAT bonds are not problematical at the present time and the insurance-linked securities market is growing rapidly, there are some issues/reforms that may be able to enhance market development in the future. Several issues are mentioned here in the spirit of providing suggestions for further research on market development and efficiency.

Insurance regulators in key jurisdictions such as the United States, the European Union, and Japan could mandate catastrophe loss reporting for events above a given industry threshold such as $1 billion. Reporting could be done to a government agency or to a private organization such as Property Claims Services (PCS) in the United States. The mandate should require that data be reported in a significant amount of detail, probably more detail than presently provided by PCS. This would solve an important current problem, i.e., the lack of a PCS-equivalent index for the European Union and Japan, and would enhance the market by providing more information on U.S. losses. Regulators could work with knowledgeable insurers and reinsurers to design the data reporting specifications and address technology issues.

Until a loss turns into a recoverable, the quality of the reinsurance counterparty is effectively ignored by regulators. This is the case, for example, in the U.S. risk-based capital system, where the charges for reinsurance are not graded by reinsurer credit quality. Explicitly incorporating reinsurance credit quality into regulatory capital calculations and related regulatory credit evaluations has the potential to provide an important boost to the insurance-linked securities market as well as improving insurance solvency regulation in more general terms.

As pointed out in Cummins (2007), personal lines insurers in the United States face price regulation in several key catastrophe-prone states. In general, insurers reevaluate loss distributions and file for price increases following major catastrophes, reflecting changing estimates of expected losses and higher reinsurance premiums. Unfortunately, the political reality is that regulators are most reluctant to allow price increases at precisely the times when insurer loss expectations and reinsurance prices are increasing most rapidly. The best solution to this problem would be to deregulate prices at the state level so that primary insurers would not be caught in this price-cost bind. Short of deregulating prices, regulators could help ease the problem by giving primary insurers credit for locking in multi-year pricing and capacity by issuing insurance-linked securities,

in view of the fact that a vast majority of reinsurance policies renew annually whereas insurance-linked securities often cover multi-year terms.

Some industry experts observe that the application of the Employee Retirement Income Security Act (ERISA) to CAT bond collateral trusts may make it marginally more difficult to attract foreign investors. As with many ERISA issues, the matter is complex and would benefit from some thorough research into the current rules and any law changes or U.S. Department of Labor rule changes that might clarify the situation and point the way to potential reforms.

Conclusions

The CAT bond market is thriving and seems to have reached "critical mass." The market achieved record bond issuance in 2005, 2006, and 2007. Bond premia have declined significantly since 2001 and the bonds now are priced competitively with catastrophe reinsurance. Even following Hurricane Katrina, bond premia were roughly comparable to yields on similarly rated corporate bonds. The amount of risk capital raised through CAT bonds has been growing, and the bonds now account for a significant share of the property-catastrophe reinsurance market. The bonds have an especially important role to play for high coverage layers and in the retrocession market. Considering CAT bonds, swaps, and industry-loss warranties, many experts believe that these alternative risk transfer devices now account for more than half of the property insurance retrocession market and are of growing importance in other parts of the market.

Regulatory and accounting issues such as the regulatory accounting treatment of non-indemnity CAT bonds and the issuance of most bonds offshore, which have been cited as impediments to the development of the market, do not presently seem to pose serious problems. However, there are a number of issues/reforms that should be explored to provide ways in which public and private institutions can facilitate market development. These include fostering better reporting of catastrophe losses to facilitate the development of better CAT loss index products. Solvency regulation should be adapted to recognize the credit quality of reinsurance receivables and give recognition to the full collateralization provided by CAT bonds. Primary insurance prices should be deregulated in the United States, and primary insurers should receive credit from regulators for entering into contracts that provide multi-year pricing and capacity through either insurance-linked securities or conventional reinsurance. Other issues to be investigated include the applicability of ERISA to CAT bond collateral trusts and the U.S. GAAP and statutory accounting treatment of triggers employed in industry loss warranties and similar contracts. Finally, issuers of CAT bonds should be required to make available bond prospectuses to researchers who could provide valuable analysis of catastrophe risk financing. The prospectuses could be made available on a government web site and users would be required to sign a users agreement proving penalties for misuse of the information contained in the documents.

The future looks bright for the insurance-linked securities market. CAT bonds, swaps. sidecars, industry loss warranties, and other innovative products will play an increasingly important role in providing risk financing for large catastrophic events. Event-linked bonds are also being used increasingly by primary insurers for lower layers of coverage and noncatastrophe coverages such as automobile and commercial liability insurance. It remains to be seen whether CAT futures and options will play an important role in catastrophe risk management in the years to come. Basis risk and counterparty

credit risk, as well as the need to educate insurance industry participants, are the primary impediments to the success of these contracts.

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