Securitization of Catastrophe Risk: New Developments in Insurance-Linked Securities and Derivatives

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Abstract: This paper discusses the most recent developments in insurance securitization and assesses the potential for growth in the insurance-linked securities (ILS) market and in insurance-linked derivatives. In particular, the authors analyze the motivations of security sponsors and investors to participate in the catastrophe (CAT)–linked capital market, and identify the key components of growth and its impediments. Finally, this article discusses the technical and regulatory issues that could be crucial to market growth. In this context, the authors recommend new private and public initiatives aimed at boosting the use and efficiency of CAT-linked securities and derivatives. [Key words: insurance securitization, reinsurance, capital markets]

INTRODUCTION

Catastrophe-linked capital market instruments appeared in the aftermath of Hurricane Andrew in 1992 on the assumption that capacity offered by the traditional reinsurance market and the retrocession market to insurers would shrink. First, the Chicago Board of Trade (CBOT) offered for trading futures and options contracts with a payout linked to the U.S. industry catastrophe losses. Securitization of catastrophe risk appeared soon thereafter with the first offering of catastrophe (CAT) bonds in 1994.

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The CAT bond market received a boost in 1997, after credit ratings agencies developed methodologies that allowed them to confidently rate these bond offerings.

The insurance-linked security (ILS) market has also diversified, beyond the traditional CAT bond structures. Over the years, companies have issued bonds linked to other triggers besides property losses, such as mortality or motor and credit triggers. Alternative financing structures such as sidecars are also becoming increasing popular as risk financing tools for insurance companies.

Finally, (natural) catastrophe-linked derivatives instruments have quietly re-emerged, after the failed attempt by the CBOT in generating insurers' and investors' interest in exchange-traded derivatives. Three futures exchanges—the New York Mercantile Exchange (NYMEX), the Chicago Mercantile Exchange (CME), and the Insurance Futures Exchange Services (IFEX)—re-introduced exchange-traded CAT-linked futures and options contracts in 2007 and 2008. The NYMEX futures and options contracts are no longer in existence due to the acquisition of NYMEX by the CME.

The purpose of this paper is to assess whether the CAT-linked security and derivatives markets have grown and have diversified enough to provide reliable substitutes or complements to the traditional reinsurance and retrocession markets. While sponsors' and investors' attitudes towards these markets have undoubtedly evolved, the authors analyze their motivations for issuing and investing in CAT-linked securities using a demand and supply framework.

The first section of this paper provides some market background and related literature. In the second section, we analyze the motivation of sponsors and investors to participate in the CAT-linked security market in order to identify the key components and impediments to its growth. A third section highlights technical considerations that could be crucial to market growth. We also detail private and public initiatives aimed at boosting the use and efficiency of CAT-linked securities. Finally, we conclude with an overall assessment of the potential for growth in both the ILS capital markets and insurance-linked derivatives.

BACKGROUND AND RELATED LITERATURE

Introduction

From 1997 through 2007, 116 CAT bond transactions were completed for a total of $22.4 billion issued. One of the most important measures of market size is the total risk capital outstanding; that measure showed

record growth in 2007. At the end of 2007, there was more than $13.8 billion in outstanding principal, representing a 62% increase over year-end 2006, which had also been a record. Annual issuance totaled almost $7 billion in 2007, 49 percent greater than the issuance in 2006 of $4.69 billion and 251 percent more than the issuance in 2005 of $1.99 billion. Although complete numbers are not yet available, we note that the market for CAT bonds has declined in 2008 and may shrink in 2009 as a result of the current financial crises, notably due to the demise of Lehman Brothers, one of the market's major participants.

While CAT bonds remain the predominant form of catastrophe risk securitization, other structures have emerged in the catastrophe risk market as well as in other areas of insurance risk. Appendix A details various security and derivatives structures in insurance securitization.

Triggers (or attachment points) on insurance-linked securities and derivatives determine the conditions under which payments are made to the security sponsor. The generic trigger types are (a) the indemnity trigger, where the payouts depend on the sponsors actual losses; (b) the index trigger, where the payouts are triggered by an estimated industry loss for CAT events; (c) the parametric trigger, where the payouts are determined by well-defined parameters of a CAT event—e.g., wind speed and location of a hurricane or magnitude and location of an earthquake; (d) the modeled trigger, where the payouts are triggered by a model industry loss that is determined by running the actual event parameters through a modeling firm's database of industry exposures; and (e) the hybrid trigger, where the payouts are determined by a combination of two or more existing trigger types.

While on the decline in recent years (with the exception of 2007), the indemnity trigger has been generally the dominant form for CAT because the payouts of indemnity-based capital market structures replicate reinsurance protection. The indemnity trigger requires the disclosure of details about the covered portfolio that make it more costly both to the insurer that would prefer not to reveal the information and to the investor who must digest the information. It also generates a possible conflict of interest since the insurer may settle catastrophic claims in a way that is disadvantageous to investors; this is a well-known moral hazard problem.

The index, parametric, modeled, and hybrid triggers remove the moral hazard problem from consideration but may leave a basis risk problem. The random difference between the insurance-linked security (ILS) payout and the insurer's loss represents the basis risk; e.g., for an index trigger it is the difference between the estimated industry loss and the insurer's actual loss. The literature portion of this section addresses the trade-off between basis risk and moral hazard in more detail.

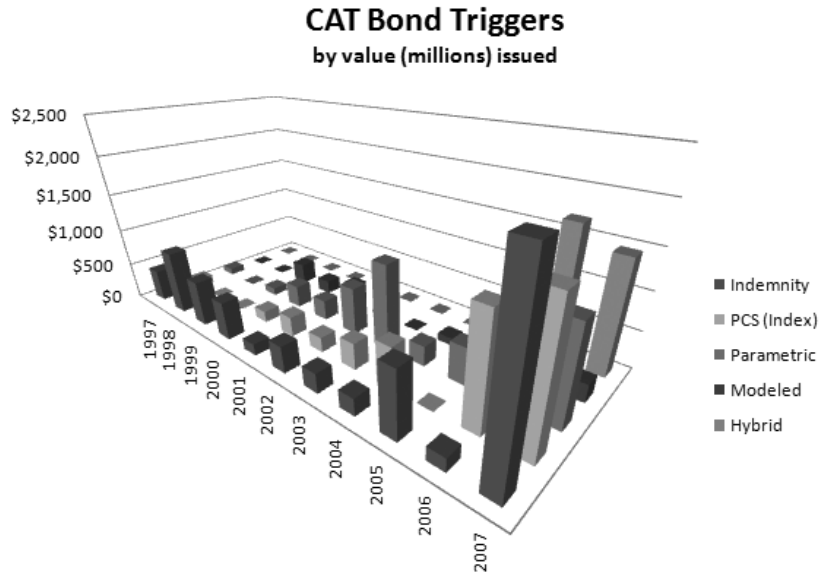

Fig. 1a. Proportion of issue value by year and trigger type. Figure generated from data in McGhee, Clarke, Fugit, and Hathawayajor (2008).

Figures 1a and 1b provide a historical sketch of trigger use.[4] Both figures seem to show more use of the indemnity trigger in 2007 than had been the case in earlier years. This is primarily due to the State Farm (Merna) $1.1 billion CAT bond issue that accounted for almost half of the year's indemnity trigger offerings. Without it, indemnity-triggered structures amounted to only $1.2 billion, compared with $1.8 billion for PCS industry loss–triggered securities. Figure 1a provides data based on the value of the issues; the data show a general increase in the use of PCS and parametric triggers with a substantial increase in PCS, parametric, and hybrid trigger use after 2005. In figure 1b, the historical sketch provides data based on the number of issues; roughly put, the data also show a decrease in the use of the indemnity trigger and an increase in the use of some of the other triggers.

[4]Also see Fig. 5 in Cummins (2008). Figures 1a and 1b here provide data over a longer time horizon broken down by the value of and the number of CAT bond issues.

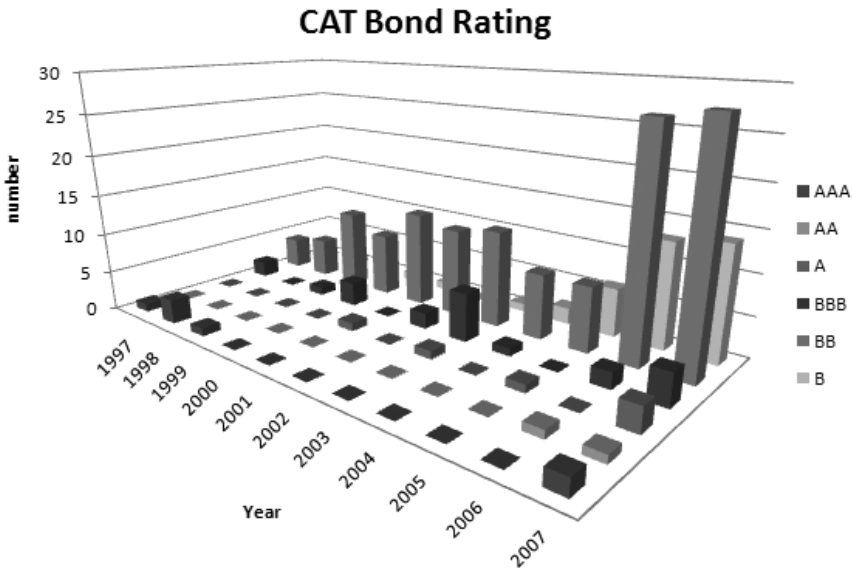

Fig. 1b. Number of issues by date and trigger type. Figure generated from data in McGhee et al. (2008).

Role of U.S. Credit Rating Agencies

U.S. credit rating agencies have been crucial in the development of the ILS market. Successful offerings of CAT bonds were rare until credit rating agencies developed methodologies for rating the bonds in 1997.

Credit rating agencies usually rely on stochastic modeling to derive estimated loss statistics. Their rating methodology of CAT-linked securities typically focuses on the following factors:

- Analysis of the issuer's insurance risk: credit ratings agencies use their own proprietary insurance capital models or rely on the input provided by catastrophe modeling firms (Risk Management Solutions (RMS), EQECAT (EQE), and Applied Insurance Research (AIR)). Typically, modeling firms construct a loss exceedance curve[5] which plots the bond issuer's loss against the probability of loss.[6] The credit rating agency then stress tests the model with different scenarios and assumptions. The trigger (or attachment point), once

[5] The exceedance curve provides the probability of a loss of a certain size occurring this year.

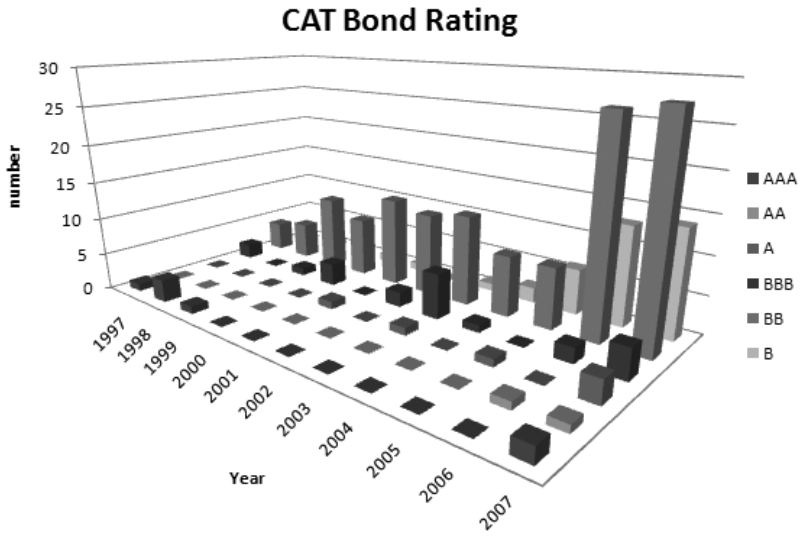

Fig. 2. Number of issues by year and rating. Figure generated from data in McGhee et al. (2008).

validated by the rating agency, is then applied to the exceedance curve to determine the probability of loss at the trigger point.

- Evaluation of default risk: credit rating agencies compare the probability of catastrophic losses with the probability of default of corporate bonds using historical data on corporate bond defaults. If probabilities of default are similar, the CAT bond receives a similar credit rating. Figure 2 shows the CAT bond ratings by year and rating from 1997 to 2007. The figure shows that the B and BB dominate historically. Only in 2007 did we see the reappearance of more highly rated CAT bonds.
- The terms and structure of the CAT bond transaction: this includes the credit quality of the collateral placed in the SPV trust and the credit rating quality of the counterparty to the swap engineered by the SPV.[7]

[6]Catastrophe modeling firms construct a loss exceedance curve by simulating thousands of hypothetical catastrophic event scenarios with varied geographical locations and event characteristics. The scenarios are then applied against the portion of the cedent's book of business covered by the bond.

- The risk of the CAT-linked security sponsor: this includes the sponsor's financial strength, length of time in business, history of sponsoring ILS, management quality, and other considerations.

Literature

The growth of the ILS market has spurred a flurry of academic research in the last ten years. The literature has essentially focused on four areas: the pricing of CAT bonds and other forms of ILS structures, trade-offs between indexed-triggered CAT bonds and indemnity-triggered bonds, the appeal of such instruments to investors as zero-beta assets, and the limitations of ILS structures.

The pricing of CAT bonds and other ILS is perhaps the most investigated area of research. Some researchers use an actuarial approach to model the yield paid on ILS. They usually start with the recognition that equilibrium models, implying that disaster risks should yield an unbiased actuarial estimate of expected loss, do not explain why yields on CAT bonds consistently exceed actuarially fair levels. Academics differ on the determinants of insurance-linked securities risk premium spreads. For CAT-linked instruments, the premium is most commonly determined as a fixed constant times the volatility of loss (other higher loss distribution moments, such that skewness, may also partly determine the premium spread). Others, such as Major (1999), attribute high yields paid on ILS structures to the uncertainty associated with actuarial probabilities. On the other hand, Froot and Posner (2000) argue that the pricing of risks in ILS structures and therefore the determination of risk premium spreads is determined by reinsurers, who, via the creation of special purpose vehicles (SPV), facilitate the issuance of ILS.

Other researchers use a financial approach to model CAT bonds and other ILS structures. Vaugirard (2003) uses an arbitrage approach to value insurance-linked securities, which accounts for catastrophic events and interest rate randomness, notwithstanding the fact that markets are incomplete. Cox and Pedersen (2000) recognize that the pricing of CAT bonds requires an incomplete market setting and develop a pricing method based on a model of the term structure of interest rates and a probability structure for the catastrophe risk.

The trade-offs between indemnity-triggered bonds and index-triggered (or industry-triggered) bonds have been well documented. Bouriaux and Russell (2002) noted that successful securitization of risk generally

[7]The SPV keeps the proceeds collected from the investors in the bond in a trust invested in fixed-income securities. The SPV then swaps the investment earnings of the trust against a LIBOR rate minus a fixed spread.

arises when the product structure meets the needs of both the issuer of the security and the investor in the security. In the case of existing insurance-linked securities, a lack of dual coincidence of wants between the insurer and the investor tends to appear. As noted earlier, insurance-linked securities have a payout tied to an index-based or industry-based trigger (either a loss or a parametric trigger) or one tied to a company-specific or indemnity trigger. Indemnity-triggered instruments appeal to the securities sponsors because they reduce or eliminate basis risk. On the other hand, index-based instruments may be more attractive to an investor than indemnity-based instruments, as the use of an industry loss or index trigger minimizes adverse selection costs. Index-triggered products are also likely to lower investors' costs in evaluating company-specific underwriting and financial results.

Company-specific capital structures, however, might be conducive to adverse selection and moral hazard. Canabarro, Finkemeier, Anderson, and Bendimerad (2000) observe that adverse selection in the context of insurance securitization reflects the fact that an insurer may try to securitize the most unattractive parts of its portfolio and keep the most profitable ones. Moral hazard relates to the fact that the insurer who transfers its risks to the investor via the capital markets might no longer have an incentive to limit its losses. CAT bond prospectuses generally provide an assessment of the risk factors associated with investing in those securities. They also present a risk analysis of the potential catastrophe and its impact on an insurer's portfolio; the risk analysis is generally performed by an independent catastrophe risk modeling firm. However, these documents offer limited information about the financial or underwriting performance of the issuer of CAT bonds, and largely ignore moral hazard and adverse selection as risk factors to investors.

Basis risk is inherent to index-based insurance-linked instruments and has been investigated by Zeng (2000), Croson and Kunreuther (2000), Cummins, Lalonde and Philips (1999), and others. In a report commissioned by the National Association of Insurance Commissioners (NAIC), the American Academy of Actuaries (1999) identified various sources of basis risk in insurance securitization: the nature, intensity and, for a weather-related event, the geographic location of an event; the operational or underwriting differences between a specific insurer's portfolio of policies and the portfolio underlying the index-based instrument; the structure of the transaction; and the construction and market penetration of the instrument's underlying index.

Although relatively new in insurance markets, basis risk is well known in the financial markets, as it represents a risk inherent in all commodity and financial transactions based on a standardized financial asset or

commodity, or on an index of those. The issue per se is not the existence of basis risk, but its assessment and quantification. Once thoroughly quantified, if possible, basis risk in a financial transaction can be minimized and almost eliminated via "over-hedging" or "under-hedging."[8]

Recent research has also focused on the benefits of index-triggered bonds over indemnity-triggered bonds. MacMinn and Richter (2004) show that, under some circumstances, reinsurers, who issue bonds to hedge against brevity risk, achieve greater shareholder value by utilizing index-triggered securities over indemnity-based securities.

Finally, research has investigated the diversification benefits of adding insurance-linked securities in investors' portfolios. Several papers have examined the hypothetical diversification benefits of holding ILS in investor portfolios and have shown that capital markets participants, by allocating a small percentage of their assets in insurance-linked securities, may create a more efficient portfolio.[9] The argument is that, generally, the returns on securities that have a payoff triggered by losses resulting from a natural disaster display a low correlation with stock and bond returns.[10] However, the results are merely suggestive. Since there is very little historical evidence of ILS returns, due to secondary market illiquidity, these research papers must assume risk parameters for these investments.

SUPPLY AND DEMAND FACTORS: IDENTIFICATION OF THE KEY COMPONENTS AND IMPEDIMENTS TO THE GROWTH OF THE CAT-LINKED SECURITY MARKETS

We can identify the key components to the growth of the CAT-linked security markets using a supply and demand framework in which the sponsors of CAT bonds and other insurance-linked securities create the supply and institutional investors generate the demand for these securities.

[8]The terms "over-hedging" and "under-hedging" refer to the process of transacting a higher or lower number of derivative contracts than the number that would be necessary for a company to perfectly hedge its exposure. Over-hedging and under-hedging examples using catastrophe insurance options can be found in Chicago Board of Trade (1995: 35–36).

[9] See, for instance: Litzenberger, Beaglehole and Reynolds (1996) and Swiss Re (2001).

[10]Unless the catastrophe brings the economy down. For instance, in Japan, the large economic losses resulting from the 1994 Kobe earthquake caused a steep decline in the Nikkei Index.

Supply

The supply of CAT-linked securities comes primarily from insurers and reinsurers; there are a few examples of corporations and countries that have also sponsored these securities. Tokyo Disney, Universal Studios, and Electricite de France are among a handful of corporations that have sponsored catastrophe-linked securities. Industry sources attribute such low interest to three factors. First, for most corporations, insurance costs are generally cheaper than the costs of transferring natural disaster risk via capital markets. Insurance pricing benefits corporate buyers because the insurer can pool and spread corporate risks. Second, while the pooling argument breaks down when peak risks arise, very few corporations around the world have peak risk exposures. Finally, the financial accounting standards board (FASB) accounting guidelines may deter U.S.-based corporations from issuing CAT-linked securities. We address FASB accounting issues in the third section of this paper.

Supply factors from insurance or reinsurance sponsors include the need for additional capacity and therefore for risk transfer or risk financing tools, their price, advances in technology, and a shifting perception of basis risk.

Need for Additional Capacity and Resulting Use of ILS Securities and Derivatives

Insurers and reinsurers provide a service to customers by assuming some of their pure risks, e.g., property, life, or other losses. The Law of Large Numbers implies that insuring the risks is possible by constructing a sufficiently large pool or portfolio of independent risks. However, the independence of the risks can be violated by events such as hurricanes, earthquakes, or pandemics. Such events make otherwise independent risks positively and highly correlated. As a result, insurance, reinsurance, and retrocession markets become more volatile. The insurers and reinsurers must either maintain greater levels of equity capital or otherwise hedge these event risks. Insurance-linked securities such as CAT bonds are instruments that transform pure risks into speculative risks and allow the sponsor, e.g., insurer or reinsurer, to transfer risk to the capital markets. These insurance-linked securities provide the same protection as equity capital, but it is generated only if the triggering event occurs. They can provide a more efficient mean of hedging some risks.

To gain a historical perspective, let us compare industry catastrophe losses with the U.S. insurer policyholder surplus. Figure 3 shows that the proportion of CAT losses in the U.S. insurer policyholder surplus has risen above 15 percent only twice in the last thirty years, the last time due to the

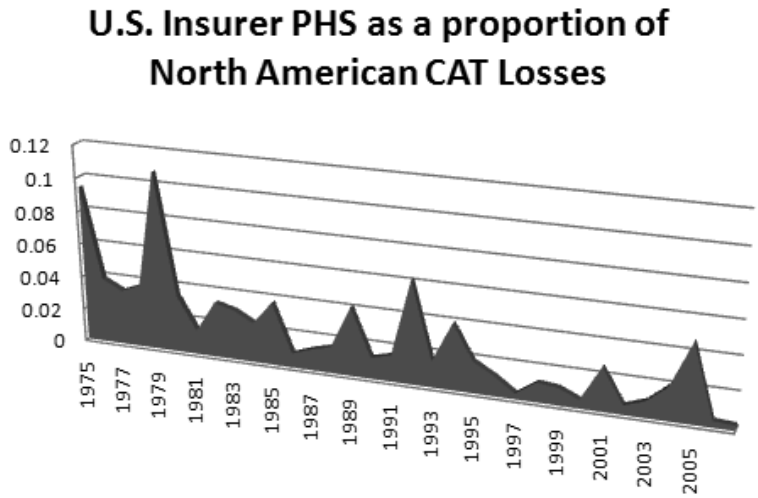

Fig. 3. U.S. insurer PHS as a proportion of North American CAT losses. *Source:* Swiss Re, A.M. Best, ISO, Insurance Information Institute.

impact of hurricanes Katrina, Rita, and Wilma in 2005. While the last spike reached over one fifth of the insurance company surplus, the reinsurance market covered only 44 percent–53 percent of the losses in 2005 (Tillinghast, 2005). This would amount to a $20.7 billion to $24 billion dollar loss to reinsurers or between 30 percent and 35 percent of their surplus.[11] While these numbers are rough approximations, they are large relative to the available reinsurer's gross surplus. In conclusion, the reinsurance market's ability to cover primary market losses has declined significantly.

As a result, more insurance companies are now fully integrating catastrophe-linked securities in their overall risk management strategy rather than seeking capital market protection as a defensive or last resort tool. McGhee, Clarke, Fugit, and Hathawayajor (2008: 13) point out that "the record market activity of 2007 demonstrates a fundamental shift in the perception of the capital markets as a risk transfer solution." Industry sources corroborate this view and observe an increased desire by sponsors to evaluate all risk transfer mechanisms equivalently. In 2007, many insurers already participating in the CAT-linked security market tapped the investment community again—for instance, Hartford, Liberty Mutual, SCOR, and USAA executed their third, third, fourth, and eleventh catastrophe bonds, respectively. Allstate, Travelers, and Chubb are among the

[11]This is based on an estimated $68 billion in U.S. reinsurer PHS in 2005 (Hartwig, 2006).

major primary insurers who established shelf programs for the first time. Also, in 2007, after a long absence from the CAT bond market, State Farm sponsored a $1.1 billion CAT bond. Finally, several sponsors who had until then avoided what they perceived to be costly catastrophe bond structures issued catastrophe bonds, despite the fact that the reinsurance market was in a soft cycle. We note, however, that the current financial crisis has dampened investment liquidity and we may observe a temporary decline in insurance-linked securities issuance and secondary market liquidity.

Finally, ILS securities also offer complementary capital capacity to reinsurers. Reinsurers aggregate CAT risks and, by doing so, gain some diversification benefits. Continued expansion, however, might require retrocession or other means to acquire the needed capital capacity to continue aggregating CAT risks. Retrocession is a very opaque means of acquiring capacity and is also a volatile market. CAT bonds, on the other hand, provide a more transparent acquisition of additional capacity.

Pricing

The price of a CAT-linked security relative to the price of reinsurance or retrocession is a major determinant of supply, to the extent that one views CAT-linked securities and reinsurance or retrocession as substitutes. If the price of reinsurance or retrocession increases, then, ceteris paribus, the supply of CAT-linked securities increases. The argument cannot, however, be pushed too far because both products can be structured differently. Reinsurance and retrocession, for example, are typically single-year instruments and may be subject to varying degrees of credit risk. CAT bonds have become multiyear instruments. These bonds may be subject to basis risk but typically little credit risk. Hence, the protection is comparable in principle but the manner in which the protection is provided is not.

In addition, there is reason to view CAT-linked securities as complements to reinsurance or retrocession.[12] The retrocession market, for example, has cycles. In a hard market, a price comparison may favor CAT- linked securities, but, from a capacity standpoint, both the insurance and reinsurance industries need a combination of traditional risk transfer markets and capital markets.

The jury is still out on how costly CAT-linked securities are, from an issuance standpoint, compared to traditional reinsurance or industry loss warrants. In its report on managing large-scale risks, the Wharton Risk Management and Decision Processes Center (2008: 200) notes: "ILS have often been non-competitive with traditional providers of reinsurance from

[12]It is not uncommon to find reinsurance covering the lower tranches while a CAT bond covers higher tranches, and from this perspective, the two might be viewed as complements.

a single 'rate on line' prospective, except for very specific risks like higher tranches of retrocession, or peak exposures in risk-prone areas" driven more by limits in available capacity.

Typically, the one-time costs associated with issuing CAT bonds are higher than those that apply to regular debt securities. Most insurance-linked products are structured via the use of Special Purpose Vehicles (SPVs) generally based offshore. Although SPVs tend to simply operate trust accounts, there are significant transaction costs associated with the issuance of CAT bonds, such as higher fees charged by rating agencies that devote more time and manpower in analyzing CAT bond structures than regular debt structures, and fees charged by CAT modeling firms. Yet overall, some market experts estimate that the legal fees associated with issuing CAT bonds have declined by about 70 percent as a result of the increasing proportion of shelf registrations of insurance-linked securities (Lane and Beckwith, 2007).

In addition, indemnity-triggered bond transactions are generally (but not always) costlier than non-indemnity-triggered bond transactions. McGhee et al. (2008) observe that indemnity-triggered bonds first require the payment of a higher risk premium to the investor relative to non-indemnity bonds. The size of the premium is a function of the type of business covered and the investors' confidence in the sponsor's underwriting, risk management, and loss and claims adjustment process. Second, there could be additional costs embedded in indemnity-based structures resulting from disclosure requirements and perceived legal exposure.

As noted, the cost comparison between CAT-linked securities and traditional reinsurance may be difficult since CAT bonds are multi-year instruments. CAT bonds address credit risk and price volatility issues that exist with reinsurance. Helfenstein and Holzheu (2006) argue that the multi-year nature of CAT bonds provides fixed-cost coverage over a multi-year period, while reinsurance premiums are much more sensitive to insurance cycles. CAT bonds also eliminate the risk of coverage and payment disputes. Catastrophe-linked capital structures are generally fully collateralized, thereby eliminating the sponsor's credit risk, while reinsurance contracts are subject to the reinsurer's credit risk. Hence, a cost comparison must include both the cost volatility and credit risk issues. An increase in either volatility or credit risk should, ceteris paribus, increase the supply of CAT-linked securities.

Advances in Technology

Advances in technology and modeling also contribute to better public understanding and acceptance of securitized products by insurance spon-

sors. Today, thanks to advances in catastrophe modeling and risk assessment methodologies, CAT bond sponsors (as well as investors in these securities) have a more sophisticated understanding of the financial impact of the risk embedded in various catastrophe-linked structures. For instance, in response to the financial impact of Hurricane Katrina on the insurance and reinsurance industries in 2005, the leading CAT modeling firms, i.e., AIR, EQE, and RMS, refined their modeling techniques to account for larger losses than those predicted. This increased awareness of potential losses has helped increase the search for capacity in the insurance industry and has driven sponsorship of ILS. In addition, catastrophe modeling firms have reduced their wind prediction horizon to near-term probabilities, i.e., 5-year horizon as opposed to 25–100 years. We also observe the development of software technology aimed at facilitating the management of a portfolio of catastrophe risks. For instance, AIR has recently developed CATRADER®, a CAT portfolio management software tool that may appeal to both sponsors and investors in the catastrophe risk market. Such technological changes has facilitated the formation of CAT funds and so increased demand and supply.

Shifting Perception of Basis Risk

Sponsors' perception of the basis risk embedded in catastrophe-linked transactions is changing. While sponsors generally prefer issuing indemnity bonds over non-indemnity bonds, they understand that their choice is a function of the cost-benefits of each trigger. With an indemnity trigger on a CAT instrument the sponsor is able to cover actual losses. Such a trigger, however, introduces moral hazard problems, e.g., less motivation to limit losses and consequent increases in the cost of coverage. An index trigger eliminates the moral hazard problem but leaves the sponsor with some risk that the actual loss will not be covered. As sponsors adjust to handling basis risk, supply should increase.

Sponsors have spent a considerable amount of in-house or external sophisticated resources understanding and quantifying their exposure to basis risk. They now weigh their choices of indemnity versus non-indemnity structures based on basis risk, pricing, and placement opportunities. For instance, in 2007, newcomers in the CAT bond market, like Allstate and Travelers, chose to issue non-indemnity bonds to ensure placement among investors. In the meantime, companies well known to investors, like USAA or Chubb, have continued to place CAT bonds with indemnity triggers easily; since USAA has sponsored new CAT bond issues each year, investors may well rely on contractual settling up to deal with the trigger. One oddity in this market is the choice made by State Farm to issue indemnity bonds that were costlier to place compared to non-indemnity bonds. Our

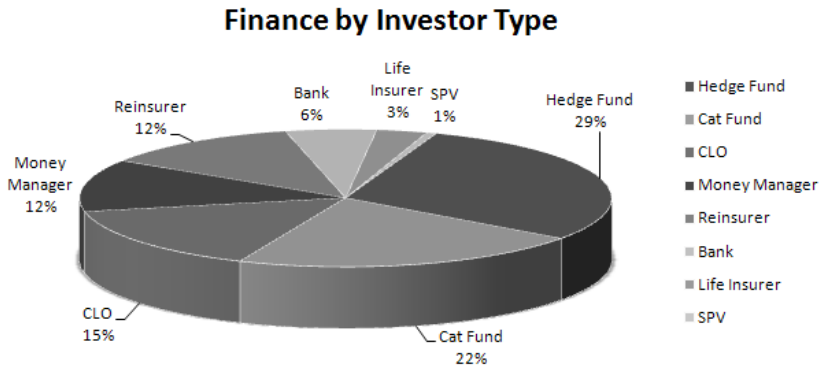

Fig. 4a. Investor base by investor type. *Source:* Goldman Sachs, May 2008.

opinion is that State Farm could have easily tapped the investor base with a cheaper non-indemnity bond. It is possible that, as a mutual company, State farm does not have to worry about efficient allocation of capital as much as publicly traded insurers.

Demand

Hedge fund managers, money managers, and other institutional investors provide services to their clients in the form of asset selection. Financial theory dictates that, if an asset has an expected return as least as great as the existing portfolio and a return uncorrelated with the portfolio, it should be included in the portfolio (see Samuelson, 1967, among others). Uncorrelated assets allow institutional investors to diversify their asset portfolios. This, in particular, generates demand in the ILS markets.

Investors' Considerations and Implications for the Catastrophe-Linked Capital Markets

Generally speaking, diversification of market participants is a key driver of growth in securitized markets. Since 2006, the number of investors in the ILS market has increased and diversified, as a result of a better understanding of the functioning of this market and of more sophisticated assessments of the financial impacts of catastrophe risks. The CAT bond market has a growing core of experienced investors, including money managers, hedge funds, dedicated CAT funds, banks, reinsurers, life insurers, non-life insurers, and some money funds. Figures 4a and 4b provide a breakdown by investor group and country for transactions placed by Goldman Sachs in 2007. Figure 4a shows that the proportion of the capital raised by Goldman Sachs in 2007 came primarily from money managers, collater-

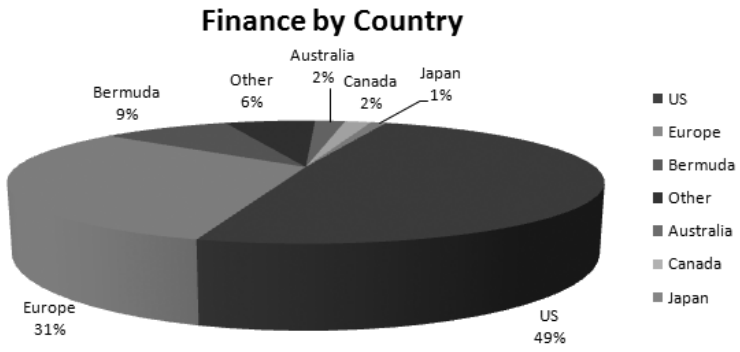

Fig. 4b. Investor base by country. *Source:* Goldman Sachs, May 2008.

alized loan obligations (CLO), CAT funds, and hedge funds, which financed approximately 78% of the CAT-linked issuance. Figure 4b shows that the institutional investors came primarily from Europe, Bermuda, and the U.S. One key factor in the continued development of CAT-linked securities is the stability and long-term availability of capital market solutions to cover catastrophe risks. That stability, availability, and growth must come from an increasing base of institutional investors in the U.S. and worldwide.

Risk-Return Profile

The risk-return profile of CAT instruments is also a determinant of demand. All managers of institutional portfolios must decide whether to include an asset such as a CAT bond on the basis of its expected return and its correlation. In its 2008 report, Guy Carpenter shows that CAT bonds provide rates of return historically greater than similarly rated corporate bonds[13]; hence the CAT instruments provide some excess return necessary for risk bearing. In a recent working paper, Stephan Dieckmann shows that CAT bond yield spreads equal between two and three times expected losses after controlling for bond-specific characteristics (Dieckmann, 2008). He also documents CAT bonds' higher yield spreads compared to equally rated corporate bonds. Although CAT bond yield spreads have recently narrowed compared to traditional corporate debt spreads, insurance-linked securities have historically provided a favorable risk and return

[13]We have been unable to reproduce the chart comparing CAT bond rates of return with similarly rated information as participants in the ILS market do not disclose yields on CAT bonds re-traded in the secondary market.

profile to investors and, more importantly, have provided them with a means of reducing portfolio risk.

Corporate capital has always been present in the aftermath of a large disaster for the right risk-return profile. For instance, in 1992, following the occurrence of Hurricane Andrew, we observed a large injection of capital in the form of newly formed reinsurance entities in Bermuda. Similarly, the occurrence of Hurricane Katrina provided the catalyst for growth in the ILS market. Today, there are many dedicated CAT funds investing solely in CAT risks. Examples of such funds are Stark Investments, Fermat, Nephila, Magnitar, Pulsar, and Coriolis. Finally, hedge funds such as Citadel Investment Group, Fortress, and JWM have focused on equity participation by investing in sidecars and other equity-related instruments.

Portfolio Diversification Benefits

There is evidence suggesting that CAT bonds exhibit low correlations with other asset classes and therefore provide significant portfolio diversification benefits. For example, Froot, Murphy, Stern and Usher's (1995) estimates of the correlation coefficients between CAT exposures and other asset classes ranged from –0.13 and +0.21 but none were statistically different from zero.[14] The favorable risk-return profile of this class of securities demonstrates that ILS may be used to reduce the risk of a portfolio and increase its expected return.[15] More recently, Heike and Kiernan (2002) have shown that the addition of a small allocation of CAT bonds to a BB high-yield portfolio, represented by the Lehman Brothers BB High Yield Index, reduces the portfolio's return volatility and boosts its expected return. Hence, portfolio diversification provides a rationale for the growing investor base for this asset class.

Catastrophe-linked instruments, with returns uncorrelated to those of other financial assets, are particularly important in providing diversification benefits. Even if the CAT instrument yielded an expected rate of return equivalent to that of the investor's portfolio, the uncorrelated nature of the return on the CAT instrument would suffice to make it desirable.

The recent sub-prime mortgage and credit market crisis in U.S. financial markets further highlights the attractiveness of zero-beta assets, like catastrophe-linked securities, in investor portfolios. Institutional investors have recently become re-acquainted with the dangers of holding securities collateralized with highly correlated assets and have shied away from mortgage-collateralized bonds or CDOs, while turning to the ILS market.

[14]Also see Litzenberger et al. (1996).

[15]See Samuelson (1967). Also see MacMinn (1984), which shows the conditions under which adding an asset to a portfolio will reduce the risk of the portfolio.

This increased investor interest partly explains the recent narrowing of CAT bond yields compared to yields on comparable traditional corporate debt.

Advances in Technology

As with sponsors, advances in technology and modeling contribute to better public understanding and acceptance of securitized products by investors. Investors need to trust CAT risk assessment methodologies developed by catastrophe modeling firms and credit rating agencies to confidently invest in insurance-linked securities. As we have noted, the occurrence of Hurricane Katrina provided the catalyst in demonstrating some weaknesses in the estimation of the financial impact of a natural disaster on a company's book of business. In order to restore investors' confidence in CAT risk assessment tools, catastrophe modeling firms revised their methodologies to adopt a near-term catastrophe outlook, and credit rating agencies refined their default rate grids. These technological improvements by the CAT modeling firms have provided the necessary changes and continuing education that fosters growth in demand.

General Impediments to Market Growth

Each existing CAT-linked structure has its own weakness and this section points them out. But overall, there are factors that may have limited the growth of CAT-linked securities and derivatives markets.

Market Fragmentation

Generally, in capital markets and derivatives markets, standardization enhances market liquidity and helps investors manage their portfolios more efficiently. Yet we observed previously that, in issuance terms, the CAT bond market is almost evenly split between indemnity structures and non-indemnity structures. This partly explains the current fragmentation of the catastrophe-linked capital markets. In addition, to a certain extent, CAT-linked capital structures seem to become more complex, with an evolution from fairly simple CAT bond structures to Collateralized Risk Obligations (CRO) reminiscent of Collateralized Debt Obligations in credit markets and to sidecars.[16] Secondary market liquidity generally increases as more standardized structures—i.e., structures with a payoff triggered by an index of pooled risks—appear in the capital markets.

[16]It seems, however, that side cars are popular structures in "hard" insurance markets and much less so in "soft" markets, as evidenced by the dwindling amount of sidecar structures observed in 2007.

Other Factors That May Impair Market Liquidity

There are other factors that may impair market liquidity; some are more specific to the ILS market while others are more specific to the derivatives markets.

In the cash market, under Securities and Exchange Commission (SEC) Rule 144A, insurance-linked securities can only be placed and traded among registered institutional investors. While institutional investors' participation has diversified recently and now includes hedge funds and other private CAT equity funds, such diversification may or not be conducive to active secondary market trading. CAT funds tend to be "buy and hold" investments while hedge funds are notoriously secretive and unlikely to add to market transparency. On the other hand, we observe an increasing participation of mutual funds in CAT-linked securities, and this may help improve market liquidity and transparency.

Price transparency is crucial to secondary market trading in cash markets. Low liquidity in insurance-linked securities may be explained by the absence of a true (electronic) trading platform open to any investor type. The ILS market is essentially an over-the-counter market, with dealer firms and other investors communicating by phone or e-mail. Data providers like Bloomberg and Reuters do not disseminate any price or yield information on CAT bonds. As a result, the insurance securitization market has suffered from a lack of price transparency. In addition, the introduction of a market available to individual investors could generate trading interest since CAT-linked securities would help retail investors diversify their asset portfolios just as it helps institutional investors.

Transparency in the underlying market is also crucial to secondary market trading in cash markets. While some sophisticated investors know that insurance companies' historical loss records may not be extremely helpful in understanding and quantifying the risk associated with future catastrophes, other investors, including individual investors, value depth and frequency of market information. The lack of standardization in insurance companies' catastrophe risk exposure records throughout the U.S. industry and the absence of public disclosure of such information may impair secondary market trading in U.S. catastrophe risks.

Secondary market activity has also been low in exchange-traded derivatives markets. To analyze why, it is important to learn lessons from the CBOT's experience in the mid-nineties. While the CBOT offered a trading venue for its catastrophe-linked futures and options, the rigid membership structure of the exchange created a barrier to entry for the risk transferor (i.e., the insurer or reinsurer), leaving the product to be traded among members who may not have had sufficient expertise or interest in pricing insurance-linked contracts. In addition, the CBOT open outcry trading

venue was clearly, in retrospect, inappropriate for such products. Some of these problems are alleviated now that derivatives exchanges have demutualized and offer electronic trading platforms open to all investor types. Yet the CME derivatives show minimal trading volume. The IFEX futures contracts also show low liquidity, but the presence of market makers may help.

We note a few reasons why, to date, derivative instruments have failed to attract investor attention. First, catastrophe seasons have been relatively quiet since the 2005 hurricanes. Second, the learning curve remains steep for both hedgers and speculators in these markets. The learning curve might be even steeper with the CME products, which settle against a parametric trigger. Because of this, basis risk in the CME contracts might be harder to quantify. In addition, it is very costly for investors to model a parametric trigger compared to an industry loss trigger, which only requires access to an industry loss exceedance curve, generally available from catastrophe modeling firms at an acceptable cost.[17] This prohibitive cost is likely to deter potential smaller investors, who otherwise might be willing to provide liquidity in the CME contract.

Another reason for investors' lack of interest in exchange-traded derivatives might be that the exchanges have adopted a penalizing margining system. U.S. futures and options markets generally calculate margins (deposits) on derivatives contracts on the basis of the historical volatility of the price of the instrument or commodity on which the futures or option contract is based. Futures and options are generally attractive to market participants because the margin, collected at the time the contracts are transacted, represents a relatively small percent of the dollar value of the contracts. In the case of exchange-traded catastrophe-linked futures and options contracts, the exchanges may require market participants to put up more margins to cover possible losses, up to 100 percent of the dollar value of the contracts, as a "predictable" catastrophe, such as a hurricane, which takes days before making landfall, approaches. This provision alleviates the low leverage benefits generally provided by exchange-traded futures and options.

The current lack of trading activity in exchange-traded derivatives may be better explained by a more fundamental reason. In general, securitization of markets starts with the development of standardized cash instruments such as CAT bonds. After liquidity occurs, derivatives are designed as tools to hedge exposure to the cash instruments. To date, there

[17]We estimate that some catastrophe modeling firms charge up to $200,000 for access to their entire capacities necessary to model a parametric index, while they'll offer industry exceedance loss curves for about $20,000.

are few signs of standardization in the catastrophe-linked security market. Each transaction is unique and cannot be standardized without significant basis risk. Consequently, there is no perfect or easy hedge between the cash and derivative markets. This makes trading in the derivatives markets less attractive to potential holders of catastrophe bonds.

This said, we note that certain exchange-traded derivatives have been designed not as traditional tools to hedge price risk, but more like over-the-counter instruments. For instance, IFEX designed its binary futures contracts to replicate industry loss warrants. As a result, these contracts may never be heavily traded and their success or failure should be more accurately measured with statistics on open interest (i.e., the number of futures positions not liquidated) rather than on trading volume.

Unfavorable Tax and Accounting Treatment

Almost all sponsors have issued catastrophe bonds via the use of offshore SPVs. In the U.S., the use of off-shore SPVs can be explained by the restrictive insurance accounting treatment of ILS and catastrophe-linked derivatives, the Financial Accounting Standard Board (FASB) accounting guidelines for SPVs (called Variable Interest Entities or VIE in the FASB documents), and taxation issues.

From an insurance accounting standpoint, in the United States, legislation adopted by the National Association of Insurance Commissioners allows insurance companies to create a protected cell—i.e., an on-shore SPV—and to claim a somewhat favorable statutory accounting statement, if the insurer sponsors an indemnity-triggered CAT bond, via the protected cell. The accounting treatment is not as favorable as that of traditional reinsurance, because insurers can claim such treatment only if and when the bond trigger is reached and the sponsor is indemnified by the SPV. On the other hand, under statutory accounting, an insurance company that buys traditional indemnity-based reinsurance can reflect the transfer of risk on its financial statements as soon as it agrees to the reinsurance contract.

The NAIC also adopted a Special Purpose Reinsurance Vehicle (SPRV) model law that allows any entity—i.e., insurer, reinsurer, insurance broker, or investment bank—to act as an on-shore special purpose reinsurer and issue insurance-linked debt to back up a reinsurance program contracted by the ceding insurer. The model law also grants the status of reinsurer to any entity that organizes as an SPRV. In other words, any fully funded SPRV instrument meeting the requirements of the model law receives a somewhat favorable credit for reinsurance treatment.[18] This report notes that U.S. states may conform to the provisions of the NAIC model law or a modification of it or enact their own law. The NAIC accounting recom-

mendations apply only to indemnity-triggered bonds. An insurance company that issues bonds with a non-indemnity trigger must account for these bonds just as a regular debt instrument.

The U.S. regulatory environment becomes even murkier with respect to exchange-traded insurance derivatives. Only three states—California, Illinois, and New York—have openly addressed, with variations, an insurance company's authority to engage in exchange-traded derivative transactions and only for hedging purposes. Most states, however, have taken a position on the issue of exchange-traded derivatives, generally as part of the Leeway (Basket) clause and only for hedging purposes.[19] From an accounting standpoint, under the current statutory accounting rules, insurers who wish to transfer some of their underwriting risks to the capital markets via exchange-traded insurance derivatives cannot account for such transactions in their underwriting function book.

From the FASB accounting standpoint, FASB has issued guidance under Generally Accepted Accounting Principles (GAAP) that has the potential to deter any corporate or insurance entity from sponsoring catastrophe bonds. In January 2003, FASB issued Interpretation No 46, Consolidation of Variable Interest Entities (FIN 46). FIN 46 introduces "variable interest entities" or VIE. If an entity such as SPV does not meet certain capitalization requirements, it is deemed a VIE and may have to be consolidated into the balance sheet of the company that created it. In a comment letter addressed to the Government Accounting Office, and published in report GAO-03-1033, the Bond Market Association notes that "such consolidation under FIN 46 would limit the appeal of catastrophe bonds because the proceeds of the bond offering would appear as additional leverage on the cedent's balance sheet" (General Accounting Office, 2003: 53).

Finally, from a taxation standpoint, one major stumbling block to the wider use of on-shore SPV by sponsors remains that, under current U.S. tax laws, on-shore SPVs do not receive a pass-through treatment similar to that afforded to mortgage-backed securities sponsors. In the mortgage market, the sponsoring entity is not taxed on the investment income from the trust account. The tax, instead, is passed to the investor in the security.

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[18]A detailed discussion of the topic is beyond the scope of this paper. An overview and discussion of the regulatory and accounting treatment of insurance-linked instruments can be found in Bouriaux (2001).

[19]The Leeway or Basket Clause is a specific clause contained in most states' insurance codes that allows insurance companies to invest up to a certain percentage (generally 5 percent) of their assets in "admitted" assets or instruments, a list of which is defined by the state. Admitted assets can be stocks, options, swaps, or other financial instruments.

TECHNICAL CONSIDERATIONS, AND INITIATIVES AIMED AT BOOSTING USE AND EFFICIENCY OF CAT-LINKED SECURITIES

Market Standardization and Triggers

We believe that a certain degree of standardization in market capital structures is a key component to the development of securitization. It seems that, after a couple of years spent on introducing more complex instruments, ILS market participants have finally realized that simpler CAT bond structures may remain the dominant form of CAT-linked securities. Despite the diversity of triggers, CAT bonds are more standardized than other insurance-linked capital structures, as evidenced by the increased number of shelf registrations. Yet the issue of triggers remains. In order for market transparency to increase and secondary market and liquidity to develop, non-indemnity structures should become the dominant form of CAT bonds. Non-indemnity triggers can be parametric or based on an aggregate of industry loss. There are clear trade-offs between these.

From the sponsor's standpoint, industry loss triggers tend to have less embedded basis risk than parametric triggers. Yet a bond or a derivative instrument triggered by an industry loss will not offer immediate payout to investors, as losses will develop over weeks and possibly months, especially losses resulting from large events like hurricanes Andrew and Katrina. In addition, the methodology for collecting and aggregating insured losses may be deemed inadequate. For instance, some ILS market participants feel that the existing industry loss triggers are inadequate in their estimation of U.S. natural catastrophe insured losses. If so, then we suggest that they consider developing a new methodology for gathering industry loss and industry market exposure information for U.S. catastrophe losses.

Parametric triggers tend to be more attractive to sophisticated investors. They are easier to model than industry loss triggers, in that they don't assess the financial impact of a natural disaster. In addition, capital market structures triggered by parametric measures can provide a quick payoff to the investor. On the other hand, from the standpoint of the smaller and less sophisticated investor, parametric triggers are likely to prove costly and difficult to model.

Data Gathering and Modeling of Perils

One of the limitations of the worldwide growth of the ILS market pertains to the lack of modeling ability for some perils and some regions, such as European floods or earthquakes in Turkey. Models perform well only if they are able to gather and process data on the occurrence and parametric characteristics of natural catastrophes. While it is true that historical information on the occurrence of natural perils is unlikely to help predict the future events, parametric information about past perils constitutes an important input in the simulation of random events by catastrophe modeling firms. Many countries and regions, including Europe, don't always keep detailed and organized records of the characteristics of certain perils.

As a result, issuance of catastrophe-linked securities may remain limited for some peril types or for some geographic areas until a robust set of parametric data has been collected. In addition, sponsors of some multi-peril indemnity bonds may find limited placement among investors.

On the basis of these observations, we strongly suggest the development of central or regional databases that would:

(a) Track parametric data on the characteristics of catastrophes occurring worldwide. We suggest the creation of a databank that would start gathering and processing data on the occurrence and parametric characteristics of natural catastrophes worldwide. Enhanced parametric data quality will help the modeling of additional perils. In addition, it will help the structuring of parametric-triggered capital market structures favored by investors.

(b) Collect and harmonize insurance companies' market exposure data. The gathering, harmonization, and public dissemination of insurer market exposure data is crucial to quantify basis risk inherent to capital market structures with payouts triggered by an industry loss index. Catastrophe modeling firms do collect market exposure data, but only make it available for a fee, as part of their modeling package. As a result, only sophisticated investors who can afford the technology can identify the risk associated with investing in catastrophe bonds.

Market Transparency

To date, the ILS market has remained opaque to the general public. There is no public dissemination of bond offerings or prices, as transactions occur over-the-counter, and the ILS market is likely to remain opaque if it is open only to institutional investors. This said, the institutions currently involved in the ILS market may not perceive market opacity as an

impediment to market growth because it is not an issue for them. They circulate lists of bond offerings and related pricing among themselves or their customers, as is common in the over-the-counter market. They can argue that there is availabe information about bond offering and bond prices, just not public dissemination of it.

Opening access of the ILS market to a broader investor base would require public dissemination of offerings, prices, and other information related to the risk associated with investing in catastrophe-linked securities.

Should Retail Investors Access the ILS Market?

We noted earlier that (a) only qualified or institutional investors have access to the ILS market and (b) only investors with a high level of sophistication are likely to access the ILS and exchange-traded derivatives markets. However, facilitating access to the ILS market to retail or individual investors, via secondary market trading or via mutual funds, may raise public policy issues, in light of investors' protection concerns embedded in U.S. securities laws and in the recent Markets in Financial Instruments Directive (MiFID) in the European Union.

In the U.S., both the Securities and Exchange Commission, which supervises issuance and trading of cash securities, options, and other over-the-counter derivatives, and the Commodity Futures Trading Commission, which supervises trading in futures markets, have, on an ongoing basis, enacted legislation aimed at protecting the individual customer. Yet individual investors often have access to securitized markets via secondary market trading or via mutual funds. For instance, GNMA mortgage-backed securities or mutual funds invested in mortgage-related instruments have been very popular among individual investors in the last twenty years. One can argue that these securities are attractive to retail investors because of their high credit quality, while most securities in the ILS market are rated in the B to BBB range, possibly limiting potential individual investors' participation.

This said, the current sub-prime mortgage crisis in the U.S. highlights the role of credit rating companies and their own fiduciary responsibility to investors. Credit rating agencies have been criticized lately for over-rating a certain number of MBS that now are in default. While credit rating agencies have recently revised their methodology in rating catastrophe bonds and other ILS, the sub-prime mortgage crisis and its impact on individual investors should constitute a wakeup call on the appropriateness of opening certain capital markets to such investors.

There are other relevant non-institutional investors' protection concerns. As mentioned previously, the assessment of risk in ILS requires a

high level of sophistication and an understanding of the nature and (non) predictability of catastrophe risks. Should catastrophe risk end up in the hands of individual investors whose investment decisions may be based on more traditional risk/return assessment measures than the ones used in CAT risks? Although CAT risks may be uncorrelated with other risks in an investor's portfolio, their own nature makes measurement of the expected rate of return obscure simply because they are difficult to predict.

Government Participation in the Development of the ILS Market

To date, government participation in the ILS market has remained very limited. For example, use of ILS were contemplated by the U.S. Treasury during congressional consideration of the Natural Disaster Act of 1997. One provision of the Act called for the U.S. Treasury to carry out a program to auction self-funded excess-of-loss reinsurance contracts covering certain natural disaster perils. These contracts would have been standardized and re-tradable among insurers and other participants. The Natural Disaster Act of 1997 was never enacted.

Governments, which have a constrained financial ability to absorb the economic impacts of weather-related disaster, could tap ILS markets either by directly issuing catastrophe-linked securities (like the sovereign-backed Cat-Mex $160 million issued by the Government of Mexico in 2006) or by creating multi-governmental facilities similar to the newly established Caribbean Catastrophe Risk Insurance Facility (CCRIF). The latter would allow these governments to share the costs of reinsurance and the costs of the CAT modeling technology, and possibly transfer extreme event risks to capital markets via issuance of catastrophe-linked securities.

Similarly, in some countries where the private insurance and reinsurance markets are relatively well organized, individual state or federal governments could develop pools of reserves from individual insurers to cover extreme event catastrophe risks, and finance a portion of these pools via the issuance of catastrophe-linked securities, rather than via the use of taxpayer money.

In the United States, for instance, after Hurricane Andrew in 1992 and the Northridge earthquake in 1994, the states of Florida and California established catastrophe authorities to stabilize markets and maintain or increase capacity. In California, after Northridge, the state formed the California Earthquake Authority (CEA) to provide residential earthquake insurance. Insurers that sell residential property insurance must offer their policyholders separate earthquake insurance. Insurers can offer a private earthquake policy, but most choose the CEA policy. Only insurance companies that participate in the CEA can sell CEA policies. The CEA funds to

pay claims come from premium contributions from and assessments on member insurance policies, borrowed funds, reinsurance, and the return on invested funds. In Florida, after Hurricane Andrew, the state established the Florida Hurricane Catastrophe Fund (FHCF) to act as a reinsurer for insurers that offer property/casualty insurance in the state. FHCF is financed by premiums charged to participating insurers, investment earnings, and emergency assessments on Florida insurance companies if needed. In both the Florida and California cases, the financing may not suffice in the event of an extremely severe disaster, and both states have the flexibility to issue bonds. Instead of tapping taxpayer money, the CEA, via Swiss Re or Lehman Brothers, has regularly issued CAT bonds since 2000.[20]

Revisiting the Regulatory, Accounting, and Fiscal Treatment of Insurance-Linked securities and Derivatives

In the U.S., it is unclear whether the unfavorable accounting treatment of non-indemnity CAT structures truly affects a sponsor's decision in issuing catastrophe-linked securities. Yet the issue of the regulatory, accounting, and fiscal treatment of insurance-linked securities and derivatives should be revisited by regulatory bodies of all countries interested in facilitating the development of this market.

First, we should broaden the comparison between CAT bonds and traditional reinsurance, in consideration of the ongoing convergence of insurance and capital markets. All insurance risk transfer instruments (insurance-linked securities and derivatives, reinsurance, or other ART instruments) should receive a regulatory, accounting, and fiscal treatment based on their relative merits and risks.

Bouriaux (2001) compares risk transfer alternatives offered by the capital and insurance markets on the basis of the risks associated with each alternative: basis risk, credit risk, and collateralization. She notes some inconsistencies in their accounting treatment. Generally, critics of a favorable accounting treatment for non-indemnity insurance-linked securities and derivatives argue that, unlike reinsurance, these instruments do not achieve full transfer of risk partly because of the existence of basis risk and partly because of the partially funded nature of some of these transactions, such as exchange-traded derivatives. Bouriaux points out that (a) basis risk can be identified and quantified and (b) that, in some instances, reinsurance

[20]The CEA issued the following amounts: $149 mil. (2000), $100 mil. (2001), $200 mil. (2002), $400 mil. (2003), $300 mil (2004) and $225 mil. (2006) (source: Goldman Sachs).

transactions can be less than fully collateralized and funded and yet, in the U.S., the NAIC grants them a favorable accounting treatment.

On the other side, we can argue that, in the insurance and reinsurance markets, a more favorable fiscal treatment of catastrophe or equalization reserves may increase the availability of traditional insurance/reinsurance. General Accounting Office (2005) notes discrepancies between the U.S. and European fiscal treatment of catastrophe reserves. A certain number of European countries allow insurance companies to establish tax-deductible reserves for potential losses associated with catastrophic events, although each country differs in the way it allows reserves to be set up and used. In the U.S., on the other hand, catastrophe reserves are not tax-deductible. Advocates of tax-deductible reserves point out several potential benefits: they would provide insurers and reinsurers with financial incentives to increase their capital and expand their capacity to avoid insolvency (for insurers), or to honor their reinsurance contracts (for reinsurance). They would also lower the costs of catastrophic coverage among policyholders of reinsurance among insurers.

In conclusion, the accounting, regulatory, and fiscal treatment of insurance-linked securities and derivatives should be examined in the context of their risks and merits compared to other catastrophe risk transfer mechanisms.

CONCLUDING REMARKS

The market for insurance-linked securities and derivatives is just over ten years old. The future of exchange-traded derivatives is uncertain, for reasons that include, among others, the existence of basis risk and the lack of volume and standardized contracts in the cash markets for catastrophe risk. The future of the ILS market and in particular of the CAT bond market seems more robust. Despite the temporary impact of the current financial crisis on the capital markets, 2006 and 2007 were record-breaking years for CAT bonds, in both the primary and secondary markets. The use of index, parametric, and hybrid triggers has increased relative to earlier years, which may lead to enhanced market standardization and secondary market trading. More research is necessary on basis risk versus moral hazard, as well as a comparison of the basis risk embedded in insurance-linked securities with different triggers, including multiple triggers. Research should also focus on the use of the ILS capital markets in the risk management of insurers and reinsurers and should include the development of a diversification theory for portfolio composed of traditional securities and event risks such as CAT-linked securities, weather derivatives, and other

event-triggered financial instruments. It is impressive that the ILS market has survived despite a less-than-level playing field on regulation, taxation, and theory. The market could thrive if all the stakeholders promoted change on these three fronts.

APPENDIX: SECURITY AND DERIVATIVES STRUCTURES IN INSURANCE SECURITIZATION

Insurance-Linked Instruments

CAT Bonds

A CAT bond is a high-yield bond that contains a provision that may cause the principal or interest payments to be delayed or lost to the investors in the event of a specified loss such as a hurricane or earthquake. The CAT bond provides the insurer with fully collateralized multi-year cover for well-defined risks on an excess of loss basis.

The insurer or reinsurer, also called the sponsor, creates a special purpose vehicle (SPV). The purpose of the SPV is to provide loss protection to the insurer or reinsurer. The insurer or reinsurer pays a premium to the SPV, issues bonds to qualified institutional investors, and uses the proceeds of the sale plus the premium to purchase highly rated short-term investments such as Treasury notes. The SPV also enters an interest rate swap to convert the periodic investment income from the short-term investments to LIBOR, makes the periodic coupon payments to investors, and ultimately repays the principal upon maturity unless a loss occurs before maturity that triggers loss payments to the insurer or reinsurer. See Figure A1 for the structure of the CAT bond.

Industry Loss Warrants

An industry loss warrant (ILW) is an index-based instrument that can be structured either as an indemnity-based reinsurance contract or as a derivative contract. An ILW is considered a reinsurance contract when (a) the contract buyer suffers a loss and (b) the industry suffers a loss over a specified threshold. It is viewed as a derivative contract when it is triggered only by an industry loss. A.M. Best (2008) has recently drawn analogies between the basis risk associated with non-indemnity-triggered CAT bonds and that of ILWs.

Catastrophe Collateralized Risk Obligations (CRO)

In a CRO, an SPV managed by a risk manager assembles a portfolio of risks consisting of traditional reinsurance and CAT-linked securities. The

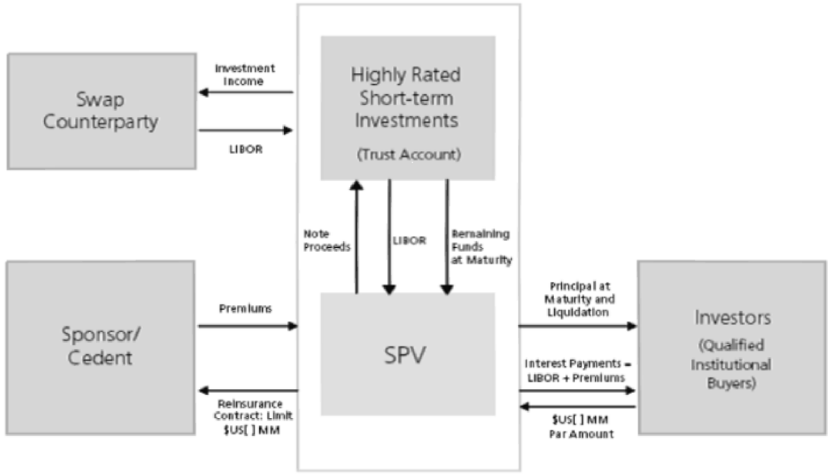

Fig. A1. Structure of a CAT bond. *Source:* McGhee, Clarke, and Collura (2007).

SPV then issues multiple tranches of notes and a tranche of equity, which successively attach upon exhaustion of the previous layer. CRO offerings, like CAT bonds, are fully collateralized. An example of a CRO is Gamut Re, which had a $310 million bond offering in May 2007. Goldman Sachs was the lead underwriter of the offering. Nephila, a private equity CAT fund, assembled the portfolio of risks, which includes traditional reinsurance, industry loss warrants (ILW), and CAT bonds. Investors in a CRO immediately benefit from portfolio diversification in insurance risk.

Sidecars

A sidecar is a reinsurance company that is created and funded by investors, such as hedge funds, to provide capacity to a single insurer or reinsurer (commonly called the sponsor) for its catastrophic losses. While CAT bonds allow insurers to transfer their property risk to the capital markets, sidecars are best described as tools that help insurers financing any risk on their books, including property risks.

The structure of the sidecar is a reinsurance company created to provide quota share reinsurance protection to the sponsor via a quota share reinsurance agreement. The sidecar assumes a percentage of the sponsor's catastrophe risk in return for a percentage of the premium. The sidecar pays a ceding commission to the sponsor; the size of that commission increases in proportion to expected profitability. The sidecar accepts premiums and pays claims as a normal reinsurer. It also distributes interest and dividends

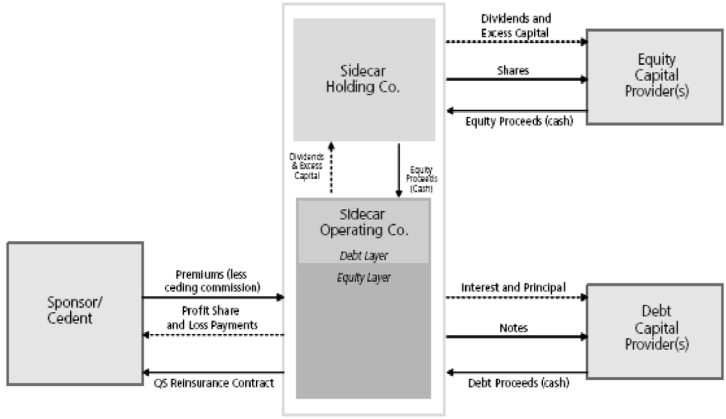

Fig. A2. Structure of a sidecar. *Source:* McGhee, Clarke, and Collura (2007).

to its shareholders. The sidecar usually has a lifespan of one or two years. See Figure A2 for the structure of a sidecar.

CAT Linked Derivatives

Event Loss Swaps

Although there is little publicly available information on over-the-counter CAT-linked derivatives, we note that Deutsche Bank has recently begun to make two-way markets in what it calls event loss swaps. The Deutsche Bank event loss swaps, in their current form, work like credit default swaps. The buyer of event loss protection pays an upfront premium to the seller of the protection, who must then pay the full notional value of the swap contract if industry-wide insurance losses breach a pre-agreed-upon trigger. Features of the Deutsche Bank swap transactions are as follows:

- The swap contracts cover a one-year risk period and are sold in notional $5 million amounts, with the buyer upfront premium being expressed as a percent of the notional amount.
- The swaps contracts cover windstorm and earthquake risks in the U.S., with threshold levels set at $20 billion, $30 billion, and $50 billion for hurricanes and tornadoes and at $10 billion and $15 billion for earthquakes.

IFEX Event-Linked Futures

IFEX is a subsidiary of the Climate Exchange plc. Group and operates via the Chicago Climate Futures Exchange trading platform. The IFEX launched event-linked futures (ELF) contracts linked to U.S. tropical wind in September 2007 and will soon offer ELF contracts on other catastrophe zones and perils. The futures contracts are designed to mimic industry loss warranties with a payout linked to "first event" of the year, "second event" of the year, and so on. The futures contracts settle against an industry wind loss as estimated by PCS and offer a binary payout of $10,000 (when the industry loss amount reported by PCS equals or exceeds one of the applicable loss trigger levels) or zero. The applicable loss trigger levels for each listed event are currently $10 billion to $50 billion, in increments of $10 billion.

CME Hurricane Futures and Options

In contrast with IFEX, the CME has adopted a radically different approach in the design of its hurricane futures and options. First, they settle against the Carvill Hurricane Index (CHI), which is based on the parametric features of a hurricane, such as maximum wind velocity and size (radius). Second, the CME futures and options expire as soon as an official hurricane makes landfall. The contracts settle in cash against the value of the Carvill index, which is immediately released after the hurricane landfall.

Other features are as follows:

- The Carvill Index is expressed in points. One index point is worth $1,000.
- CME currently offers futures and options contracts on the following regions: Gulf Coast, Florida, Southern Atlantic, Northern Atlantic, and Eastern.
- The CME recently expanded its range of contracts to include seasonal aggregated futures contracts and options with a binary payout.

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