*Chapter 8*

# Development of CAT-linked Securities

We can draw from observations made in chapter six of this report about the nature of natural catastrophe risks and their economic costs, the general conditions for market growth and liquidity in securitised markets and the possible roles of CAT-linked securities, to identify the key drivers of, impediments to, and issues in the development of, a CAT-linked securities market.

## 8.1. Drivers of the development of CAT-linked securities

### *a) Demand for additional risk transfer capacity*

Chapter six documents the need by insurers and reinsurers for additional risk transfer or risk financing capacity. Growing CAT bond issuance in the pre-financial crisis environment supports the statements made in that chapter: for instance, in 2007, the record year for issuance, 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 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 US$1.1 billion CAT bond. Finally, issuance of CAT-linked securities by reinsurers remained strong, with re-insurer transactions outpacing insurer-sponsored transactions.[1]

When asked about future growth in the CAT-linked securities markets, some industry participants foresee demand for additional risk transfer capacity emerging from second-tier insurance companies, and from reinsurance companies that can synthetically "blend" their insurance clients' risk portfolios and transfer the blended risk to capital markets. Industry contacts also mentioned the possible role of state catastrophe pools that may securitise their extreme event risk rather than finance it with taxpayer money.

Demand for additional risk transfer capacity and securitisation may emerge from countries that have huge exposure to catastrophe risks, a constrained financial ability to absorb the financial impacts of financial disasters, and/or an inexistent or inefficient reinsurance market infrastructure. Recent illustrations are the newly launched MultiCat Program and the recently established Caribbean Catastrophe Risk Insurance Facility (CCRIF), both promoted by the World Bank. MultiCat is a CAT-bond issuance platform that allows governments and other public entities to access international capital markets, while the CCRIF functions as a mutual insurance company controlled by participating Caribbean governments (with some support from donor partners and guidance from the World Bank).[2]

### *b) Broader investor base and portfolio diversification benefits*

Diversification of market participants is a key driver of growth in securitised markets. In the last two years, the number of investors in the CAT-linked securities 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, (i.e., see figure 8.1a and 8.1b for a breakdown by investor group and country in transactions placed by Swiss Re).

Since CAT bond structures trade over the counter, the secondary market is less transparent than the primary market and liquidity estimates vary considerably. Industry estimates of market participation range from scores to hundreds of investors. Figure 8.1a shows that a large proportion of the capital raised by Swiss Re has come primarily from dedicated CAT funds, money managers, and hedge funds, i.e., those groups financed approximately 84 percent of the CAT-linked issues[3]. Figure 8.1b shows that investor base for CAT bonds placed by Swiss Re has been largely U.S. and European.

Figure 8.1a. I**nvestor base**[4]

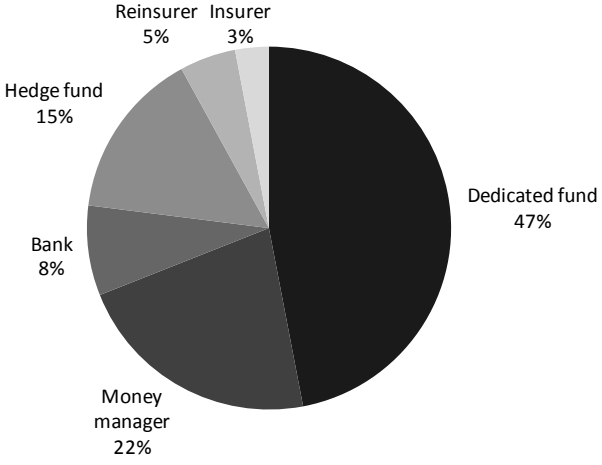
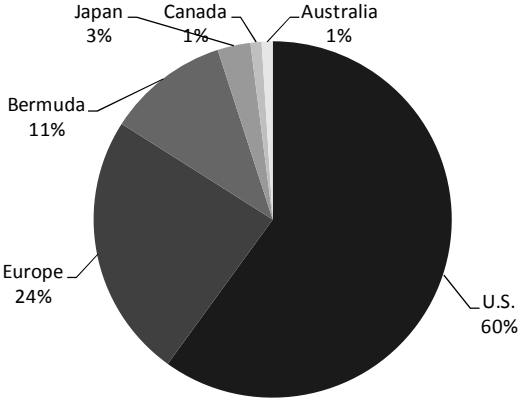


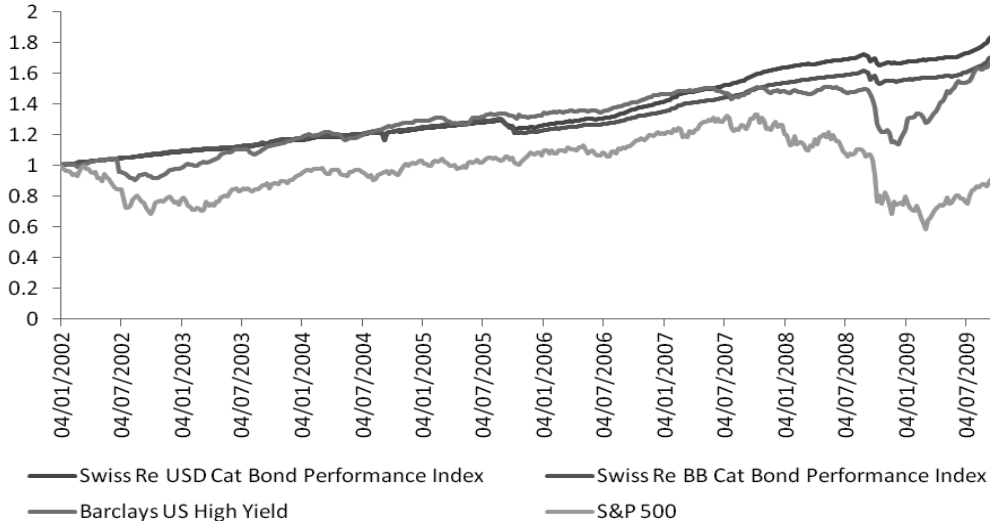

Figure 8.1b. **Investor base by country**




Source: Swiss Re Capital Markets, as of October 14, 2009

The risk-return profile of CAT instruments is a determinant of demand. All managers of institutional portfolios must decide whether to include an asset such as a CAT bond based on its expected return and its correlation. We can see in Figure 8.2 below that CAT bonds as a whole have historically provided rates of return greater than BB-rated corporate bonds, as measured by the Barclays U.S. High Yield Bond ETF, though the situation is more nuanced when making the comparison with the universe of BB-rated CAT bonds, where returns on (U.S.) high-yield bonds have for some periods exceeded the relevant BB CAT bond index; overall, however, CAT instruments have provided more stable returns and offered sufficiently attractive (and often excess) returns to attract capital market investors.

Figure 8.2. **CAT Bond Performance (Swiss Re CAT Bond Performance Index)**[5]




Source: Swiss Re Capital Markets, as of 9 October, 2009.

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, a large injection of capital in the form of newly formed reinsurance entities in Bermuda was observed. Similarly, the occurrence of Hurricane Katrina provided the catalyst for growth in the CAT-linked securities 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.

That said, it is observed, however, that the most recently issued CAT bonds have tranches with ratings primarily in the B to BBB range. Lower ratings-higher yields securities may attract investors like hedge funds or CAT funds from a risk-reward standpoint, but may deter investors looking for A to AAA-rated securities. Investors in highly rated securities constitute the vast majority of investors in other securitised markets, such as the MBS or ABS markets.

Moreover, it is worth noting while individual and less sophisticated investors can, in theory, assume CAT risk via participation in mutual funds, only a few mutual funds, to date, specialise in natural disaster risk. While it seems obvious that both better price transparency and greater transparency in the underlying risks are crucial to enhanced secondary market trading, the institutional community shows little interest in opening up the CAT-linked securities market to smaller or individual investors. In addition, the high costs of CAT risk assessment may be prohibitive to some investor types.

CAT-linked securities have historically provided a favourable risk and return profile to investors and, more importantly, have provided them with a means of reducing portfolio risk. More specifically, there is evidence that CAT bonds exhibit low correlations with other asset classes. For example, Froot (Froot, Murphy, et al 1995)[6] 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. The favourable risk-return profile of this class of securities demonstrates that the CAT-linked securities may be used to reduce the risk of a portfolio and increase its expected return. 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".[7] Hence, portfolio diversification provides a rationale for the growing investor base for this asset class.

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

### *c) Advances in technology and modelling of CAT risk*

As mentioned in chapter six, advances in technology and modelling also contribute to better public understanding and acceptance of securitised products. Today, thanks to advances in catastrophe modelling and risk assessment methodologies, both bond sponsors and institutional investors have a more sophisticated understanding of the financial impact of the risk embedded in various CAT-linked structures. In response to the financial impact of Katrina on the insurance and reinsurance industries in 2005, the leading CAT modelling firms, i.e., AIR, EQE and RMS, further refined their modelling techniques. This increased awareness of potential losses has helped increase the search for capacity in the insurance industry and has driven sponsorship of CAT-linked securities. In addition, catastrophe modelling firms have introduced two views of Atlantic hurricane risk (Standard and Warm SST-conditioned in the case of AIR, and Near- and Long-term in the case of RMS and EQUECAT).

The development of software technology aimed at facilitating the management of portfolio of catastrophe risks can also be observed. For instance, AIR has been using its software tool, CATRADER®, since 2001 to help investors structure and evaluate securitised CAT transactions and enable the testing of portfolio optimisation strategies. RMS has also released a licensed software product "Miu" that allows investors and issuers to quantify and tailor a portfolio of catastrophe risk positions packaged in any form: CAT bonds, OTC derivatives, sidecars, ILWs, and various forms of reinsurance. The equivalent EQECAT's product is called eCAT.

### *d) Broader sponsor base: corporate/sovereign issuers*

At the beginning, CAT risk securitisation transactions were sponsored only by insurance and reinsurance companies, but the investor base grew over time. Besides insurers and reinsurers, there have been few corporate issuers of CAT bonds to date: Tokyo Disney, Universal Studios and Électricité de France are among a handful of corporations that have sponsored CAT-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, applicable accounting rules may deter corporations from issuing CAT-linked securities.[8]

As noted in chapter six, some level of public sector participation may facilitate the growth of securitised markets. To date, government participation in the CAT-linked securities market has remained very limited.

In this respect, it is interesting to note that the World Bank recently launched the MultiCat Program, a CAT-bond issuance platform aimed at providing governments and other public entities with easier access to international capital markets to insure themselves against certain risk posed by natural hazards. The MultiCat Program is designed to allow participants to buy coverage for multiple perils, countries and regions. Perils that can be covered include: earthquakes, floods, hurricanes and other wind storms. In developing this project, the World Bank worked closely with the Government of Mexico that already had an experience as sovereign issuer in the catastrophe bond market with the 2006 US$160 million single-peril CAT-Mex transaction covering earthquake risk.

In October 2009 Mexico was the first sovereign sponsor to use the newly established MultiCat platform. A US$290 million multi-peril series of notes was issued to cover certain seismic and weather-related risks. The transaction,[9] whose lifespan is three years, was structured in four classes, covering six geographical zones of Mexico and three risks: earthquake and hurricanes from the Pacific and Atlantic Oceans, using the following parametric triggers:

- Class A (earthquake), divided in three subzones (A, B and C):
  - Zone A, trigger Mw>=7.9
  - Zone B, trigger Mw>= 8.0
  - Zone C, trigger Mw>= 7.4
- Class B (hurricane Pacific)
  - Zone 1, trigger central pressure <=944mb
- Class C (hurricane Pacific)
  - Zone 2, trigger central pressure <=944mb

- Class D (hurricane Atlantic)
  - Zone 1, trigger central pressure <=920mb

The transaction, whose collateral is invested in U.S. Treasury Money Market Funds (TMM), experienced robust demand across each of the four tranches and was upsized from the original offering size of US$250 million to the final offering of US$290 million.[10]

It is important to note that Mexico undertook a comprehensive catastrophe risks management strategy for private and public sectors before deciding to make use of CAT-linked securities.

The recently established CCRIF provides another example of possible ways in which governments may indirectly access CAT-linked securities capital markets. The CCRIF pools catastrophe reserves from participating governments, and transfers some of its natural disaster risks to reinsurance markets or capital markets via the use of CAT-linked instruments.

Those governments that have a constrained financial ability to absorb the economic impacts of natural hazards could tap CAT-linked securities markets either by directly issuing CAT-linked securities (as in the case of Mexico) or by creating multi-governmental facilities similar to CCRIF. The latter would allow these governments to share the costs of accessing reinsurance and capital markets and the costs of the CAT modelling technology, with a view to transferring extreme event risks from the pooling facilities to capital markets via the issuance of CAT-linked securities.

Since, as discussed, CAT risk securitisation transactions very often entail some degree of basis risk, it becomes crucial to determine the objectives pursued by the sovereign sponsor. The CAT bonds issued in May 2006 and October 2009 on behalf the Mexican government, for instance, are mainly aimed at providing the necessary liquidity for emergency response measures, not at covering the losses caused by a severe earthquake or hurricane. A similar objective is pursued by the CCRIF, which allows Caribbean governments to purchase parametric insurance coverage that will provide them with an immediate cash payment after the occurrence of a major hazard event, thus enabling them to overcome the liquidity crunch that may follow a disaster and start recovery operations without delays.

In OECD countries where private insurance and reinsurance markets are well developed and their activity is organised and coordinated in the context of an integrated disaster risk management strategy,[11] governments could consider developing pools of reserves from private insurers to cover extreme (uninsurable) event catastrophes risks, and finance a portion of these pools via the issuance of CAT-linked securities, rather than via the use of taxpayer money. However, any such government intervention should be based on a cost-benefit analysis given the potential to crowd out private sector solutions.

Moreover, in countries that have high exposure to catastrophe risks, a constrained financial ability to absorb the financial impacts of financial disasters, and/or an inexistent or inefficient reinsurance market infrastructure, governments should investigate the extent to which CAT-linked securities would provide one of the means of hedging the risk of uninsured economic losses.

At a more general level, it should be noted that an increasing number of sponsors are now fully integrating CAT-linked securities into their overall risk management strategy rather than seeking capital market protection as a defensive or last resort tool. As recently

pointed out by market observers, the record market activity of 2007 demonstrated a fundamental shift in the perception of the capital markets as a risk transfer solution. Industry sources corroborated this view and observed an increased desire by sponsors to evaluate all risk transfers mechanisms equivalently. In 2007, several sponsors, who had until then avoided what they perceived to be costly CAT bond structures, issued CAT bonds, despite the fact that the reinsurance market was in a soft cycle. In the current crisis environment, the situation is less clear.

## 8.2. Impediments to the development of CAT-linked securities

Each existing CAT-linked structure has its own weakness. Overall, there are common factors that may have limited the growth and liquidity of CAT-linked securities and derivatives markets.

### *a) Market fragmentation / lack of standardised transactions*

A certain degree of standardisation in market capital structures is critical for the development of CAT-linked securities. In chapter six, it was noted that standardisation enhances market liquidity and helps investors manage their portfolios more efficiently. Yet, it was observed previously that there is a variety of CAT bond structures, with indemnity structures being predominant. There is thus some fragmentation in the CAT-linked capital markets. In addition, and to a certain extent, CAT-linked capital structures seem to have become more complex with an evolution from fairly simple CAT bond structures, to CRO (reminiscent of CDO in credit markets), to sidecars.[12] However, secondary market liquidity generally increases as more standardised structures (i.e., structures with a payoff triggered by an index of pooled risks) appear in the capital markets.

It seems that, after a couple of years spent on introducing more complex instruments, CAT-linked securities market participants have come to the realisation that simpler CAT bond structures may remain the dominant form of CAT-linked securities. Despite the diversity of triggers, CAT bonds are more ”standardised” than other capital structures as evidenced by the increased number of shelf registrations.

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 or Katrina. In addition, the methodology for collecting and aggregating insured losses may be deemed by some to be inadequate. For instance, some CAT-linked securities market participants feel that the existing industry loss triggers (i.e., PCS) are inadequate in their estimation of U.S. natural catastrophe insured losses, despite their widespread use in CAT-linked securities. If this is the case, then a proper assessment of these triggers should be carried out and, if there is scope for material improvement, consideration should be given to the development of a new methodology for gathering industry loss and industry market exposure information for catastrophe losses.

In Europe, PERILS AG *(Pan-European Risk Insurance Linked Services)* was founded in January 2009 and incorporated as a joint stock company in Zurich, Switzerland.[13] The company, whose aim is to aggregate and provide industry-wide European catastrophe insurance data as a subscription service, is backed by a group of major insurance,

reinsurance and intermediary companies,[14] each with equal shareholding. The methodology envisioned by the group in collecting industry loss data is similar to that used by PCS. PCS estimates industry losses by surveying U.S. insurers who had exposure in the disaster zone once the catastrophe occurred. It collects information on the number and average size of direct claims that an insurer expects to pay and aggregates this information across insurers. The European group would attempt to collate the same information, but based on industry loss and insured exposure numbers from disaggregated data collected by CRESTA zone, i.e., more at a U.S. county level.[15]

### *b) Lack of standardised data-gathering*

One of the constraints on the development and expansion of the CAT-linked securities market has been the need to have a high quality CAT loss model for that region and peril. As the availability of such models has expanded since the late 1990s, so the range of countries and perils served by CAT-linked securities issuance has itself expanded. For example, the first European windstorm securitisation in 1998 was based on the availability of trusted second-generation CAT loss models for the peril. The decision for the risk modelling companies to build a CAT model for a new country and peril is based first on the commercial assessment that the insurance and reinsurance interest in that territory is of sufficient size to merit the investment. The quality of the model will then chiefly be determined by the depth and detail of the historical record and the availability of high quality information on recent loss data for calibrating vulnerabilities relevant to the local building stock. Inevitably, therefore, there are many developing countries and perils for which there is no CAT model, or a model considered too rudimentary to support issuing a CAT-linked security. In a developing country, without relevant institutions of meteorology and geology, there will also typically be far less actual monitored observational and historical data on which to base the model. CAT models only perform well if insurers are themselves able to collect high-quality data on the insured when they underwrite the risk, and in many territories the insurers themselves do not have the tools to collect such data.

As a result, issuance of CAT-linked securities may remain limited for some peril types and geographic areas because the available CAT models do not exist, or are not considered sufficiently robust. These problems will be particularly exacerbated for indemnity CAT-linked securities structures, as there will also likely be distrust of exactly what data has been available to be fed into the model for the analysis as well as exactly how claims management will be maintained in the aftermath of a major catastrophe. The development of global, open source disaster risk assessment models promoted by the OECD through the Global Earthquake Model (GEM) initiative constitutes an important first step in this direction; other natural perils should be considered as well.[16]

For this reason, parametric CAT-linked securities structures tend to be favoured for developing countries by rating agencies and investors. Parametric triggers have always tended to be more attractive to sophisticated investors, who understand that the modelling for these triggers will involve significantly less uncertainty than for indemnity deals. It is easier for an investor to understand the basis of the modelling than industry loss triggers, in that they do not assess the insured exposure and vulnerability of the building stock, or undertake a comprehensive assessment of all the sources of loss, which are required to capture the financial impact of a natural disaster.

In addition, capital market structures triggered by parametric measures can be settled within weeks of a potential loss, unlike indemnity or industry loss deals that may take up

to 18 months before the final loss is known. Even for the issuer, the advantage of the speed of settlement may be a significant factor in choosing a parametric structure. Also, by using second-generation parametric structures involving recorded measurements, it is possible to apply weightings to each instrumental value when constructing an overall index for the event to match the geography of the underlying portfolio of properties (and any localisation of vulnerability), so that it becomes possible to create an index that more closely matches the losses being modelled. This reduction of basis risk also makes such structures more attractive to the issuer. Second-generation triggers have been employed for issuing securitisations: in the U.S. for California earthquake, in Japan for earthquake and typhoon wind, in the U.K. for windstorm and flood (using flood heights preserved on buildings within the construction of the index), and in Western Europe for windstorm.

Given the relative advantages of second-generation parametric structures, the main deterrent to their wider use, especially in developing countries, concerns the availability of a suitable dense network of hazard (wind speed, river height and earthquake strong motion) recording stations and, most importantly, recording procedures. There may, for example, be no guarantee that wind speed recorders will continue to record through intense tropical cyclones, because the equipment will have been dismounted and stored to protect it from damage. Also, it is common that the duration of battery power to cope with an inevitable loss of offsite power is insufficient to record through the passage of the storm. River flow gauges are often destroyed in extreme floods, and earthquake strong motion instruments also rely on batteries that require renewal every few months. Therefore, the expansion of second-generation triggers to new territories requires that government agencies of meteorology, hydrology and seismology (or even private companies in these areas) have appropriate standards regarding the installation and management of their networks of instrumental recorders.

There are three required components in this respect. First the choice of instrumentation and instrument siting must be sufficiently resilient to withstand the strongest potential hazard. Wind speed recorders designed to monitor wind speeds at airports, for example, are generally insufficiently robust to withstand a hurricane. Second, instruments should be spaced every 10-20 kilometres to ensure that the overall hazard field of an earthquake or windstorm is fully captured and that there is redundancy of observation (where a station fails to record). Third, there needs to be a maintenance guarantee for the equipment, batteries must be checked and replaced regularly, and the recording procedures tested to ensure they operate under all conceivable adverse conditions.

A government that chooses to support this level of instrumentation, recording, and reporting will provide the foundation for the use of second-generation parametric triggers in risk transfer. In particular, in the developing world, where information on property values, building types, and locations may be much harder to obtain, such risk transfer structures may provide the only effective way of designing a satisfactory risk transfer mechanism that does not suffer from a potentially large basis risk – as can be the case with first-generation parametric structures based only on earthquake magnitude or tropical cyclone intensity and track.

As mentioned above, a new standardisation effort was recently made by a consortium of European insurance and reinsurance market participants that established PERILS, whose aim is to calculate, monitor, and distribute to subscribers industry indices that would track aggregate losses incurred from European wind risk and industry market exposures based on CRESTA[17] zones. PERILS has been established to aggregate and

provide industry-wide European catastrophe insurance data as a subscription service. The aggregated data sets will be derived from data voluntarily provided by European-based insurers. From January 2010, PERILS will provide two main products to subscribers which are likely to include insurers, reinsurers, brokers, risk modellers, banks and other insurance industry stakeholders. These two products are: *(i)* aggregated industry-wide insurance exposure data (insured values), which will be catalogued by risk type and CRESTA zones (defined European geographical zones for natural catastrophe insurance). The data will be provided on an annual basis; (*ii*) industry loss estimates per risk type and CRESTA zones, following large natural catastrophe events. Overall, the combination of consistent industry exposure portfolio data and corresponding event loss information is likely to enhance the modelling of natural catastrophe risk. Greater transparency on industry losses will also further facilitate the establishment of accurate and robust loss triggers for catastrophe bond structures, ILWs and other capital markets products.

### *c) Lack of transparency in the underlying risk and valuation complexity*

To date, the CAT-linked securities market has remained opaque to the general public. CAT-risk transferred to investors via CAT-linked securities is assessed by complex risk models developed by specialised firms: valuation of CAT-risks, therefore, requires specialised knowledge and an understanding of such models. Transparency and reliability of risk modelling are a crucial factor in the development of this market. As mentioned above, advances in catastrophe modelling and risk assessment methodologies allow bond sponsors and institutional investors to progressively develop a more sophisticated understanding of the financial impact of the risk embedded in various CAT-linked structures.

Furthermore, there is no public dissemination of bond offerings or prices as transactions occur OTC. As noted above, the CAT-linked securities market is likely to remain opaque if only open to institutional investors. This said, the institutions currently involved in the CAT-linked securities market might 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 OTC market. They can argue that information on bond offering and bond prices is available, but that it is not publicly disseminated.

Exchange-traded CAT-linked derivatives markets have also remained opaque, with the exception of the CCFE. The CME and NYMEX do not post price and volume information on their websites. Real-time price quote providers also do not carry this information. By contrast, the CCFE provides price and volume information on its website. Opening access of the CAT-linked securities market to a broader base of investors would require public dissemination of offerings, prices, and other information related to the risk associated to investing in CAT-linked securities.

## 8.3. Issues in the development of CAT-linked securities

### *a) Cost comparison*

The jury is still out on how costly CAT-linked securities are, from an issuance standpoint, compared to traditional reinsurance or ILW. In its report on managing large-scale risks, the Wharton Risk Management and Decision Processes Center[18] notes that

"from a single rate-on-line prospective, it is true that insurance-linked securities bear a higher cost than that of reinsurance or retrocession. However, there are exceptions for specific risks like higher tranches of retrocession and peak exposures in high-risk prone areas".

Typically, the one-time costs associated with issuing CAT bonds are higher than those that apply to regular debt securities. Most CAT-linked securitisation transactions have been structured via the use of SPVs that are generally based offshore. Although SPVs tend to simply operate trust accounts, there are significant transactions costs associated with the issuance of CAT bonds, such as higher fees charged by rating agencies which devote more time and manpower in analysing CAT bond structures than regular debt structures, and fees charged by CAT modelling firms. Yet overall, the legal fees associated with issuing CAT bonds have declined with the increasing proportion of shelf registrations of CAT-linked securities (Lane and Beckwith 2007).

Indemnity-triggered bond transactions are generally - but not always - costlier than non-indemnity-triggered bond transactions. As noted by Guy Carpenter,[19] 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 are additional costs embedded in indemnity-based structures resulting from disclosure requirements, the level of detail required on the underlying insured exposure in terms of nature and locations of the properties and their insurance coverage required to model the risk, and perceived legal exposure.

In any case, it is very difficult to accurately compare the cost of traditional reinsurance and the cost of CAT-linked securities[20], since:

- CAT bonds are often multi-year programs that address price volatility issues;[21]
- CAT bonds, especially the most recent structures, entail lower counterparty risk than traditional reinsurance;[22]
- Non-indemnity CAT bonds may allow for a much faster settlement of the payments due in the event of loss, with advantages to both sponsors and investors and a saving of time and cost;
- Non-indemnity CAT bonds entails some degree of basis risk, which can be reflected in the pricing of these instruments;
- CAT bonds rarely include reinstatement provisions, a typical feature of traditional reinsurance.

### *b) Trade-off between moral hazard and basis risk*

Securitisation of risk becomes more successful when the capital structure provides an equal playing field between risk transferors and risk takers. In the CAT-linked market, there could be a lack of "dual" coincidence of wants between the insurer and the investor. As explained previously, CAT-linked securities may have a payout tied to indemnity or non-indemnity triggers (i.e., parametric triggers or industry loss triggers).

Indemnity-triggered instruments appeal to sponsors because they reduce or eliminate basis risk. On the other hand, non-indemnity based capital structures may be more attractive to an investor than indemnity instruments, as the use of an industry loss index

trigger or a parametric trigger minimises moral hazard costs. Index structures also are likely to lower investors' costs in evaluating company-specific underwriting and financial results. Company-specific capital structures, moreover, might be conducive to adverse selection and moral hazard. Adverse selection in the context of insurance securitisation reflects the fact that an insurer could securitise 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 market might no longer have an incentive to limit its losses.

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 standardised financial asset or commodity, or on an index of these. The issue per se is not the existence of basis risk, however, but its assessment and quantification. Once thoroughly quantified, if possible, basis risk in a financial transaction can be minimised and almost eliminated. For instance, it is common to use derivative instruments to eliminate basis risk in security or commodity portfolios via "over-hedging" or "under-hedging".[23]

The novelty here is that, with respect to CAT-linked securities, it is much more difficult to assess the anticipated impact of a catastrophic event on an insurer's portfolio than to assess the market risk or interest rate risk of a specific security and to compare it to that of a standardised hedge instruments like a futures contract. [24]

In a 1999 report commissioned by the National Association of Insurance Commissioners (NAIC), the American Academy of Actuaries argues that it is possible to statistically identify and measure the basis risk embedded in hedging transactions performed with index-based securities.[25]

In addition, empirical evidence has supported the hedging effectiveness of non-indemnity instruments, despite the existence of basis risk.[26,27] However, these studies must be assessed with caution. Findings can vary based on the statistical method used, e.g., simulation models versus analysis of historical data, and on the source of basis risk embedded in a specific derivative transaction. Recent research has also focused on the benefits of index-triggered bonds in comparison with indemnity-triggered bonds. In a highly stylised model, MacMinn and Richter (2004) show that, under some circumstances, reinsurers who issue bonds to hedge against brevity risk (i.e., the risk of premature death) achieve greater shareholder value by utilising index-triggered securities instead of indemnity-based securities.

As noted above, recent history in the CAT-linked securitisation market shows increased confidence by issuers of CAT bonds in index-based triggers; see Figure 7.3 for historical issuance of bonds by trigger type. Sponsors, with the help sometimes of reinsurance brokers, have spent a lot of time and resources understanding their exposures to basis risk. Meanwhile, investors have become increasingly comfortable with indemnity-based capital structures. Some of them now tend to recognise indemnity risk as another risk component in a transaction, provided that they have a sufficient grasp of catastrophe modelling techniques and a good level of comfort with bond sponsors.

While moral hazard exists in indemnity-based capital instruments, CAT bonds can be structured to minimise its impact. For instance, a structure involving co-insurance may help to mitigate moral hazard. This explains why, in dollar issuance terms, the CAT bond market is now almost evenly split between indemnity versus non-indemnity triggered securities in terms of issuance.

Finally, a reinsurer can, by acting as an intermediary between a sponsor and investors in a CAT-linked securities transaction, bridge the gap between the different trigger preferences of these counterparties. On the basis of its risk warehousing and risk assessment capacity, a reinsurer can transform an indemnity-based upstream risk transfer contract into non-indemnity based downstream CAT-linked security and manage the associated basis risk. Basis risk sensitive sponsors are thereby provided with access to the CAT-linked securities market, which fosters market growth and – due to the non-indemnity downstream trigger – standardisation.

### *c) Regulatory and solvency issues*

The future development of CAT-linked securities markets also depends on how lawmakers will address a number of key accounting, solvency and regulatory issues going forward. In this respect, key questions include:

To what extent should regulated insurance and reinsurance companies be allowed to obtain capital relief for transfers of CAT-risks by way of securitisation on terms that are consistent with other methods of transferring risks, such as traditional reinsurance or retrocession?

To what extent should a SPV providing protection to the sponsor of a CAT bond transaction be regulated?

Regarding the first question, comparable levels of capital relief should, in principle, be allowed for comparable levels of risk transfer, irrespective of the legal form of the transaction and the amount of capital relief should reflect the amount of risk transferred.[28] In practice, market fragmentation, lack of standardised transactions, complexity in the valuation of the securitised CAT-risk, and the incidence of basis risk may induce insurance regulators to take a very prudent approach.

With respect to the second question, in theory, if the SPV writes the equivalent of a reinsurance contract to the sponsor, it should be treated as a reinsurance undertaking from a regulatory (e.g., authorisation process, licensing requirements, requisites to carry out the activity) and solvency (e.g., capital requirements, rules on investment of assets covering technical provisions) perspective. However, it should be noted that an SPV will usually enter into a single transaction – or a series of transactions within a shelf offering program – and will not conduct a diversified operating business. Moreover, CAT bond transactions, especially the most recent structures, are highly collateralised, so that counterparty default risk is kept at a minimum.

While a clear and reliable regulatory framework aimed at ensuring that ISPVs are able to fulfil their obligations towards the investors and the sponsor is certainly desirable, since it would guarantee the effectiveness of risk transfer for the purposes discussed above, the structural and functional differences between an ISPV participating in a CAT-linked securities transaction and a traditional reinsurance undertaking should be clearly recognised and reflected in the applicable regulatory and solvency regime.

In this regard, it is interesting to note recent developments that occurred at the European level. In the European Union ("EU"), the Reinsurance Directive (Directive 2005/68/EC) ("RID") authorised Member States to implement, if they wish, insurance SPVs (or "ISPVs") into local laws and it enabled domestic regulators to establish a "light touch" authorisation and regulatory regime for ISPVs, defined as: "*…an undertaking...which assumes risks from insurance…or reinsurance undertakings and*

*which fully funds its exposures to such risks through the proceeds of a debt issuance or some other financing mechanism whereby the rights of the providers of such debt...are subordinated to the undertaking's reinsurance obligations ...*".

According to the RID, ISPVs are not reinsurance undertakings, but they do conduct reinsurance-like activities. The RID expressly requires that an ISPV 'fully funds' its insurance risk exposure through the proceeds of financing mechanisms 'subordinated' to its reinsurance obligations. While apparently simple, the concept that an ISPV must be "fully funded" is not straightforward and it may give rise to different interpretations, with significant practical impact.[29]

It is important to note that ISPVs established in one EU Member State – and regulated by the authority of such State, according to the home country control principle – can assume risks from insurance undertakings established in other Member States and regulated by the authority of such other State. Therefore, Members States that choose not to allow ISPVs to be established within their territories still have to introduce detailed rules setting the conditions for the use of amounts outstanding from an ISPV as assets covering technical provisions (i.e., they must specify to what extent and under what conditions insurance undertakings established in such State are allowed to obtain capital relief for transfers of risks by way of securitisation to ISPVs established in another State). Such rules may be qualitative or quantitative and they may vary across EU jurisdictions, so that harmonisation is not assured in this respect.[30]

According to many commentators, one of the main legal impediments to structured finance solutions in the European insurance sector has been the lack of simple transformer structures that ally tax efficiency and flexible regulatory and prudential requirements, whilst allowing for the issue of debt securities and providing reinsurance coverage. Regulators in the EU have either imposed restrictions on these structures or have not recognised that certain transformer structures ought to be regulated in a different way from traditional reinsurance companies. The implementation of the RID should help removing some of the regulatory hurdles that have prevented the insurance industry from fully taking advantage of capital markets. For this reason, it is useful to provide a brief overview of the RID implementation measures adopted in the U.K. and in France.

In the U.K., as part of the implementation of the RID, the FSA has taken the opportunity to facilitate the creation of a market in the U.K. for insurance special purpose vehicles. Before the RID, an ISPV in the U.K. – as elsewhere in Europe – would have to be authorised, supervised, and indeed taxed, as a full reinsurance company, and would need to maintain a regulatory capital surplus in the same way. The new regime introduced in the U.K. recognises the relatively lower levels of risk associated with the structure of SPV transactions. The authorisation requirements are minimal, with little documentation required that would not already be produced as part of setting up the SPV. Supervision takes place through the oversight of the ceding company, rather than separate supervision of the ISPV. Concerning the solvency requirement for an ISPV, the FSA took the view that the term 'fully funded' simply means that the ISPV's reinsurance liabilities must be capped at the value of the assets available to fund those liabilities.

In France, the implementation of the RID allowed SPVs, established under the form of the '*organisme de titrisation'*, to acquire or transfer insurance or reinsurance risks under certain conditions.[31] The *Autorité de contrôle de l'assurance et des mutuelles* (ACAM) must authorise the establishment of the ISPV, bearing in mind that the rules applicable to such vehicles are designed to result in a much lighter and quicker procedure than that applicable to insurance companies. Under French law, the ISPV is neither an

insurance nor a reinsurance undertaking. Furthermore, the law expressly states that the agreements entered into by an ISPV do not qualify as insurance contracts, with all of the related regulatory and tax consequences. ISPVs are not subject to minimum solvency margin or capital requirements, other than that their assets must be equal or greater to their liabilities, meaning that: *(i)* once the initial funds necessary to cover the ISPVs reinsurance liabilities have been raised in the capital markets, the corresponding proceeds and other assets must remain sufficient throughout the life of the ISPVs to cover the reinsurance risks they bear and *(ii)* the repayment of the capital markets investors is subordinated to the payments due by the ISPVs to the ceding company (or other insurer creditors) in the event of the materialisation of the underlying insured risks. Moreover, under certain conditions: *(i)* amounts recoverable from the ISPV by the ceding insurer (or other insurance creditor) may be considered as reinsurance or retrocession in calculating the ceding insurer's solvency margin requirements and *(ii)* amounts outstanding from the ISPV may be treated as reducing, or included as assets covering, technical provisions.

Finally, it should be noted that the future implementation of the Solvency II regime, currently in preparation, is expected to further broaden the scope of admissible risk transfer mechanisms accepted by European regulators,[32] especially for those insurance undertakings that will take advantage of the option to use internal models to assess their solvency capital requirements.[33]

### *d) Market transparency and liquidity issues*

Industry sources indicated that secondary market activity in CAT bonds has improved in the recent years; however, it is difficult to establish a reliable bond turnover to issuance ratio. Trading in CAT-linked exchange–traded derivatives has been very low.[34] Low liquidity in CAT-linked securities may be explained by the absence of a true (electronic) trading platform open to any investor type. The CAT bond market is essentially an OTC market with dealers firms and other investors communicating by phone or via e-mails. Data providers like Bloomberg or Reuters do not disseminate any price or yield information on CAT bonds. As a result, the CAT-linked securitisation market has suffered from a lack of price transparency.

Transparency in the underlying market is also crucial to secondary market trading. 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 catastrophe perils, other investors, including individual investors, value depth and frequency of market information. The lack of standardisation in insurance companies' catastrophe risk exposure records throughout the U.S. industry and the absence of public disclosure of such information may be impairing secondary market trading in CAT-linked securities.

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

The assessment of risk in CAT-linked securities 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 the context of CAT risks? Although CAT risks may be uncorrelated with other risks in an investor's portfolio, the nature of these risks makes measurement of the expected rate of return obscure simply because they are difficult to predict. Hence, it becomes difficult for an investor to distinguish an investment from a speculative plunge. The problem can become even more difficult when considering more than one CAT instrument because the nature of the instrument makes risk sensitive to spatial location as well as other characteristics that are not common in diversification decisions. These observations suggest that having an appropriate level of financial education and understanding of CAT risks is a pre-requisite for retail investor access to the CAT-linked securities market.

The current lack of trading activity in exchange-traded derivatives may be better explained by a more fundamental reason: in general, securitisation of markets starts with the development of standardised cash instruments (like CAT bonds). After liquidity occurs, derivatives are designed as tools to hedge exposure to the cash instruments. As noted above, to date there are few signs of standardisation in the CAT-linked security market. Each transaction is unique and cannot be standardised without significant basis risk. Consequently, there is no perfect easy hedging between the cash and derivative markets. This makes trading in the derivatives markets less attractive to potential holders of catastrophe bonds.[35]

## *Notes*

1. GC Securities (2008), op. cit,, p. 26. According to Guy Carpenter, reinsurer-sponsored CAT bond transactions have typically outpaced insurer-sponsored transactions.
2. More details are provided, in Chapter 8.1. d).
3. In the aftermath of the collapse of Lehman in 2008, dedicated insurance-linked securities funds increased their market share, while generalist (multi-strategy) hedge funds reduced their participation, mostly through large redemptions.
4. Figures 4.1a and 4.1b are based on Swiss Re CAT bond placements.
5. The Swiss Re CAT bond performance index tracks the aggregate performance of USD denominated catastrophe bonds, The index captures all rated and unrated CAT bonds, outstanding perils, and triggers, and seeks to capture the universe of CAT bonds. The Swiss Re BB CAT bond performance index tracks the aggregate performance of USD denominated, BB-rated catastrophe bonds rated by Moody's and S&P.
6. See also Litzenberger, R. H., D. R. Beaglehole, et al. (1996).
7. See also Samuelson, P. A. (1967) and MacMinn, R. D. (1984).
8. "Pure" non-indemnity triggers in general do not achieve the desired effects in the corporate accounts (EBITA protection, elimination of earnings volatility due to mark-to-market measurement). However, some sort of dual trigger (non-indemnity trigger

enriched by indemnity element) could offer a viable solution in overcoming these potential regulatory obstacles.

9. The World Bank Treasury acted as arranger for the transaction, and appointed Swiss Re Capital Markets Corporation and Goldman Sachs as co-lead managers and joint bookrunners and Munich Re as advisor.

10. The term sheet is the following: Class A, size: 140 million US$, expected loss: 4.65%, rating (S&P): B, coupon: TMM*+1150 bps / Class B, size: 50 million US$, expected loss: 4.07%, rating (S&P): B, coupon: TMM*+1025 bps / Class C, size: 50 million US$, expected loss: 4.22%, rating (S&P): B, coupon: TMM*+1025 bps / Class D, size: 50 million US$, expected loss: 2.39%, rating (S&P): BB-, coupon: TMM*+1025 bps.

11. See Monti A. (2008), "Policy Approaches to the Financial Management of Large-Scale Disasters", in 'Financial Management of Large-Scale Catastrophes', op. cit.

12. It seems, however, that sidecars 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. Side cars are meant to provide temporary sources of risk capital that enable investors to profit from hard markets and then exit.

13. See http://www.perils.org.

14. AXA, Allianz, Groupama, Guy Carpenter, Munich Re, Partner Re, Swiss Re, Zurich.

15. Initially, PERILS will focus on European wind events for which total insured losses exceeded the threshold of EUR 200 million. Expansion into other geographies and insurance-relevant perils such as earthquake and flood are planned for the future.

16. GEM is a public/private partnership initiated and approved by the Global Science Forum of the OECD. GEM aims to be the uniform, independent standard to calculate and communicate earthquake risk worldwide; see http://www.globalquakemodel.org

17. Catastrophe Risk Evaluation and Standardizing Target Accumulations (CRESTA); see http://www.cresta.org

18. Doherty, N. A., G. M. F., et al. (2008), Managing Large-Scale Risks in a New Era of Catastrophes: Insuring, Mitigating and Financing Recovery from Natural Disasters in the United States, Wharton Risk Management and Decision Processes Center.

19. See GC Securities (2008), op. cit., p. 16.

20. See World Economic Forum (2008), op. cit., p. 23.

21. The volatility of reinsurance and retrocession prices impacts the market for CAT-linked securities. At larger volatility levels, the multiyear CAT bond gains a strategic advantage by providing coverage at a known price. Price stability in risk coverage enhances the insurer or reinsurer's ability to invest in new business or expand current business. This then allows the creation of value at an advantageous time that might not otherwise be possible. Equivalently, the CAT bond solves a corporate underinvestment problem: see Froot, K. A., D. S. Scharfstein, et al. (1993), Garven, J. R. and R. D. MacMinn (1993), and MacMinn, R. D. (2005). See also Helfenstein and Holzheu (2006) who 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.

22. Often catastrophe reinsurance claims for peak perils coincide with times of industry distress, while CAT bond proceeds are invested in highly rated securities, thus reducing counterparty risk.

23. 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 the CBOT PCS Catastrophe Options User's Guide (1995, p. 35-36).

24. In this respect, it is interesting to note that sometimes reinsurers act as intermediaries between the sponsor and the investors in a CAT-linked securities transaction, bridging the gap between their different trigger preferences. On the basis of its risk warehousing and risk assessment capacity, a reinsurer has the ability to transform an indemnity-based upstream risk transfer contract into non-indemnity based downstream Cat-linked securities and to manage the associated basis risk. Basis risk sensitive sponsors are thereby provided with an access to the CAT-linked securities market.

25. American Academy of Actuaries Index Securitization Task Force (1999), "Evaluating the Effectiveness of Index-Based Insurance Derivatives in Hedging Property/Casualty Insurance Transactions", American Academy of Actuaries.

26. See, for instance, Major, J. A. (1999). Also see Harrington, S. and G. Niehaus (1999).

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

28. CAT-linked securities, insurance and reinsurance, and other ART instruments should receive a regulatory, accounting, and fiscal treatment based on their relative merits and risks. For instance, Bouriaux (2001) compares risk transfer alternatives offered by the capital and insurance markets based on the risks associated to each alternative: basis risk, credit risk, and collateralisation. She notes some inconsistencies in their accounting treatment. Generally, critics of a favourable accounting treatment for non-indemnity insurance-linked securities 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 (i.e., exchange-traded derivatives). Bouriaux points out that (a) basis risk can be identified and quantified and (b) that, in some instances, reinsurance transactions can be less than fully collateralised and funded and yet, in the U.S., the NAIC grants them a favourable accounting treatment.

29. For example, in the U.K. the term 'fully funded' simply means that the ISPV's reinsurance liabilities must be capped at the value of the assets available to fund those liabilities. Moreover, there must be full subordination of the finance providers to the claims of the ceding insurer or other insurance creditor towards the ISPV. In Germany, the present value of the ISPV's assets must, at any time, be higher than the maximum potential claims of the ISPV arising under the underlying insurance risks. In order to meet such test, the ISPV may enter into hedging agreements. In France, ISPVs must be fully funded, i.e. at any time their maximum liabilities resulting from the underlying insurance risks, net of hedging agreements, must not exceed their assets. Moreover, ISPV investments are subject to quality tests, i.e., very high quality/liquid investments. Further, agreements entered into by ISPVs in order to

transfer insurance risks cannot impose unlimited commitments on the ISPVs. See Touraine H., European Insurance Securitisation Vehicle; Where do we Stand, What are the Issues?, Freshfields Bruckhaus Deringer LLP, November 2008.

30. The text of the Solvency II proposal adopted on 22 April 2009 expressly recognizes that: "(63b) Appropriate rules should be provided for special purpose vehicles which assume risks from insurance and reinsurance undertakings without being an insurance or reinsurance undertaking."

31. The new 'organisme de titrisation' – which is a revised, amended and enhanced evolution of the prior 'fonds commun de créances' (French securitisation vehicle) – can be created either as a co-ownership ('fonds commun de titrisation') or as a limited liability company ('société de titrisation').

32. "Under the new Solvency II framework, European insurance and reinsurance undertakings can use securitisation in the same way as they use reinsurance to meet their capital requirements which should have a positive effect on supply and facilitate the development of the insurance securitisation market. These techniques can be used to obtain commensurate solvency capital relief, provided that insurance undertakings can demonstrate that they understand the nature and limitations of such techniques, and provided that there is a real transfer of risk." See CEIOPS (2009), Insurance Linked Securities Report CEIOPS -DOC-17/09.

33. Solvency II will introduce economic risk-based solvency requirements across all EU Member States for the first time. These new solvency requirements will be more risk-sensitive, comprehensive (e.g., not focussed on the liability side of the balance sheet (insurance risks) but also the asset side, and consideration of other types of risks such as market, credit, and operational risks), and sophisticated than in the past, thus enabling a better coverage of the real risks run by any particular insurer. Solvency II requires states to permit the establishment of insurance special purpose vehices (Article 209) subject to prior supervisory approval, with the Commission expected to adopt implementing measures to ensure a harmonised EU approach. For further information, see: http://ec.europa.eu/internal_market/insurance/solvency/index_en.htm.

34. It is important to learn lessons from the CBOT's experience in the mid-nineties. While the CBOT offered a trading venue for its CAT-linked futures and options, the rigid membership structure of the exchange created a barrier to entry for the risk cedent (the insurer), leaving the product to be traded among members who may not have had a great expertise or interest in pricing insurance contracts. In addition, the CBOT open outcry trading venue was clearly inappropriate for such products. Some of these problems are alleviated now that derivatives exchanges have demutualised and now offer electronic trading platforms open to all investor types. Yet, the NYMEX and CME derivatives instruments show minimal trading volume. The IFEX futures contracts also show low liquidity, but the presence of two market makers (Deutsche Bank and Swiss Re) may help.

35. That said, it should be noted that the currently listed 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 options 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 rather than on trading volume. Open interest refers to the number of exchange-traded derivatives contracts that are still "open", i.e. number of positions that have not yet been liquidated.