

# Alternative solutions for public and private catastrophe funding in Austria

M. Gruber

alpS GmbH – Center for Natural Hazard Management, Grabenweg 3, 6020 Innsbruck, Austria

also at: Department of Banking and Finance, University of Innsbruck, Universitaetsstr. 15, 6020 Innsbruck, Austria

Received: 1 October 2007 – Revised: 16 April 2008 – Accepted: 5 June 2008 – Published: 1 July 2008

**Abstract.** The impacts of natural hazards as well as their frequency of occurrence during the last decades have increased decisively. Therefore, the public as well as the private sector are expected to react to this development by providing sufficient funds, in particular for the improvement of protection measures and an enhanced funding of damage compensation for affected private individuals, corporate and public entities.

From the public stance, the establishment of an appropriate regulatory environment seems to be indispensable. Structural and legal changes should, on the one hand, renew and improve the current distribution system of public catastrophe funds as well as the profitable investment of these financial resources, and on the other hand, facilitate the application of alternative mechanisms provided by the capital and insurance markets.

In particular, capital markets have developed alternative risk transfer and financing mechanisms, such as captive insurance companies, risk pooling, contingent capital solutions, multi-trigger products and insurance securitisation for hard insurance market phases. These instruments have already been applied to catastrophic (re-)insurance in other countries (mainly the US and off-shore domiciles), and may contribute positively to the insurability of extreme weather events in Austria by enhancing financial capacities. Not only private individuals and corporate entities may use alternative mechanisms in order to retain, thus, to finance certain risks, but also public institutions.

This contribution aims at analysing potential solutions for an improved risk management of natural hazards in the private and the public sector by considering alternative mechanisms of the capital and insurance markets. Also the establishment of public-private-partnerships, which may contribute to a more efficient cat funding system in Austria, is considered.

## 1 Introduction – The current cat funding system in Austria

As in most European countries, the catastrophe funding system in Austria bases upon two main pillars: the public catastrophe fund and the private insurance industry. These two institutions do not collaborate very closely. Damage compensation payments are coordinated only in a few specific cases, as e.g. in the case of hail insurance for the agricultural sector.

In 1966, the first Austrian Catastrophe Fund Act<sup>1</sup> was passed, which provided financial means for preventive measures conducted by the WLW<sup>2</sup> in collaboration with local authorities and for rendering assistance to the Austrian federal states in terms of supportive payments to the injured. Today the WLW is organised as a special department of the Austrian Ministry of Life, which is responsible for taking action in the field of agriculture, forestry, environmental and water management. The activities of the WLW focus on mountain torrent and avalanche protection but also on the protection against a variety of other natural hazards. Until the next legal amendment, the cat fund was financed by imposing surcharges on the Income Tax, the Tax on Wages, the Capital Returns Tax and the Corporation Tax.

After several extensions and amendments the Austrian Catastrophe Fund Act was renewed in 1985.<sup>3</sup> One year later, in the year of Tschernobyl, new regulations had to be implemented in order to provide sufficient funds to the victims of the nuclear catastrophe.<sup>4</sup>

<sup>1</sup>Katastrophenfondsgesetz 1966 (Catastrophe Fund Act), BGBl. 207/1966.

<sup>2</sup>“Wildbach- und Lawinverbauung”, i.e. mountain torrent and avalanche protection.

<sup>3</sup>Katastrophenfondsgesetz 1985 (Catastrophe Fund Act), BGBl. 539/1984.

<sup>4</sup>Katastrophenfondsgesetz 1986 (Catastrophe Fund Act), BGBl. 396/1986.



Correspondence to: M. Gruber  
(monika.gruber@uibk.ac.at)

After several years without major catastrophes the fund reserves had accumulated to almost 200 mio. Euro in 1995 and had to be reallocated to another purpose of use. Due to this development the Austrian Court of Audit suggested new regulations concerning the management of cat fund reserves. Basing on these suggestions, the currently effective Catastrophe Fund Act<sup>5</sup> was put into force, which imposed a limitation of accumulated fund reserves at max. 29 mio. Euro per annum. Every year about 300 to 350 mio. Euro of tax revenues are allocated to the catastrophe fund.<sup>6</sup>

Along § 9(2) Finanzausgleichsgesetz 2005<sup>7</sup> the cat fund is endowed with 1.1% of the annual tax revenue of the Income Tax, the Tax on Wages, the Capital Returns Tax and the Corporation Tax. The Austrian Federal Ministry of Finance can also grant additional financial means in case of extraordinary catastrophes by enacting special laws.<sup>8</sup>

Currently 73.27% of the fund are invested into preventive measures against flood and avalanche events, the assessment of water quality, the establishment of warning and alarm systems, grants to frost and hail insurance premiums<sup>9</sup> in the agricultural sector, the coverage of extraordinary damages to agricultural regions, the purchase of additional roughage (in particular in the years 2002 and 2005), and the coverage of costs associated with the prevention of water contamination.<sup>10</sup>

The funds' financial means are distributed among the Austrian Federation ("Bund"), the federal states ("Laender") and the local authorities ("Gemeinden") subject to the laws. In addition, an emphasis is placed on catastrophe prevention by means of prudent spatial planning and hazard zone mapping. Since the beginning of 2006, the Federal Ministry of Agriculture, Forestry, Environment and Water Management provides the hazard zone mapping system HORA, which can be used by insurance companies for the insurance premium calculation and their adjustment to the HORA flood and earthquake risk zones.<sup>11</sup>

Beside the chance of being supported by the public catastrophe fund in an emergency (claims can not be asserted), private or business entities may also insure with private insurance companies. Beside those insurance companies that are headquartered in Austria, the freedom of services and estab-

lishment allows insurance companies headquartered in any European member state to write policies in all other member state (under consideration of regulations concerning the mutual recognition of insurance concessions). In 2007, 708 insurance companies were headquartered in the European Economic Area (EEA).<sup>12</sup>

Despite this obviously large range of insurance facilities many households and companies are still uninsured. In particular, since the implementation of enhanced hazard zone maps, such as HORA, insurers are better informed about the actual risk exposure of property. Thus, at present, they either provide policies with very limited coverage for damages arising from natural hazards, or require higher insurance premiums for buildings situated in endangered zones. For strongly endangered areas most insurers even ceased to underwrite this type of risk. According to the Austrian Underwriting Association most insurance companies situated in Austria cover for damages to private buildings and households on average up to 7500 Euro. Only a few insurers pay up to 50% of the amount insured (actually, 50% of the maximum limit). Business entities are granted more flexible contract conditions than private households. As business entities also have access to combined policies (in particular "all risk policies"), higher covers for damages are available. But even these policies can not cover for all types of hazardous events and regularly exclude extraordinary, i.e. extreme events.

As the number and intensity of catastrophic events seems to rise continuously, both the public and the private sector have realised the need for another renewal of the cat funding system. In the following, some remarks will be made concerning capacity constraints in insurance markets, "alternative" solutions provided by capital and insurance markets, as well as the feasibility of Public Private Partnerships.

## 2 Some remarks on insurance market capacity

Because of the increasing amount of damages caused by natural hazards in recent years, not only Austrian but also internationally operating insurance and reinsurance companies frequently emphasise, that they would no longer be able to cover all damages to insured property, if this trend was to be continued in future. "In the wake of the 2005 US hurricane season and growing concerns about natural disasters in the years ahead, obtaining sufficient insurance coverage for catastrophic loss has been extraordinarily difficult for many of our clients," said Brian Storms, Chairman and Chief Executive Officer of Marsh (Marsh, 2007).

Several scientific papers have discussed the issue of scarce capacity in insurance markets and used various arguments in order to explain the reasons for the existence of such constraints.

<sup>12</sup>Directive 73/239/EWG, OJ 1973 L 228/3, Directive 88/357/EWG, OJ 1988 L 172/1, Directive 92/49/EWG, OJ 1992 L 228/1.

<sup>5</sup>Katastrophenfondsgesetz 1996 (Strukturanpassungsgesetz 1996), BGBl. 201/1996.

<sup>6</sup>See Federal Ministry of Finance, www.bmf.gv.at, 08.04.08.

<sup>7</sup>Finanzausgleichsgesetz 2005 (fiscal sharing provisions), BGBl. I 156/2004.

<sup>8</sup>In 2002 the so-called HWG 2002 added 500 mio. Euro to the fund; in 2005 the additional funds granted by the HWG 2005 amounted 251 mio. Euro. See Federal Ministry of Finance, www.bmf.gv.at, 08.04.08.

<sup>9</sup>§§ 1 and 2 Hagelversicherungs-Foerderungsgesetz (hail insurance provisions), BGBl. 64/1955.

<sup>10</sup>Wasserrechtsgesetz 1959 (water right), BGBl. 215/1959.

<sup>11</sup>See Federal Ministry of Agriculture, Forestry, Environment and Water Management, HORA, www.hochwasserrisiko.at.

Primarily, two schools of thought can be identified: capacity constraint and arbitrage theory. Both theories aim at explaining the underwriting cycle, in particular, the stage of rapidly increasing premiums and profitability typically associated with decreasing capacity. Emphasis is generally put on the relationship between capacity and market prices (and/or underwriting profit margins) and if this relationship actually exists.

*Capacity constraint models* (see for example Bloom, 1987; Winter, 1988; Gron, 1989, 1991), assume that this cyclical phenomenon is mainly caused by *real frictions and imperfections* in insurance markets. In the case of major shocks, such as natural catastrophes, the insurers' net worth is influenced negatively and the supply curve for insurance cover is shifted to the left. In addition, risks associated with the underwritten policies are assumed to be imperfectly diversifiable.

As insurers need to hold a certain net worth in order to avoid bankruptcies and to be capable of meeting all claims made by policyholders, the cost of capital plays an important role in capital-constraint models. Winter (1988) and Gron (1989) both argue that capital from internal sources is less costly than capital from external sources. Therefore insurers will normally hold relatively high amounts of equity capital to ensure claims that exceed the expected losses.

In order to cope with a shock in the short-run and to adjust steadily to the long-run equilibrium, insurers preferably increase prices after such events and then accumulate retained earnings. By this means, demand is reduced which helps insurers to recover the initial net worth and to adjust prices downwards, when converging towards the long-run equilibrium again.

Therefore, capacity constraint theory, which mainly uses supply (and demand) arguments, assumes the existence of a negative relationship between capacity and underwriting profit margins. The underwriting profit margin is a profitability measure for insurance companies: "revenues – costs" in relation to "revenues" (see also Gron, 1991). When capacity is low, prices and, thus, the underwriting profit margins, are high until the insurer has recovered again.

In contrast to the capital constraint theory, which argues with endogenous market imperfections, *arbitrage models* base their argumentation upon the existence of – mostly exogenously given – *institutional lags, accounting practices and regulatory lags*. Capital is assumed to adjust quickly and without considerable costs. Further assumptions of these models are free market entry and the existence of competitive markets. As a consequence, the effects stemming from major shocks don't persist in the long-run, because capital can be acquired easily and almost costlessly. Thus, the price of insurance coverage simply equals the present value of costs (associated with the actuarial risk covered by the insurance policy over the entire contract period). The supply curve is not expected to be shifted in the short-run after major events.

Consequently, a continuous adjustment towards a long-run equilibrium is not necessary.

In essence, arbitrage theory blames the instability of the regulatory environment for being the main driver of the insurance market cycle, in particular, of capacity crises. "A change in law can cause a revision of the expected loss for all policies that are currently outstanding but which have already been priced." (See Doherty and Posey, 1997, p. 56.) *Inappropriate loss forecasting and ratemaking methods* used by insurers as well as institutional lags, changes in the economic environment, inflow of capital to the insurance market are also dealt as triggers for shifts of the long-run supply curve (see Venezian, 1985; Cummins and Outreville, 1987). Finally, these models don't find any systematic relationship between capacity and underwriting margins.

The arbitrage models have been expanded and combined in different ways. In various papers capital market concepts are applied to insurance pricing, such as the Capital Asset Pricing Model (see Hill, 1979; Fairley, 1979; Cummins et al., 2002), the Arbitrage Pricing Theory (see Kraus and Ross, 1982) or corporate debt models (see Merton, 1974; Cummins and Danzon, 1997; Doherty and Garven, 1986).

Doherty and Garven (1995) combined the idea of present value and capital constraint models. They found that changes in interest rates cause changes in the level of underwriting profits. In case that an insurer suffers from an asset liability duration mismatch, this change can also affect the value of the insurer's equity and disturb its capital structure. Consequently, capital adjustments after an interest variation can be more costly for this firm, as the access to equity capital may become more difficult. This shows more evidence of frictions in responding to changing capital market conditions, which finally supports the capacity constraint models of insurance market cycles.

Froot (2001) takes a broader point of view on risk management and capacity issues in respect of catastrophic reinsurance. After conducting a reinsurance market analysis he states that protection for high-risk layers is often not purchased or simply not available, and that prices regularly deviate from fair values. Froot (2001) finds evidence for eight potential explanations for this deviation from risk management theory, which would suggest a perfect hedging strategy against such high risk. Five of his eight hypotheses base upon supply-side shifts, three explanations focus on demand-side deviations.

First, a reason for capacity constraints might simply be, that there is *insufficient capital* in the reinsurance market as holding large amounts of collateral on the balance sheet is costly for any reinsurer. Financing imperfections (see also Froot and O'Connell (1997)), adverse selection and agency issues might make external capital too costly after poor performance (due to a catastrophic event). He argues further, that *capital market shortages* can prevent reinsurers from investing more into mitigation measures, which would reduce

the size of the entire cat risk pool. But reinsurers rather avoid high upfront expenditures.

Second, Froot hypothesizes that especially reinsurers can use their *market power* to keep capacities at a certain level and to impose premiums that are calculated above fair value. Thus, reinsurers tend to consolidate in order to gain more market power, to profit from economies of scale and to reduce the costs of obtaining external capital. But as far as cat bond issuances have shown, deviations from fair prices seem to be driven by the existence of *barriers* to reinsurance market entry rather than by capacity constraints, as cat bonds only added a tiny fraction to the total reinsurance capacity. Thus, what cat bonds actually account for is the release of barriers to the reinsurance markets (regarding the market power argument see also Froot and O'Connell (1997)).

Third, Froot discusses the potential impact of *frictional costs* on reinsurance premiums. Premiums are assumed to be high because financial instruments as well as reinsurance contracts are illiquid and have high transaction and brokerage costs. Furthermore, reinsurance companies manage their risks by means of aggregate limits rather than risk exposures, which can also lead to frictional inefficiencies and, again, costs. These costs need to be considered when setting up contract conditions, i.e. premiums. Improved reinsurer risk allocation could help to reduce the cost of capital even in case that financing imperfections are in place.

Fourth, *moral hazard and adverse selection* can be considered as market distorting factors that influence reinsurance premiums and capacity. But Froot argues that they seem to play a "relatively harmless" role for cat reinsurance, in comparison to other forms of insurance and reinsurance, because catastrophic reinsurance policies are usually associated with high deductibles and coinsurance structures. Indeed, risk retention and low-risk layers tend to be most affected by moral hazard and adverse selection.

Fifth, *ex-post third party intervention* is blamed to be the driver of a decrease in reinsurance demand after a catastrophic event. As soon as governmental funds are dedicated to catastrophe funding and/or state aid programs are initiated, the incentive for entering into a private insurance contract is weakened. In this case, a decrease in private insurance demand results in lower insurance prices and lower capacity on the reinsurance market.

Sixth, it is argued, that the *corporate form* of reinsurance could be inefficient. Agency costs in association with intransparent reinsurance contracts and a strong influence of underwriting managers, who aim at gaining larger market share and providing shareholders with higher returns, might result in an inefficient allocation of market resources and, finally, to lower capacities provided by reinsurers.

Seventh, as managers (underwriting agents) are said to primarily maximise the value of their equity rather than the firm value, the shareholders' interests (high return on invested capital) override policyholders' interests (low premiums, high degree of insurance cover). Thus, insurance man-

agers avoid to underwrite high risk policies in order to reduce the need for – costly – high-risk reinsurance. Due to these *agency issues*, reinsurance demand may be restricted.

Finally, Froot hypothesizes that reinsurance demand is dampened due to *behavioural factors*. He argues that the *perceived* likelihood that reinsurance will pay in the case of catastrophic events might be "too low to matter". For this reason, the importance of high-risk covers is often undervalued, i.e. reinsurance in these layers is likely to be neglected. As another behavioural aspect Froot mentions, that a lack of clarity associated with catastrophic risk could make insureds willing to pay higher premiums than suggested by expected utility theory.<sup>13</sup>

Froot concludes that these behavioural issues can only explain some elements of cat reinsurance buying patterns. The actual management of catastrophic risk seems to deviate substantially from the pattern suggested by theoretical approaches. In one point he agrees with theory: reinsurance cover is regularly overpriced.

In contrast to the broad perspective on the reinsurance market discussed above, Jaffee and Russell (1996) concentrate on the question why insurers do not hold large catastrophe reserves. Accounting rules against the earmarking of funds, tax provisions, opportunity costs (in terms of using the fund for lucrative takeovers, high dividend payments to shareholders, or the reduction of insurance premiums), and regulatory constraints (e.g. premium limitations or mandatory insurance associated with the insurer's obligation to contract) are presented as being the main reason for reinsurers' reluctance to aggregate catastrophe reserve funds. The authors suggest to improve the acceptance for earmarking of funds, to enhance ex ante funding and to permit alternative means of funding. These measures might help to return to fair insurance premiums and expand capacities due to a more efficient capital allocation.

Beside the arguments discussed above, another approach tries to explain the problems associated with natural hazard insurance focusing on the characteristic features of this risk and, in particular, on the concept of insurability. Business entities may either try to avoid, minimise or limit such risks, or apply mechanisms for retaining, funding or transferring them. Traditionally risk is transferred by entering into an insurance contract.

Berliner (1982) and Karten (1972) amongst others determined *criteria of insurability*, such as the randomness, the independence, the uniqueness and the predictability, i.e. the frequency and the size of the risk event. Only if these criteria

<sup>13</sup>Also the basic papers in the field of Behavioural Finance describe an underweighting effect for moderate and high probability events. On the other hand people generally tend to overweigh rather low probabilities. However, Kahneman and Tversky (1979); Kunreuther (1984); Slovic et al. (1977) among others showed that people rather neglect very low probability events and, thus are not willing to insure against such events, even when high losses are expected.

are met, the risk is considered as being insurable on the traditional market. Otherwise the risks are denominated “uninsurable” and need to be managed in a different – alternative – way.

The risk of natural catastrophes generally fulfills the insurability criteria of *randomness*. Human beings can not directly influence the loss distribution for example by initiating the occurrence of such events. Randomness is also a crucial criterion regarding moral hazard in insurance decisions. Insured events which are completely random will hardly cause moral hazard problems for the insurer (see Froot, 2001). In the case of natural catastrophes, moral hazard can only indirectly be an issue if the insureds neglect their due diligence e.g. concerning the maintenance of protection measures.

The criterium of *independence* is fulfilled if losses do not occur simultaneously and from the same cause to large numbers of policyholders. Natural hazard events can be seen as globally insurable (see Cummins, 2007), as they are usually independent of losses in other geographical areas. On the other hand they can hardly be diversified or reinsured on a local scale because they regularly trigger a large number of policies in similar risk classes at the same time within a certain region. Therefore, cumulation risk among the “natcat”-policies is a major issue in this context which makes it difficult, particularly for direct insurers, to write policies on these risks.

Problems may also arise concerning the *predictability*, thus the frequency and the size of catastrophic risk. As extreme events typically occur on a very infrequent basis, there is only scarce data that could be used for computations. Furthermore, catastrophic risks are also called low frequency – high severity risks, which implies that the size of the potential damage is remarkable. In addition, catastrophic events can not easily be determined and segregated from other insured events (*uniqueness* of the insured event/risk). For example, if a policy includes flood events this does not imply that damages caused by a simultaneous debris flows will also be covered by this policy. In practice it will be difficult to identify the damages caused by the flood on the one hand and the debris flow on the other hand (for a more detailed discussion of insurability see Faure, 1995; Gollier, 1997; Holsboer, 1995; Vaté and Dror, 2002; Kunreuther, 2002, among many others).

Thus, catastrophic risk may remain uninsured because of the risk’s characteristic features, which complicate actuarial pricing. The inaccuracy and uncertainty associated with these calculations lead to insurance premiums being set at a relatively high level in order to cover for estimation errors. Consequently, market supply and demand are affected which will regularly cause the market to change.

For the Austrian insurance market several arguments mentioned above appear to be applicable in order to explain the current situation. Austrian insurance companies increased their premiums and restricted their maximal compensation payments to very low levels after the flood events of 2002

and 2005. Thus, the catastrophe seemed to have influenced the underwriting cycle by reducing capacities in the years 2002 and 2005 leaving behind a rather limited insurance supply. So a certain connection between insurance underwriting cycles and the capacity issue appears to be existing in this case, which supports capacity constraint theory.

Furthermore, one can find evidence for the arguments of arbitrage models, as in all European member states new directives have been put into force in the last decade, such as Directive 2002/13/EC on solvency margins, Directive 2002/87/EC on the supplementary supervision of financial conglomerates, or Regulation (EC)1606/2002 on the application of International Accounting Standards. These regulations, which also have to be integrated into the Austrian legal framework, can be seen as institutional and accounting lags, i.e. the main drivers of insurance markets in arbitrage models. Besides, inappropriate loss forecasting may have been an issue as the large part of the Austrian insurance companies obtain loss calculations, loss forecasting and ratemaking methods from the large Europe based reinsurance companies. These computations and simulations are generally very precise, but for the Austrian geographical area there may not be sufficient data to measure risk exposures and insurance premiums in the field of natural hazards in an appropriate way. Thus, both approaches are able to explain insurance market cycles and capacity deviations in Austria.

The Austrian insurance market also shows evidence for most of the arguments presented in Froot (2001). In particular, the issue of third party intervention, i.e. governmental funding, turned out to be a crucial aspect. For example, owners of buildings which were damaged by the avalanche events of Galtr in 1999 were offered special insurance policies by a few risk tolerant – insurers. But they mostly rejected these offers arguing that the government would fund a whole program of protection measures which would render such insurance policies unnecessary in future.

Also, the unequal distribution and allocation of funds to the federal states of Austria forms part of the general discussion about the catastrophe fund. After the flood events in 2002 and 2005 the regulations and criteria regarding the distribution of funds among the persons concerned strongly differed among the federal states. Many times insured people were not compensated additionally by the catastrophe fund, although the policies regularly covered a maximum of 7500 Euro which is something like a drop in the ocean if a family’s entire house is destroyed. In this case, it would have been better to be uninsured against natural hazards in order to get more out of the catastrophe fund, which shows that the incentive scheme in Austria is negatively influenced by third party intervention.

Other arguments mentioned by Froot (2001) are also relevant for the Austrian landscape. According to the Austrian Insurance Supervisory Law insurance companies can only be established in certain corporate forms, such as stock corporations or mutual insurance associations. In Austria most

primary insurers are stock corporations which are expected to reward shareholders with a constant rate of return on their investments. This may cause agency issues to have a certain impact on the allocation of resources in the company and also on the underwriting policy of agents, who will tend to avoid underwriting of high risk policies. The latter would afford the building of major reserves on the balance sheet which is not preferable regarding shareholder value maximisation (see Jaffee and Russell, 1996). Also the cost of capital mustn't be neglected in this context. On the other hand, it will probably be much easier for stock companies than for mutuals to access additional capital resources and to reduce the overall risk by means of diversification. In particular large reinsurance (stock) companies should thereby be able to dampen the impact of agency issues and to maybe even use the underwritten risk in order to gain higher profits (see Viswanathan and Cummins, 2003).

Moreover, since the beginning of 2007 the IFRS, which prohibits catastrophe and equalisation provisions, have to be applied by Austrian insurers. This may be another incentive to reduce high-risk policies in the insurers' portfolios, but at the same time it may be an incentive to apply innovative financing structures.

Moral hazard and adverse selection can also have an impact on the Austrian market for natural hazard insurance. Although one can not directly influence the occurrence of the insured event, moral hazard can be realised when protection measures are not established or not well maintained so that the individual behaviour changes the actual exposure, which the insurer might not necessarily be aware of. These problems will be present with insurance contracts in general, independently of the Austrian system. In order to reduce moral hazard associated with traditional insurance policies the insurer should implement control mechanisms or impose certain conditions in order to preserve the highest possible level of randomness of the insured risk.

While the arguments of market power and frictional costs associated with reinsurance contracts rather seem to be of general importance as well, the availability of capital in the (re)insurance market seems to matter in particular for Austria. After the flood events of 2002 and 2005 insurers limited their supply of natural hazard policies as otherwise additional collateral would have been needed in order to guarantee the companies' financial stability in the case of natural catastrophes occurring.

Having considered theoretical as well as empirical arguments accounting for a lack of (re-)insurance in differing ways, we can now turn to alternative solutions that might help to overcome traditional (re-)insurance market problems.

### 3 ART – solutions for uninsurable risks?

While the fundamental features of catastrophic risks can not crucially be amended, new concepts may be able to deal with

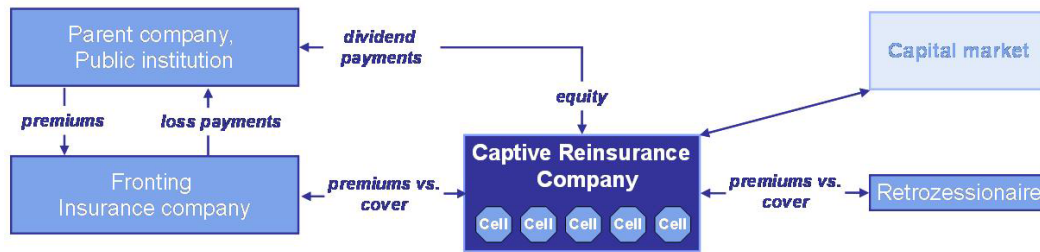
the issues presented in Sect. 2. The widely used term "ART" comprises various forms of alternative risk transfer and financing mechanisms (the latter is also referred to as "ARF"). The notion of risk transfer generally means that actuarial, financial, operational and other types of risk can be transferred from one business entity to another. Whenever this risk transfer mechanism is insufficient or inappropriate, capital market structures can also be applied in order to manage these risks by means of specialised funding arrangements. These instruments are said to be "alternative" as conventional risk transfer and financing structures are amended, combined and finally used as alternatives to traditional mechanisms, whenever additional cover and capacity is needed.

Primarily companies, but also public institutions and groups of private individuals can benefit from the advantages of using instruments such as captive insurance companies, insurance-linked securities, contingent capital solutions and finite risk. In the following paragraphs these mechanisms are described in more detail. Furthermore, their advantages regarding the opportunity to overcome capacity and insurability problems will be discussed. Concrete suggestions for an "alternative" Austrian catastrophe funding will be made in Sect. 4.

The *first impulse* for the creation of alternatives to traditional insurance contracts was given by a serious liability-crisis of the US insurance market in the 1980s. As underwriters faced a major lack of capacity the government released major barriers related to insurance market entry by enforcing the US Liability Risk Retention Act 1986 (1988). This act facilitated the establishment of on-balance sheet reserves and specialised risk pools for groups of business entities with similar risk exposure. Since that time an impressive number of *internal and external self-insurance* structures has been established.

Self-insurance, or also "pre-funded retention", comprises no actual risk transfer. Risk is retained by the business entity, which provides cover for future expenditures by building up loss reserves on its balance sheet. These reserves should be earmarked, which means that the firms management ought to ensure that the funds shall not be used for any other purpose than the coverage of ex-ante defined economic losses, as for example claims arising from natural catastrophes of product liability (see Banks, 2005), Culp (2006).

Beside the original – internal – form of self-insurance several external self-insurance structures have emerged, with captive insurance companies ("captives") and Risk Retention Groups being the most widely used. Risk transfer and financing are combined in the way, that special purpose entities take responsibility for the transformation of risk, instead of accounting for expected future losses by building earmarked reserves. As Risk Retention Groups can only be established in the application area of the US Liability Risk Retention Act, this structure can not be considered as an alternative solution for Austria.



**Fig. 1.** The basic captive reinsurance structure.

In the past, the majority of *captives* was established by industrial enterprises in off-shore domiciles as legally separate corporate entities, which insure and/or fund risks that can not (or only against overpriced premiums) be insured via traditional contracts. Captives can either be set up by one single company (Single-Parent) or by multiple companies (Multi-Parent) and can take the form of a direct insurer or reinsurer. In any case, corporate risks are transferred from parent companies to the captive against the payment of a premium, which can be compared with traditional insurance structures.

But captives offer additional benefits to their users. They can help to smooth and systematically protect the balance sheet of the parent company. They provide the parent with pre-funded and profitably invested financial means whenever loss cover is needed. Being a shareholder the parent is involved in the decision making process and participates directly in the positive as well as negative development of the captive. This gives an incentive for risk preventive measures within the parent company and may contribute to the depletion of moral hazard and to the improvement of the entire risk management process. So, captives help to overcome moral hazard and agency issues mentioned in Sect. 2 by allowing for individually optimal and mostly high deductibles as well as participation in the captive's profit or loss. It also provides the company with additional financial means, not only from insurance but also from capital markets. In addition, these structures give companies the opportunity of directly accessing reinsurance markets – beside capital markets – which would otherwise be impossible. This finally leads to an expansion of capacities, as on the one hand the market for catastrophic risk is enlarged and on the other hand synergies regarding risk assessment and simulation techniques can bring benefits.

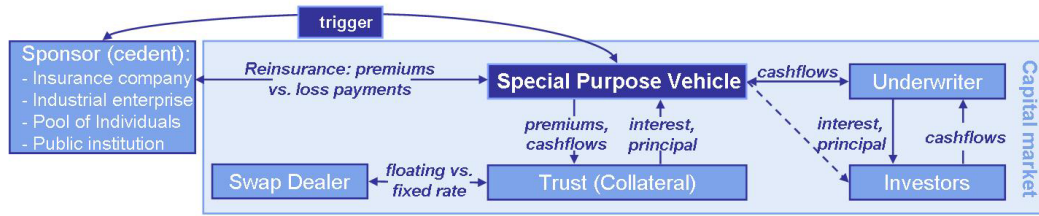
In addition, a captive benefits from low taxation of investment and premium income in off-shore domiciles, flexible structures due to the relatively small size of these companies in comparison to traditional (re-)insurers. Captives are also said to be less dependent on insurance market cycles than traditional insurers. Finally, a captive can be liquidated easily, if it is not needed any more (see Lee and Ligon, 2001; Eisenhauer, 2004; Booth, 2006).

But the captive concept also has to be viewed critically as several taxation issues are still not clearly regulated. Therefore in certain cases (depending on the domicile of the captive and the parent) the concept might be associated with certain legal risk. Moreover, it is a fact, that the higher the parent company's annual premium volume, the more cost efficient the captive. Thus, smaller business entities should preferably use special group captives or rent-a-captive solutions (see Culp, 2006). Figure 1 shows a basic captive reinsurance structure.

Another solution for public and private catastrophe funding is provided by capital markets, in particular by *Insurance-Linked Securities*, such as cat bonds, insurance and weather derivatives, or contingent capital solutions. Most of these instruments base upon a securitisation process, which can be explained as the transformation (i.e. pooling and re-structuring) of illiquid assets or liabilities from the balance sheet into marketable securities. Companies acting in different industries apply this mechanism in order to cope with a wide range of risks. Insurance and weather derivatives as well as index-based cat bonds, being a specific field of application, are also referred to as catastrophe index-linked securities (see Lane, 2002).

*Catastrophe bonds* securitise risks associated with natural hazards. In particular, reinsurance companies and large corporations issued cat bonds in order to reinsure or retrocede these low frequency – high severity risks appearing on their balance sheet. Several parties are involved in these transactions. A “sponsor” cedes liabilities arising from catastrophe exposure to a special purpose vehicle, which will then carry out the actual securitisation. The liabilities are transformed into a marketable cat bond and issued by the special purpose vehicle. In general, investment banks are also involved as consultants to sponsors and as distributors of cat bonds to investors. The sponsor enters into a reinsurance contract with either a reinsurance company, a subsidiary of the reinsurer or even directly with the SPV. Cash payments from investors as well as reinsurance premiums are collected and reinvested by the SPV supported by a specialised trust (see Fig. 2).

Generated investment returns serve as a loss reserve and can finally be used for damage compensation payments to the



**Fig. 2.** The basic cat bond structure.

sponsor. For investors the coupons as well as the principal can be at risk, if the cat bond is triggered, which means that the contractually determined level of the underlying value or index is exceeded. Various forms of triggers have been used for cat bonds: Indemnity-based triggers are related to actually reported damages. Parametric or technical triggers are calculated using technical parameters, such as temperature, storm force, magnitude of earthquakes or rainfall. Index-based triggers base upon complex simulation techniques using data from particular insurance markets and also parametric data sets (see Bantwal and Kunreuther, 1999; Nell and Richter, 2000).

Cat bonds have proved to be, on the one hand, a valuable source of capital for companies and, on the other hand, an attractive asset for investors due to their relatively low correlation with other securities. Thus, cat bonds can contribute positively to the diversification effect in investors' portfolios. Until 2006 solely large industrial companies issued cat bonds. But then in June 2006 the government of Mexico took protective action for the case of a major earthquake by forming a special purpose vehicle to issue catastrophe bonds and collecting the bond proceeds in a public cat fund.

Theoretically, this structure could also be used for catastrophe funding in Austria adding capacity to the national insurance market and to public financial means. In this case, the fund could also act as public reinsurer or guarantee fund for private insurers (see Fig. 6). Moreover, the cat fund could benefit from higher fund performance and more transparency as this would be expected by investors.

The most positive feature of cat bonds is that they manage to reduce moral hazard and agency costs, as the only trigger of payments is an index calculated on the basis of parametric or insurance market data. Indemnity-based cat bonds are triggered either by market-wide damage reports or by insurer specific triggers, which can not be influenced by the insured. Regarding the criteria of insurability index-linked cat bonds also facilitate a very precise definition of the "unique" event, which triggers payments to the insured. Furthermore, sufficient capital will be provided at the issuance of the bond adding capital market capacity to the insurance market.

The negative aspect of such products is, though, that the positive effect of reduced moral hazard might be offset by the existence of basis risk. Thus, in order to render cat bonds

an efficient tool for financial protection against natural hazards it is crucial to choose the appropriate index or triggering indemnity level. This is also true for all other index-linked securities, such as weather or insurance derivatives (see also Brandt and Laux, 2005; Doherty and Richter, 2002; Doherty, 1997, among others).

In contrast to the cat bond structure, insurance and weather derivatives are alternative solutions for companies rather than public institutions. Derivatives, such as options, swaps, futures or forward agreements, which are related to indemnity of modelled indices (e.g. GCCI, PCSI) are called *insurance derivatives* and are usually traded over the counter. However, as past experience shows this type of derivatives has barely been deployed, although the CBoT tried to boost the market by offering over-the-counter support service as well as an exchange platform in the 1990s (see Culp, 2006). Since spring 2007, a new generation of insurance derivatives was born, which can be traded at NYMEX exchange. Again, the derivatives are written on the Property Claims Services Index (PCSI).

Whenever parametric data are used to calculate the underlying index, the transactions are denoted as *weather derivatives*. The contract may, for example, determine a certain level of the temperature-index. If this level is exceeded within the contract period, the option is exercised and a certain amount is paid out in order to compensate for damages that are expected to be related with this index-level.

Of course, basis risk is a major concern when pricing weather derivatives and setting the trigger level. Basis risk arises when the underlying index and the contractual trigger level do not precisely depict the firm's exposure. The more accurate the contract is adjusted to the actual exposure of a company, the better basis risk can be reduced.

However, weather derivatives can also be used for diversification means. They can also amplify capacities available for the coverage of weather-related damages, and help to smooth the balance sheet of any company which intends to protect itself against damages (see Banks, 2002; Jewson and Brix, 2005).

*Contingent capital solutions* link insurance and financial markets by raising funds from capital markets upon the trigger of an insurance-related event. They can either take the form of contingent *equity* or *debt*. In the first case, a company



has the option to issue new equity shares to investors after a pre-determined event thereby adding equity capital to its balance sheet and obtaining coverage for losses caused by the specified event. In the second case, a company buys the option to take out a loan after an ex-ante defined event in order to cover for damages.

From the conclusion of the contract until the realisation of an actual loss, the company pays an option-like commitment fee. Therefore, the seller of this option guarantees the company, in the case of a contingent equity solution, to buy the company's shares and, in a contingent debt structure, to provide credit against *fixed contract terms* (interest payments, repayment period, etc.). The company can take advantage of these contingent capital facilities in the way that either way the company obtains access to less expensive capital after the occurrence of a financially stressful event. Without this option, the price for regular funding in the capital markets or bank loans could be much higher after such an event, as the company's liquidity and/or creditworthiness could be dampened at that time (see Culp, 2006).

In the US accounting regulations also allow insurers to issue *Contingent Surplus Notes* (CSN). The structure combines the notions of cat bonds and equity put options. By selling trust-issued notes to investors, capital flows into the special purpose trust, which purchases high quality securities such as T-Bills. Investors are granted higher-than-average yields in order to give them an incentive to invest into the notes. Upon the occurrence of a predefined trigger event the insurer has the right to sell contingent surplus notes to the trust to raise capital at fixed conditions. This gives insurers improved access to capital markets and provides them with capital for the payment of damage compensations to the insureds.

The advantage of contingent capital solutions in general is that insurers can obtain a post-loss funding commitment in advance for fixed conditions that might be difficult to realise after a loss event, if the option was not in place (see Froot, 2002). Furthermore, the company can strategically choose between debt or equity solutions, which will mainly depend on their actual preferences concerning the capital structure. In contrast to an insurance contract, the company has to repay the loan as soon as the company has recovered again, or, repurchase its CSN within a certain period after the event.

On the other hand, taking out a loan in times of low solvency can also be risky for a company. If it is not able to recover within the contractually determined period, insolvency is simply delayed. One could use similar arguments for contingent equity or CSN solutions, as investors will not be remunerated with the expected yield any more, if the company doesn't recover within a certain period.

Regarding the issues discussed in Sect. 2 contingent capital solutions can be seen as an attractive alternative to traditional insurance contracts, in particular in the case of contingent debt solutions. If a corporate or governmental institution raises funds by using contingent credit lines, moral hazard should not affect the behaviour of these entities, as the credit

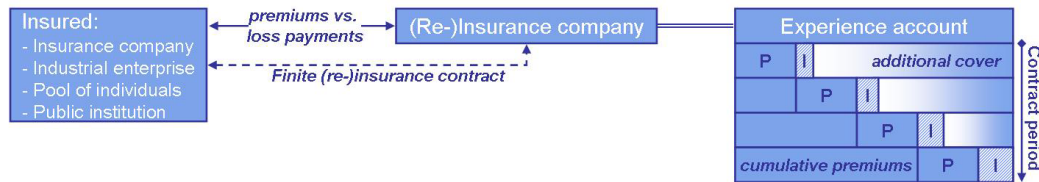
funds must be repaid within a certain period after the event including interest. The original risk is neither transferred nor borne by the capital provider. As mentioned above the repayment of the loan might not always be easy after the occurrence of a catastrophic event. Thus, the "insured" will prefer to avoid risk or to take risk-mitigating measures, which leads to reduced moral hazard (see Neftci, 2000). The concept itself resembles the participation of captive owners in profits and losses, which encourages risk averse behaviour as in the case of the captive the owners are policyholders and shareholders at the same time.

Also agency costs should be lower in the case of contingent capital solutions than for traditional insurance contracts. This relates closely to the accounting issues, which are also brought up by arbitrage models. Surplus notes as well as loans increase the company's assets, but in contrast to loans the notes do not increase the liabilities as they are regarded as policyholders' surplus (under US accounting rules). This will regularly have an effect on the behaviour of managers. As no liabilities have to be considered on the balance sheet in the case of CSN funding, they will rather be willing to insure also high risk events as the financing will not have a negative impact on the balance sheet and the shareholder value.

The situation for loans is different, as liabilities need to be considered in the balance sheet. Thus, agency costs can still be an issue. The repayment of the loan and the interest need to be considered in advance when choosing this post-event funding alternative at a priori fixed contract terms. Though, lending capital might be a good alternative for companies or also for public cat funds in order to dispose of additional liquid capital without the need for earmarking certain internal funds. In practice, earmarking may rather be difficult to proceed over longer periods of time. From the accounting as well as from the political perspective this feature of contingent loans seems to be a crucial aspect. Insurance market capacities and public funds can be increased by adding financial means via the capital market. Due to this diversification of resources companies or public institutions have access to additional funds independently of insurance market cycles and the market power of (re-)insurance companies (as mentioned in Sect. 2).

Furthermore, the insurability-problem concerning the accurate definition of the risk event can partly be solved by using contingent capital structures. Both, contingent equity and debt structures are typically linked to one or more triggers, for example the industry's index level or the company's stock development in connection with a parametric trigger. Such structures counter moral hazard, but to a certain extent they can include basis risk, similar to index-linked catastrophe bonds (see Culp, 2004, p. 388).

Regarding the applicability of contingent capital instruments, new regulations would have to be implemented in order to allow insurance companies to issue a special type of notes, such as the CSN, and to allow for beneficial accounting. Currently, the CSN structure can only be applied under



**Fig. 3.** The basic finite (re-)insurance contract.

US law. Contingent credit lines (loan commitments) can already be applied by Austrian companies. This mechanism is well established in the field of hedging unfavourable credit events worldwide (see Neftci, 2000).

Therefore, contingent capital solutions may serve as supplemental sources of financial means for private but also public institutions in times of capacity shortages in insurance markets.

Finally, the concept of *finite reinsurance* may be a useful alternative to classical insurance contracts. The term finite reinsurance was defined in the EU Directive 2005/68/EC (OJ 2005 L 323/1) as a reinsurance contract *under which the explicit maximum loss potential exceeds the premium over the lifetime of the contract by a limited but significant amount, together with at least one of the following two features: (i) explicit and material consideration of the time value of money; (ii) contractual provisions to moderate the balance of economic experience between the parties over time to achieve the target risk transfer.*

The early finite risk contracts were called *time and distance* policies offered by Lloyd's of London. The treaties involved the payment of a large one-off premium by the ceding insurer to the reinsurer, as well as a fixed schedule for the repayment of funds to the cedent at maturity. Due to the fact, that these policies only transferred timing risk, leaving aside underwriting risk, they faced major regulatory problems and were abandoned (see Culp, 2006).

Today, finite contracts can be concluded either between an insurer and reinsurer, or between industrial company and an insurer. The mechanism is deployed in order to manage, transfer and/or finance various types of risk, such as financial, operational or timing risks. In contrast to this, traditional contracts solely provide cover for actuarial risks. Finite (re-)insurance may also feature the consideration of positive loss histories, participation clauses and multi-year contract periods in order to spread insured risks over time. The premiums paid to the (re-)insurer are collected in a so-called loss-experience account for the entire contract period and can finally be paid back to the cedent, if the collected premium capital has not been used for damage compensations (see Fig. 3). These repayments may also include investment returns (see Banks, 2005; Holzheu et al., 2003).

Finite covers can take the form of *retrospective or prospective* covers. This means that they can either transfer risks which were already realised in a past period, but though have

not been reported to the cedent yet; or in the case of prospective covers, they cover present and future losses. The special feature of finite risk contracts is that the (re-)insurer will provide additional capital, if the means of the experience account are not sufficient in order to cover the damages. In this regard the structure equals traditional excess-of-loss-covers.

The main advantages arising from finite risk contracts are the transfer of both timing and underwriting risk with flexible weights in each part, as well as the possibility of smoothing balance sheets and improving insurers' ratings. Because of the combination of risk transfer and financing this concept made authorities doubtful concerning the proper legal treatment of finite risk contracts. Most controversies were declared by the EU Directive, but some questions are still to be discussed further (see also Culp and Heaton, 2005).

However, the concept itself is convincing and can be applied by private or public business entities which prefer to bundle various types of risk, transfer them to another business entity and see their premiums accumulated in their individual loss-experience-account. Although finite risk contracts have not been used by public institutions in the past, they could be a good vehicle for linking public funds with the reinsurance industry and vice versa.

Similar to captive and contingent capital structures also finite risk contracts help to reduce moral hazard due to the integration of financial market structures. As finite risk contracts are combinations of financing and insurance contracts, the "insured" has an incentive to mitigate risks in order to keep the level of funds in the loss-experience account as high as possible. The better the loss experience, the higher is the repayment at the end of the contract period. Another positive aspect of this type of insurance contract is that it helps to increase available capacities, as risks can be bundled, transferred, financed and spread over time, which in combination with the XOL-feature of these contracts facilitates an enhanced capital availability at the occurrence of a risk event.

Though, also finite risk contracts are typically treated as insurance contracts from an accounting perspective, which implies that the contracts may not help to become more independent of insurance market cycles or to reduce agency issues from the managers' perspective. Also, the insurability (along the criteria defined in Sect. 2) of the risk itself is equal in the case of finite and traditional insurance contracts. Therefore the main advantage of finite risk contracts is the

financing feature combined with an XOL cover, which makes this risk transfer mechanism an attractive alternative for private and in particular for public catastrophe funding.

Captive insurance companies, cat bonds, contingent capital solutions, insurance and weather derivatives as well as finite (re-)insurance contracts are primarily used by companies. But there are crucial arguments for considering these instruments to be useful alternatives, or also simply supplements to public funding as it is carried out at present. In the following section, some solutions are suggested for a joint use of alternative and traditional as well as private and public concepts. Concrete suggestions will be made for the integration of alternative structures into the Austrian catastrophe funding system.

#### 4 Public private partnerships and alternative funding

In the past, various forms of collaboration between public and private entities have been established in order to manage projects in the fields of construction, health care, transportation and communications infrastructure. In most cases, institutions decided to enter a public private partnership (PPP) in order to obtain and benefit from a central platform, which is responsible for funding, planning, implementing and maintaining a certain project (see Smith and Wohlstetter, 2006; Davies, 2006). In particular for complex and very costly projects this type of partnership is considered more and more advantageous (see for example the establishment of the Brenner Eisenbahn GmbH, Bonaventura Strassenerrichtungs-GmbH in Austria; PPP projects in Germany as described in German Institute of Urban Affairs (2005)).

The notion of PPP has not been *defined* on EU community level yet. However, the European Commission stated in its Green Paper on PPPs that the term refers to *forms of cooperation between public authorities and the world of business which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service* (see Commission of the European Communities, 2004). In addition, characteristics of PPPs were identified, such as the relatively long duration of the relationship, the method of joint funding, the crucial role of the economic operator as well as the distribution of risks between the public and the private partner.

The European Commission found that the major incentive for PPPs during the last years can be seen in budget constraints of the member states. Using the words of Michael Saunders, *the private sector is taking on new roles as States seek to meet more public needs with fewer dollars*. He continues by explaining that PPPs facilitate project cost savings, improved quality and system performance from the use of innovative materials and management techniques, and that PPPs may substitute private resources and personnel for constrained public resources (see Saunders, 2006).

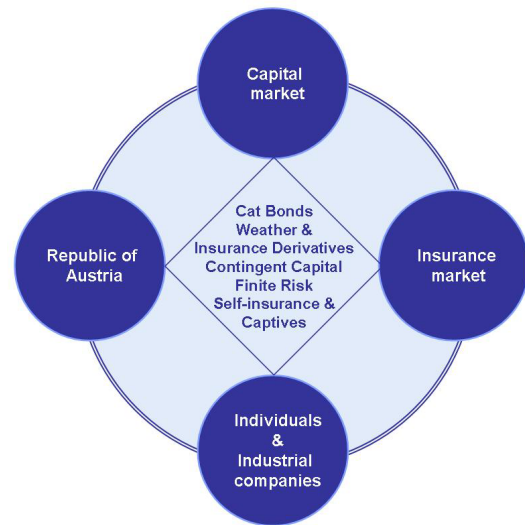


Fig. 4. Potential public and private partners in Austria.

These statements are not only true for the funding of transportation or health care infrastructure, but also regarding the market for insurance covers. Therefore, PPPs must be considered as a means for providing new sources of capital and obtaining access to markets in order to supplement traditional insurance market capacities (see Fig. 4).

Returning to the concepts presented in the previous section, one could, for example, suggest to use a *captive structure* as a platform, primarily for accumulating and managing financial means. Private households, companies or organisations (e.g. tourism associations) could write policies with this captive. Additionally, the captive structure can also issue cat bonds or manage the risk portfolio by using weather derivatives, finite risk contracts or also contingent debt solutions. The structures would be the same as shown in Figs. 1, 2 and 3.

This arrangement would enable private and public institutions to collaborate strategically and to optimise the incentive system in Austria, i.e. by attuning compensation payments funded by private insurers and others funded by the government. If more than one institution, either private or public, founded a joint captive the structure can be compared to the mutual insurance structure, already existing in Austria, but with the difference that the captive members would not necessarily be bound by a joint and several liability. Also, reinsurance coverage can be accessed directly by the members via the captive (see Fig. 5).

Furthermore, this self-insurance structure may indirectly improve the private or public institutions' risk management policy. First of all, risks need to be identified and assessed accurately. If the institution does not follow a strategic approach for assessing and dealing with its risks the real exposure would not be known. This could cause unforeseen

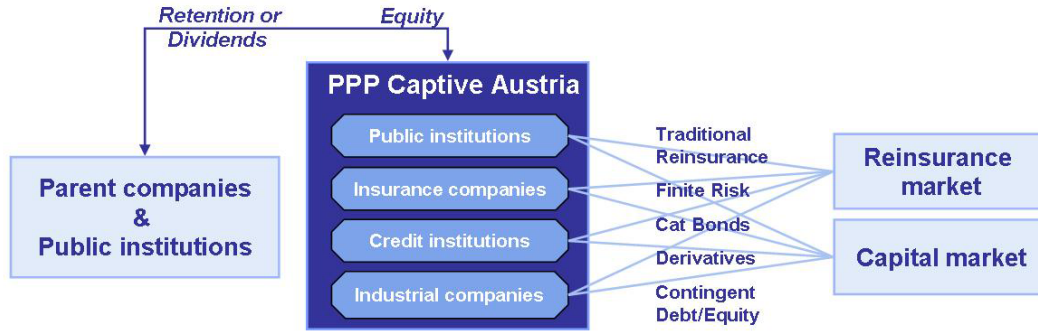


Fig. 5. PPP in the form of a captive structure in connection with other alternative risk transfer mechanisms.

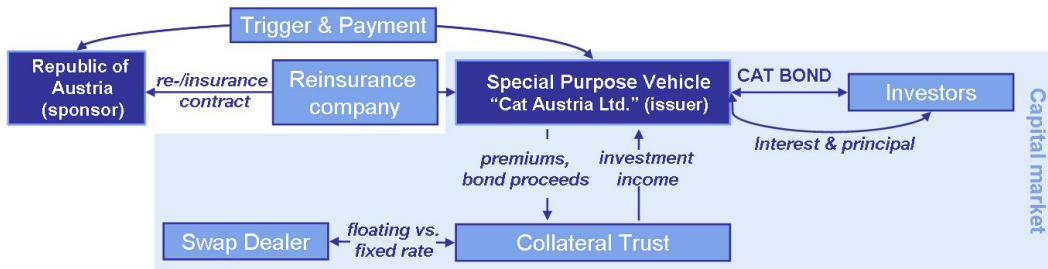


Fig. 6. Austrian cat funding system with governmental catastrophe bond.

negative effects in the case of a catastrophic event, as losses may be higher than initially expected. Consequently, strategic risk management is crucial regarding the institutions' solvency in the long-run. Only if the institution is aware of its true risk exposure, risks can be managed and either transferred or financed in an efficient way.

The mentioned alternative mechanisms may also be applied independently from each other. For example, the system in Austria could be structured as follows: Basic cover is provided by primary insurers, as for example insurance against moderate storms and floods. Additional coverage can be obtained by industrial companies or associations of private individuals by means of alternative capital market solutions, such as weather derivatives, insurance derivatives, contingent loans or even corporate cat bonds.

Originally, when the ART market was still at a starting point, these instruments as well as the captive or finite risk insurance concepts were only applied to the reinsurance market. Over the years the ART market has developed further and is now offering tools which have proven to be effective also for industrial companies regarding the expansion of coverage supply and capacity in general. Because of this, a growing number of European insurers and credit institutions have become interested in ART mechanisms. A few Austrian credit institutions have "experimentally" offered weather derivatives. Some Austrian industrial compa-

nies even purchased such weather contracts over the counter from reinsurance companies or at exchanges (e.g. CME). As studies have shown (see for example Bank and Wiesner, 2008; Bank and Gruber, 2008) many companies in Austria, which are not insured against natural hazards for various reasons, are hardly informed about alternatives to traditional insurance contracts. Thus, in future the communication and information policy has to be considered as a major issue in order to obtain a higher insurance market penetration, not only by traditional but also alternative means, in Austria.

As an "excess-of-loss cover" and third element in this suggestive system the Republic of Austria issues a *cat bond* (as shown in Fig. 6) in order to increase the amount of available cat funds. By this means the Republic can add financial means obtained from the bond issuance to the capacity of the public cat fund, or it can even replace a portion of the current fund. The issuance is conducted either directly by the state or by a special purpose vehicle supported by a reinsurance company. In the latter case, the cat fund (i.e. the state) closes a reinsurance contract with this intermediary which probably facilitates an easier handling of the structure in general. The bond proceeds as well as the insurance premiums paid by the cat fund to the reinsurer are transferred via a special purpose vehicle to a trust and is invested in high-rated securities. Floating rates may also be swapped in order to guarantee fixed coupon payments to the investors, who lend

capital to the government. Thus, the structure is comparable to a classical government bond, but with higher coupon payments rewarding for the catastrophe risk exposure.

The trigger might, either be parametric, for example, calculated on the basis of Austrian precipitation and temperature reports, or indemnity based. In the latter case, the bond will be triggered if, for example, the damages required payments higher than a certain level (assume 200 mio. Euro). Consequently, the investors will not receive coupon payments and if necessary, also the principal is “at risk”. The cashflows are transacted either via the reinsurer or directly from the SPV to the Republic of Austria (i.e. the public cat fund).

Presumably this system would require legal amendments. Particularly the distribution of financial means from the public catastrophe fund to concerned private and corporate entities would need to be well determined in order to actually improve the system as a whole. In conclusion, the availability of additional financial means for catastrophe funding must be seen as an advantage, but regarding practical issues the distribution scheme and criteria are decisive for the success of traditional as well as alternative mechanisms.

## 5 Conclusions

Insurance markets regularly go through soft and hard market phases. In particular on the latter, a lot of research has been done in order to explain why at a certain point of time insurance premiums rise and market capacities decrease. There is no doubt that in hard market phases, which are usually caused by major events, insurance industry is not capable of covering all damages, if a catastrophe occurs. However, catastrophes may cause financial distress in both, hard and soft market phases.

Alternative mechanisms have been developed – mainly by the capital and reinsurance markets – which can be applied in order to provide additional capital that is needed for damage compensation payments. Captives, cat bonds, insurance and weather derivatives as well as finite reinsurance and contingent capital solutions were presented as alternatives available to public and private entities. Most of these mechanisms – originating in the US – have successfully been used worldwide by companies since the 1980s, either in a separate or combined way. The paper suggests to integrate these concepts into the Austrian insurance system and to open minds for more flexible structures that facilitate collaboration among private and public entities. Experience shows that positive effects of PPPs prevail, no matter if they were applied to improve prevention and mitigation of damages, or to improve recovery processes after major events.

At this point one should remark that a first attempt for the creation of a special catastrophe pool was made by considering a public private terror pool. However, the pool remained a “private private partnership” including Austrian insurance companies as the state was not willing to grant its guaran-

tee to cover an excess-of-loss layer. Alternatively, this paper suggests to encourage public decision makers to provide funds for XOL covers by applying securitised products, such as cat bonds or contingent capital facilities, or by applying captive and finite risk insurance.

In the end, the ideas outlined in this paper, would – if put into practice – benefit the Austrian economy and society, as catastrophe funding would no longer be associated with limited insurance supply, scarce capacities and intransparent distribution mechanisms.

Edited by: S. Fuchs, M. Bründl, R. Bernknopf, and T. Glade

Reviewed by: two anonymous referees

## References

- Bank, M. and Gruber, M.: Betriebliche Elementarschadenversicherung in Österreich – eine empirische Analyse (available only in German), alpS working paper, 02, 2008.
- Bank, M. and Wiesner, R.: Der Einsatz von Wetterderivaten in Österreich – eine empirische Studie (available only in German), alpS working paper, 01, 2008.
- Banks, E.: Weather risk management, Wiley & Sons, 2002.
- Banks, E.: Alternative risk transfer, Wiley & Sons, 2005.
- Bantwal, V. J. and Kunreuther, H. C.: A Cat Bond Premium Puzzle?, Wharton School Center for Financial Institutions, University of Pennsylvania, 5, 1999.
- Berliner, B.: Limits of insurability of risks, Englewood, Cliffs, N.J., Prentice-Hall, 1982.
- Bloom, T. S.: Cycles and solutions, Best's Review: Property/Casualty Insurance, 88, 20–24, 1987.
- Booth, G.: A captive audience. Captive Survey 2006, Reactions, 30–33, 2006.
- Brandt, S. and Laux, C.: ART versus reinsurance: the disciplining effect of information insensitivity, CFS Working Paper, 21, 2005.
- Commission of the European Communities: Green Paper on public-private partnerships and community law on public contracts and concessions, COM (2004) 327 final, 2004.
- Culp, C. L.: Alternative risk transfer in: Risk management: challenge and opportunity, edited by: Frenkel, M., Hommel, U., and Rudolf, M., Springer, Berlin, 369–390, 2004.
- Culp, C. L.: Structured Finance & Insurance, Wiley Finance, 2006.
- Culp, C. L. and Heaton, J. B.: The uses and abuses of finite risk reinsurance, Journal of Applied Corporate Finance, 17(3), 18–31, 2005.
- Cummins, D. J.: Reinsurance for natural and man-made catastrophes in the United States: Current state of the market and regulatory reforms, Risk Management and Insurance Review, 10(2), 179–220, 2007.
- Cummins, D. J. and Outreville, F. J.: An international analysis of underwriting cycles in property-liability insurance, J. Risk Insur., 54, 246–262, 1987.
- Cummins, J. D. and Danzon, P. M.: Price, financial quality and capital flows in insurance markets, J. Financ. Intermed., 6, 3–38, 1997.
- Cummins, J. D., Doherty, N. A., and Lo, A.: Can insurers pay for the “big one”? Measuring the capacity of the insurance market

- to respond to catastrophic losses, *J. Bank. Financ.*, 26, 557–583, 2002.
- Davies, B.: Public private partnerships, *School Leadership and Management*, 26(3), 201–203, 2006.
- Doherty, N. A.: Innovations in managing catastrophe risk, *J. Risk Insur.*, 64, 713–718, 1997.
- Doherty, N. A. and Garven, J. R.: Price regulation in property-liability insurance: a contingent-claims approach, *J. Financ.*, 41, 1031–1050, 1986.
- Doherty, N. A. and Garven, J. R.: Insurance cycles, interest rates and the capacity constraint model, *J. Bus.*, 68(3), 383–404, 1995.
- Doherty, N. A. and Posey, L. L.: Availability crises in insurance markets: optimal contracts with asymmetric information and capacity, *J. Risk Uncertainty*, 15, 55–80, 1997.
- Doherty, N. A. and Richter, A.: Moral hazard, basis risk and gap insurance, *J. Risk Insur.*, 69(1), 9–24, 2002.
- Eisenhauer, J. G.: Risk pooling in the presence of moral hazard, *B. Econ. Res.*, 56(1), 107–111, 2004.
- Fairley, W. B.: Investment income and profit margins in property-liability insurance: theory and empirical results, *Bell J. Econ.*, 10, 192–210, 1979.
- Faure, M. G.: The limits to insurability from a law and economics perspective, *The Geneva Papers on Risk and Insurance – Issues and Practice*, 16, 65–88, 1995.
- Federal Ministry of Finance: Der Katastrophenfonds in Österreich (available only in German), [www.bmf.gv.at/Budget/Finanzbeziehungenzu\\_658/Katastrophenfonds/Katastrophenfonds\\_deutsch.pdf](http://www.bmf.gv.at/Budget/Finanzbeziehungenzu_658/Katastrophenfonds/Katastrophenfonds_deutsch.pdf), last access: 8 April 2008.
- Froot, K. A.: The market for catastrophic risk: a clinical examination, NBER working paper, 8110, 2001.
- Froot, K. A.: The evolving market for catastrophic event risk, in: *Risk Management. The state of the art*, edited by: Figlewski, S. and Levich, R. M., Kluwer Academic Publishers, Norwell, 37–65, 2002.
- Froot, K. A. and O’Connell, P.: On the pricing of intermediated risks: theory and application to catastrophe reinsurance, NBER working paper, 6011, 1997.
- German Institute of Urban Affairs: Public Private Partnership Projekte, on behalf of the German Federal Ministry of Transport, Building and Urban Affairs, 2005.
- Gollier, C.: About the insurability of catastrophic risks, *The Geneva Papers on Risk and Insurance – Issues and Practice*, 83, 177–186, 1997.
- Gron, A.: Capacity constraints and cycles in property-casualty insurance markets, Working Paper, Massachusetts Institute of Technology, 1989.
- Gron, A.: Price determination in insurance markets with capacity constraints: theory and evidence, Working paper, University of Chicago, 1991.
- Hill, R. D.: Profit regulation in property-liability insurance, *Bell J. Econ.*, 10, 172–191, 1979.
- Holsboer, J. H.: Insurability and uninsurability: an introduction, *The Geneva Papers on Risk and Insurance – Issues and Practice*, 20, 407–413, 1995.
- Holzheu, T., Karl, K., and Raturi, M.: The picture of ART, *Swiss Re, Sigma*, 1, 2003.
- Jaffee, D. and Russell, T.: Catastrophe insurance, capital markets, and uninsurable risks, *J. Risk Insur.*, 64, 205–230, 1996.
- Jewson, S. and Brix, A.: Weather derivative valuation. The meteorological, statistical, financial and mathematical foundations, Cambridge, 2005.
- Kahneman, D. and Tversky, A.: Prospect Theory: an analysis of decision under risk, *Econometrica*, 47(2), 263–291, 1979.
- Karten, W.: Zum Problem der Versicherbarkeit und zur Risikopolitik des Versicherungsunternehmens – betriebswirtschaftliche Aspekte, *ZVersWiss*, 2(3), 279–299, 1972.
- Kraus, A. and Ross, S. A.: The determination of fair profits for the property-liability insurance firm, *J. Financ.*, 37, 1015–1028, 1982.
- Kunreuther, H.: Causes of underinsurance against natural disasters, *The Geneva Papers on Risk and Insurance*, 31, 206–220, 1984.
- Kunreuther, H.: The role of insurance in managing extreme events: Implications for terrorism coverage, *Risk Anal.*, 22(3), 427–437, 2002.
- Lane, M. (Ed.): *Alternative risk strategies*, Risk Books, 2002.
- Lee, W. and Ligon, J. A.: Moral hazard in risk pooling arrangements, *J. Risk Insur.*, 68(1), 175–190, 2001.
- Marsh: Marsh bringing new capacity to the property catastrophe risk market through innovative insurance offering, *News: Press Releases*, 11-01-2007, 2007.
- Merton, R. C.: On the pricing of corporate debt: the risk structure of interest rates, *J. Financ.*, 29(2), 449–470, 1974.
- Neftci, S.: Contingent capital, providing insurance opportunities, *Credit Risk Special Report*, Oktober, 19–21, 2000.
- Nell, M. and Richter, A.: Catastrophe Index-Linked Securities and Reinsurance as Substitutes, Working Paper Series: Finance and Accounting, Johann Wolfgang Goethe-University Frankfurt, 56, 2000.
- Saunders, M.: Bridging the financial gap with PPPs, *Public Roads*, 70(1), 2–13, 2006.
- Slovic, P., Fischhoff, B., Lichtenstein, S., Corrigan, B., and Combs, B.: Preference for insuring against probable small losses: insurance implications, *J. Risk Insur.*, 44, 237–258, 1977.
- Smith, J. and Wohlstetter, P.: Understanding the different faces of partnerships: a typology of public-private partnerships, *School Leadership and Management*, 26(3), 249–268, 2006.
- Vaté, M. and Dror, D. M.: To insure or not to insure? Reflections on the limits of insurability, in: *Social reinsurance: a new approach to sustainable community health financing*, edited by: Dror, D. M. and Preker, A. S., World Bank Publications & ILO, 125–152, 2002.
- Venezian, E. C.: Ratemaking methods and profit cycles in property and liability insurance, *J. Risk Insur.*, 52, 455–499, 1985.
- Viswanathan, K. S. and Cummins, D. J.: Ownership structure changes in the insurance industry: an analysis of demutualization, *J. Risk Insur.*, 70(3), 401–437, 2003.
- Winter, R. A.: The liability crisis and the dynamics of competitive insurance markets, *Yale Journal of Regulation*, 5, 455–500, 1988.