

Occasional Studies

Reinsurers as  
financial intermediaries  
in the market for  
catastrophic risk

# DNB Occasional Studies

Vol.8/No.2 (2010)

John Lewis

*Central bank and prudential supervisor of financial institutions*

---

©2010 De Nederlandsche Bank NV

Corresponding author: John Lewis  
e-mail: [j.m.lewis@dnb.nl](mailto:j.m.lewis@dnb.nl)

Aim of the Occasional Studies is to disseminate thinking on policy and analytical issues in areas relevant to the Bank.  
Views expressed are those of the individual authors and do not necessarily reflect official positions of De Nederlandsche Bank.

Editorial Committee  
Jakob de Haan (chairman), Eelco van den Berg (secretary), Hans Brits, Pim Claassen, Maria Demertzis, Peter van Els, Jan Willem van den End, Maarten Gelderman and Bram Scholten.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopy, recording or otherwise, without the prior written permission of the Nederlandsche Bank.

Subscription orders for DNB Occasional Studies and requests for specimen copies should be sent to:

De Nederlandsche Bank NV  
Communications  
P.O. Box 98  
1000 AB Amsterdam  
The Netherlands  
Internet: [www.dnb.nl](http://www.dnb.nl)

# **Occasional Studies**

Vol.8/No.2 (2010)

*John Lewis\**

## **Reinsurers as financial intermediaries in the market for catastrophic risk**

\* Research Department, De Nederlandsche Bank, P.O. Box 98, 1000 AB Amsterdam, The Netherlands.  
Tel: +31 20 524 2835, e-mail: [j.m.lewis@dnb.nl](mailto:j.m.lewis@dnb.nl)

# Abstract

In a world of perfect markets, primary insurers could hedge catastrophic risks using financial instruments. In practice however, most primary insurers deal with catastrophic risk by the use of a financial intermediary – a reinsurer. This paper uses insights gained from the institutional economics literature on the existence of banks, to motivate the existence of reinsurers as financial intermediaries. Reinsurers can be motivated by the information acquired by the act of reinsuring, by their role as an efficient form of delegated monitoring, their ability to bear basis risk and to provide liquidity in the aftermath of a catastrophe.

*JEL classifications:*

**G22** (insurance); **G32** (financial risk management); **L20** (firm organization)

*Keywords:*

Reinsurance, catastrophic risk, financial intermediaries, transaction costs

I am grateful to Neeltje van Horen and Dwight Jaffee for useful discussions and feedback on the paper. The views expressed are those of the author and not necessarily those of De Nederlandsche Bank.

# Contents

Introduction	7
The limits of capital market solutions	11
Reinsurers as financial intermediaries	15
<i>Information externalities</i>	15
<i>Reinsurers as delegated monitors</i>	17
Catastrophe bonds and other capital market mechanisms	19
Concluding remarks	23
References	25



# Introduction

Catastrophic risk (very low probability events with very high costs) poses a particular problem for primary insurers. The risks faced by individuals are too highly correlated for the risk to be effectively pooled across policyholders, and hence they must be smoothed across time, rather than pooled intra-temporally. Examples of such risks include major hurricanes, earthquakes in urban centres and certain terror attacks.

Catastrophic risks are an extreme example of non-poolable risk. In most years the catastrophic event does not occur, but in the rare year it does, the primary insurer must pay out claims many times its premium income, and which may even exceed its own capital buffer. Deadweight costs of bankruptcy (including managers human capital) or regulatory concerns could then motivate the hedging of these risks.

Thus for the primary insurer the problem of dealing with catastrophic risk is matching a relatively smooth flow of annual premium income to highly uneven loss payments. Failure to do so could result in the bankruptcy of the primary insurer when a catastrophic event occurs. This is, as Jaffee and Russell (1997) note, “a capital market problem, not an insurance problem”. In a world of complete markets, this problem could be dealt with via appropriate contingent claims traded on financial markets directly without the existence of reinsurers.

This paper uses insights gleaned from the literature on banking to explain why cat risks are typically borne by specialist institutions (reinsurers) rather than being directly traded through the market mechanism. In the banking literature, informational asymmetries may generate an outcome in which loans are handled via financial intermediaries, rather than by anonymised market transactions in financial instruments. Similarly, this paper shows that informational asymmetries in the market for catastrophic risks may cause markets to break down and lead to the emergence of specialist institutions – reinsurers – to retain these risks on their own balance sheets. It follows the intuition of Allen and Gale (2000) and others<sup>1</sup> that certain intermediaries such as banks and firms may exist because they co-ordinate the plans of individuals more efficiently than the market mechanism.

---

<sup>1</sup> The lineage of this intuition goes back much further. See Coase (1935), Malmgren (1961), Fama (1985).

In reality, a variety of non-capital market solutions have emerged – the most predominant of which is emergence of reinsurers. Primary insurers can hedge their catastrophic risk via a reinsurance contract with a reinsurer, who then usually retains this catastrophic risk on their own balance sheet. Correspondingly, it is rare for primary insurers to hedge catastrophic risk using financial instruments traded on financial markets. Whilst some capital market based instruments do exist – such as catastrophe bonds (cat bonds), these account for only a small fraction of the total risk ceded. Guy Carpenter (2008a) calculates the top 40 global reinsurance groups have around \$31bn of reserves, whereas outstanding capital committed to catastrophe bonds totally only \$13.6bn – less than 5% of capital placed in reinsurers. Moreover, these cat bonds are typically issued by reinsurers, and not by primary insurers, and hence they do not supplant the role of the reinsurer.

Although the costs of catastrophic events are very large relative to individual primary insurers (and quite large relative to reinsurers), these costs are relatively small when compared to the size of global capital markets. For example, an upper estimate of the costs to primary insurers of Hurricane Katrina is up to \$79 billion – a roughly comparably sized event would be 0.5% fall in US stock prices which would wipe approximately \$70bn off share values.<sup>2</sup> Therefore, there is something distinctive about catastrophic risk – other than its size – which must explain why the risk is dealt with using intermediaries rather than financial instruments.<sup>3</sup>

This paper highlights several properties of reinsurance which may explain this. First, the informational costs of gathering relevant information may be high, which then constitutes a barrier to market participation. Second, in the wake of a catastrophe a primary insurer may face a moral hazard problem with respect to the monitoring of claims. Third, if the exposure of individual primary insurers to a given event differs and is not public knowledge, then standardised market contracts could lead to an adverse selection problem.

Various explanations developed in the banking literature may explain why a reinsurer may overcome these problems and hence supplant the market mechanism. For example, reinsurers may acquire information as a by-product of providing reinsurance services that potential entrants do not possess. That could then explain both the existence of intermediating institutions, and the difficulty of new firms in supplanting existing reinsurers. Also, a reinsurer may serve as an efficient form of delegated monitoring which is superior to the market based solution.

---

<sup>2</sup> Based on a figure of \$14.840 trillion for the market capitalisation of US stock markets (Source:Thompson Datastream, 16th April 2008)

<sup>3</sup> The issue of how much catastrophic risk is ceded, and the workings of the reinsurance market in general are beyond the scope of the paper. See Froot (2001) for a good account of the incomplete provision of reinsurance and Froot and O'Connell (2001) for a detailed analysis of the pricing of catastrophic risk. For an overview of the allocation of catastrophe risk, see Niehaus (2002).



The paper also analyses the increasing role played by catastrophe bonds. It provides a potential resolution to the anomaly that where catastrophic risks are managed by means of financial instruments, the issuer of the financial instrument is typically an intermediary (the reinsurer) rather than the primary insurer directly. Even if markets are willing to hold catastrophe bonds, reinsurers may still be able to intermediate by providing traditional reinsurance services to primary insurers, and then re-packaging the risk as a catastrophe bond. Reinsurers may be better able to monitor primary insurers than capital markets. In addition, they may be better able to bear basis risk and settlement delays better than primary insurers. Lastly, they may be able to provide payment more quickly after a catastrophe and/or with a lower basis risk than a hedging strategy based on financial instruments would do.

The relative contribution of this paper is to explain the existence of reinsurers as financial intermediaries, using insights gained from the literature on banking. The literature has made great progress on explaining the specific characteristics and pricing behaviour of reinsurers when dealing with catastrophic risk.<sup>4</sup> This strand of the literature begins by assuming the existence of a reinsurer, and then given this, analyses the relationship between the reinsurer and primary insurers. Why the reinsurer exists (as opposed to a market mechanism doing the job) is not typically analysed. To the author's knowledge, the only attempt to use transactions costs to motivate the role of reinsurers is Plantin (2006), which uses an extension of Holmström and Tirole's (1997) model of monitoring to explain the emergence of reinsurers. Whereas Plantin's approach is not able to explain why reinsurers have to commit their own capital, this paper can offer a rationale for why reinsurers must do this, and cannot simply operate as external monitors paid to watch over the capital of others. In addition, this paper develops a richer account of the existence of reinsurers, which goes beyond their role as monitors.

The paper is organised as follows. Section 2 analyses the departures from Arrow-Debreu world which make it impossible for primary insurers to directly hedge their catastrophic risk. Section 3 considers the role of reinsurers as financial intermediaries and draws on insights from the banking literature on imperfect information to explain why reinsurers may emerge. Section 4 considers catastrophe bonds and their limitations as a solution to the problem. Section 5 concludes.

---

<sup>4</sup> See for example, Doherty and Smetters (2005), Froot (2001), Froot and O'Connell (2008), Jaffee and Russell (1997), Doherty and Richter, (2002), Plantin (2006). Jean-Baptiste and Santomero (2000)



## The limits of capital market solutions

In a world of perfect information and complete markets<sup>5</sup>, primary insurers could simply deal with catastrophic risk through direct transactions in capital and asset markets. In such a world, primary insurers should be able to hedge catastrophic risk by acquiring a portfolio of assets and financial instruments which yields a state contingent income flow that matches their state contingent loss payments. This formed the basis of the approach pioneered by Borch (1962) which views reinsurance in terms of an optimal risk sharing arrangement among risk sharing agents and the approach stemming from Mayers and Smith (1990) which borrows from the literature on corporate hedging.

This approach explains why primary insurers seek reinsurance for catastrophic risk and how that risk might be priced, but does not account for the institutional structure by which this takes place. Specifically, primary insurers hedge the vast majority of their catastrophic risk via intermediary institutions (reinsurers) rather than by doing it themselves via hedging with a portfolio of financial assets as neo-classical theory would predict. The reinsurer makes two separate contracts with two mutually unconnected agents – it obtains capital from one agent, writes a reinsurance contract with another and consequently retains the catastrophic risk on its own balance sheet. The question then arises as to why agents choose to transact with an intermediary rather than transacting directly via the marketplace.

To answer this, a useful starting point is the framework of supporting assumptions underpinning the Arrow-Debreu result. To start with, the assumption of complete markets is not satisfied. The complete set of instruments and/or contingent commodities a primary insurer would require to hedge catastrophic risk simply does not exist. At most, there are a handful of event contingent instruments such as mortality bonds or catastrophe bonds and these may carry a considerable basis risk – a bond which pays out in the event of a hurricane hitting Florida is an imperfect hedge against a primary insurers' losses which will depend on the speed, timing and

---

<sup>5</sup> In a pure Arrow-Debreu-world, primary insurers would not exist either. Thus, in this thought experiment we suppose that complete markets exist for primary insurers, even if some other imperfection is present which motivates the existence of primary insurers.

location of the hurricane. Separate instruments which respond to changes in these parameters do not generally exist.<sup>6</sup>

Stiglitz (1995) notes that completeness of market for state contingent commodities will be hampered by the high dimensionality of their characteristics. A separate commodity or asset must exist for each of an almost infinite number of states of nature. As the contingency is progressively more precisely defined, the smaller the number of participants. The greater the number of state contingent markets, the fewer participants each one would have. But, for state contingent markets to be reasonably deep, liquid and competitive, they must attract a large number of participants. For example, the costs to a given primary insurer of a terror attack depend almost entirely on the location and mode of the attack. To hedge against terrorism risk would thus require one instrument for each conceivable type of terror attack, and for all conceivable parameters. Unless participation costs (including costs of acquiring relevant information) are zero then the number of participants in each market will be small, and hence these markets would be illiquid, uncompetitive and thin.

In its weaker form, this inconsistency implies that there is a tradeoff between completeness and the competitiveness (and liquidity) of individual markets. With regard to catastrophic risk, hedging via incomplete markets could lead to quite substantial basis risk. For example, the costs of a hurricane depend on parameters such as wind speed and where the hurricane falls – inability to hedge against variation in these parameters (alongside the occurrence of the hurricane itself) could generate substantial basis risk.

An important feature of catastrophic risk markets is that there is unlikely to be a natural counterparty who wishes to hedge the other way – e.g. hedge against the risk of earthquake “not occurring”.<sup>7</sup> As Jaffee and Russell (1997) note, that leaves only speculative traders as possible participants on the other side of the market. In a world of perfect information, this would not be particularly problematic. Capital would flow to equalize risk-adjusted returns across all assets, and hence, higher expected returns would attract additional capital on the risk bearing side of the market. However, in reality, it is likely that the cost acquiring of relevant information for potential entrants on the other side of the market may be quite high. For example, accurate pricing of such instruments would require modeling of the probability of the event occurring and also of the claims stemming from a given event.

Whilst primary insurers can acquire a good deal of relevant information at little or no cost as a by-product of their insurance services, speculative capital may have to

---

<sup>6</sup> Catastrophe bonds and the like are dealt with in more detail later in the paper.

<sup>7</sup> See Hoyt and McCullough (1999) for a discussion of this point.

invest considerable time and resources in building up the relevant expertise. The greater is the number of contingent markets, the more specialised knowledge is required, and thus the higher the informational costs.

However, the costs associated with correctly pricing risks are only one component of the problem. Information asymmetries between primary insurers and financial market participants could also have the potential to generate moral hazard and adverse selection problems.

Adverse selection could occur if providers of reinsurance were unable to fully distinguish between primary insurers who differed with respect to a given attribute – for example, exposure to a given catastrophic event.<sup>8</sup> If a standard reinsurance contract was offered to all primary insurers based on “average” characteristics, then this would be more attractive to primary insurers with a high exposure than to those with a low exposure. If the dispersion in exposure across primary insurers was big enough, this could result in a classic adverse selection “Lemons” problem (Akerlof, 1970). Primary insurers with lower exposure to the risk would decline the contract, leaving the only the more highly exposed primary insurers in the market. Pricing the contract based on the average population parameters would be unprofitable, and pricing the contract based on the average parameters of those insurance firms left in the market would result in higher premia which would drive the lowest exposed of the remaining firms to decline the contract. This could then lead to the breakdown of the market.

Moral hazard is possible in reinsurance markets because the provider of reinsurance cannot fully observe the actions of the primary insurer. This can occur both *ex ante* and *ex post*. *Ex post*, after a catastrophe, the provider cannot observe the effort taken by the primary insurer to monitor the accuracy of claims and to mitigate losses.<sup>9</sup> If a reinsurance contract is in place, this correspondingly lessens the incentive of the primary insurer to expend costly resources on monitoring of claims. Similarly, *ex ante*, the reinsurance provider cannot fully observe the effort taken by the primary insurer to screen out bad risks. To the extent that claims are reinsured, the primary insurer has less incentive to discern bad risks.

An alternative market mechanism would be for a contingent contract between the primary insurer and a provider of capital which specified the payoffs for the primary insurer in each and every state of nature. The amount that the primary insurer

---

<sup>8</sup> This could arise from a variety of factors – it could reflect the specific characteristics of the policy book of the company, or it could be related to differences in the primary insurers ability/willingness to monitor claims after the disaster.

<sup>9</sup> See for example, Doherty and (2005), Cutler and Zeckhauser (1997)

would have to pay would be determined on the open market, and in principle the reinsurance contract could be traded like any other financial instrument.

In principle, this would overcome the completeness and liquidity problems discussed above, because the number of contracts would simply equal the number of primary insurers, rather than the far larger number of states of nature. In practice, however, incidences of primary insurers obtaining this kind of “re-insurance” directly from the capital market are extremely rare., because there is likely to be a large information asymmetry between the primary insurer and the capital market, with respect to the riskiness of the primary insurer’s policy book. This issue is dealt with more thoroughly in the next section.

## Reinsurers as financial intermediaries

In practice, the most common hedging strategy against catastrophic risk is a specific reinsurance contract with another party – usually a reinsurer. The reinsurance contract essentially states that in exchange for a premium, the primary insurer receives a schedule of payouts conditional on either (a proportion of) the primary insurers indemnity, specific parametric triggers (e.g. strength of hurricane, fatalities etc), total industry losses or a combination thereof.

A notable feature of these arrangements is the fact that primary insurers do not transact with directly providers of capital in financial markets. Instead the reinsurance contract is signed with an intermediary – a reinsurer.<sup>10</sup> In some ways, the role and nature of the reinsurer as an intermediary, is similar to that of a bank.<sup>11</sup> In theory, borrowers and savers could interact directly with each other; but in practice this interaction takes place via an intermediary bank which takes deposits from savers oversees the lending of these funds to borrowers and retains the default risk on its own balance sheet. For banking, a literature has emerged which explains why borrowing takes place through monitored loans rather than directly placed debt (see Diamond, 1991; Fama, 1985; Dia 2008) which emphasises the role of informational asymmetries and transactions costs.<sup>12</sup> By contrast, the reinsurance literature has devoted less attention to the question of why reinsurers exist.

### *Information externalities*

The transactions costs literature on banks posits that banks gain valuable information on their borrowers as by product of providing transactions and deposits services for them, and as a result of transacting with them on a repeated basis (see Black,

---

<sup>10</sup> In this discussion, we use the term “reinsurers” to refer to independent reinsurances entities. Cases where insurance companies set up their own captive reprimary insurers purely to place risk on the market, are considered to be examples of the insurance company interacting “directly” with the market (albeit through a reinsurance captive).

<sup>11</sup> On the other hand, important conceptual differences remain between banks and reprimary insurers as financial intermediaries. For example, the potential complementarities between the provision of deposit services, transactions services and lending, emphasised by some authors (Kashyap et al 2002) do not have an obvious carry over to reinsurance.

<sup>12</sup> Of course, important differences remain. For example, primary insurers cannot suddenly withdraw their funds from a reprimary insurer and hence cause a self fulfilling “bank run” because primary insurer premium payments to the reprimary insurer do not represent a liability for a reprimary insurer, in the way deposits do for a bank.

1975; Fama, 1985; Sharpe 1995; Stiglitz and Weiss, 1983). In the same way, reinsurers may gain an informational advantage through repeated interaction with the same primary insurer. That means that, in the same way that a bank has an intrinsic “inside lending” advantage by repeated lending to a bank, a primary insurer has a “inside reinsurance” advantage.

Specifically, having provided reinsurance on one or more occasions, to a given primary insurer, the incumbent reinsurer acquires private information about the primary insurer which is unavailable to external agents. This gives the incumbent reinsurer an informational advantage over outside reinsurers, which if strong enough means that each reinsurer – primary insurer pair will remain together in subsequent periods.

The intuition of this argument is analogous to Sharpe (1995). Suppose that primary insurers have either high or low exposure to a given hazard. The total proportion of high and low exposure firms is public knowledge, but which group a given primary insurer belongs to is private information.<sup>13</sup> After providing reinsurance in the first period, the incumbent reinsurer learns the true exposure of all its clients. The incumbent reinsurer can then offer a contract to its existing customers based on its private information, whereas an outside reinsurer can only offer a contract based on the public signal. Consider the actuarially fair contracts that each could offer given their information sets. The incumbent can offer a differentiated contract – a higher premium for higher exposure primary insurers, and a lower one for low exposure primary insurers. On each group the expected profit would be zero. The outside offer would be a uniform contract based on population average characteristics. The low exposure firms would stick with their incumbent reinsurer, whereas the high exposure firms would take the outside offer. Knowing this, no outside firm would ever make an offer priced on average characteristics, because they would know this would only attract the high exposure firms and hence not be profitable. Adapting Sharpe’s intuition, the equilibrium outcome is that the incumbent need only offer the low exposure firms a contract at price of epsilon less than uniform outside contract, and the high exposure firms a price equal to the actuarially fair price for high exposure groups. That generates the property that each primary insurer chooses to remain with its initial reinsurer for subsequent periods. That implies that in all periods after the first, reinsurers are able to make supernormal profits. These profits are effectively “returned” to primary insurers by competition for business in the first period, which lowers first period premia to below actuarially fair rates.

---

<sup>13</sup> The model of Sharpe makes a less extreme assumption – namely that the incumbent bank receives better signal about lender type than the public signal. However, for ease of verbal exposition, the simpler setup (incumbent knows everything, outside firms know only population parameters) is used.



This implies that a primary insurer is more profitable to its current reinsurer than it would be to an outside reinsurer, and hence gives incumbent reinsurers market power over the primary insurers they have previously transacted with. This can explain a couple of important stylised facts about the reinsurance market.

First, it explains the stylised fact that reinsurance becomes more expensive in the wake of a catastrophe as reinsurers have depleted reserves and hence reinsurance becomes more scarce (Froot, 2001). The puzzle was why profit making firms don't enter the market in response to the higher market price for reinsurance. The story above provides a simple explanation – A new entrant cannot replicate the profits of the incumbent primary insurers because it does not have the same information set as the incumbent. A rise in the price of reinsurance may fail to induce new firms into the market, because it is still not sufficient to compensate for their relative lack of information and hence it is not profitable for them to enter

Second, it explains the relative dominance of a small group of long-standing reinsurers. Firms which have been in the business longer have acquired more information than newcomers which gives them a built-in competitive advantage. For reinsurance, the information learning process may be slower than for banks. Whereas a bank gets perhaps yearly data on the performance of its firms, exposure to catastrophic risk may be slower to discover, because one may have to wait for an occurrence of a similar catastrophe. The relative infrequency of catastrophic events may thus further reinforce the advantage of incumbency. Precisely this point has been made in the context of banking by Dell'Arriaccia et al (1999). In their model, potential entrants face an adverse selection problem because they do not have the same knowledge as longstanding banks – if this is of sufficient size, then this constitutes a barrier to entry which deters entry to a duopolistic market in which super-normal profits are earned.

#### *Reinsurers as Delegated Monitors*

A related strand of the literature on banking emphasizes the role of banks and other financial intermediaries as delegated monitors. Diamond's seminal (1985) paper develops a rationale for banks in terms of cost advantages in monitoring. Without financial intermediation, an entrepreneur would borrow money from several different individuals. If monitoring of the entrepreneur is left up to the lenders, there could be either wasteful duplication of monitoring effort, or a free rider problem as lenders leave it up to each other to monitor. By collecting deposits of agents and then writing a single contract with the borrower, the bank has a cost advantage in monitoring lender behaviour and can hence intermediate profitably between depositors and lenders.

A similar argument could be extended to reinsurers. Recall from the previous section that a primary insurer who can reinsure their losses faces potential moral

hazard. Providers of reinsurance may then have to monitor the behaviour of the primary insurer to ensure that adequate care is taken in checking claims and in writing policies. If reinsurance is provided by a diverse set of agents, there is scope for a free rider or effort duplication problem. However, if the primary insurer has a single reinsurance contract with one reinsurer, then like Diamond's bank, the reinsurer has a cost advantage in monitoring.

Taken a step further, this logic can also explain an important stylised fact of the reinsurance market – namely that reinsurers have to enter the market with their own capital, and assume risks on their own balance sheets, rather than simply selling their services as raters of risks or independent monitors. Suppose that a diverse group of capital market participants wrote a reinsurance contract with a single primary insurer and then agreed to hire an independent monitor to check on the behaviour of the primary insurer. If it were costly (or impossible) to observe what the monitor was doing, then the moral hazard would simply get relocated backwards a step – i.e. it is difficult to monitor the monitor. This problem could be eliminated if the monitor instead offered to bear the full consequences of its monitoring actions on its own balance sheet. That is consistent with observed characteristics of reinsurers – they obtain funding externally, write out reinsurance contracts, and retain significant risks on their own balance sheets.

## Catastrophe Bonds And Other Capital Market Mechanisms

A related solution is the issuance of catastrophe bonds (cat bonds). In the absence of a catastrophic event investors in the cat bond receive a coupon each year (which includes a premium over the risk free rate) and at the end of the bond's term they receive their capital back. However if a pre-defined catastrophic event occurs, then the investors forfeit the coupon and part of their capital.<sup>14</sup>

The cat bond serves to shift the risk arising from the catastrophic event from the issuer to the bond holder and enables the issuer of the bond to obtain contingent access to capital. Cat bonds have grown substantially in recent years both in terms of the number, and the risk capital committed which peaked at around \$14bn in 2008 (Guy Carpenter, 2009)

Catastrophe bonds tend to have event based or modelled loss triggers rather than indemnity based triggers (Guy Carpenter, 2009). In theory, the former removes the problem of ex post moral hazard, since the issuer of the bond still bears the marginal cost of claims. Moreover, event based triggers tend to be easier for ratings agencies and other external monitors to evaluate, because they only require the evaluation of the probability of an event occurring, and not the associated costs of a given event. In addition, under an indemnity trigger the issuer may have to disclose information about the underlying book of policies which they may prefer to keep confidential for competitive reasons.

A disadvantage of event based triggers is that they create basis risk. McGhee (2004) and Guy Carpenter (2007) identify this is a key issue in restraining the growth of catastrophe bonds. However, the extent of this basis risk depends on the type of trigger used.

---

<sup>14</sup> A similar instrument is the catastrophe option. Under a catastrophe option, the seller must pay the buyer if a given catastrophe losses index goes beyond a certain level. That replicates most of features of a catastrophe bond, except that the buyer need not tie up their capital "up front", as they would when putting their capital into a catastrophe bond. In reality however, the take up has been quite limited. After setting up catastrophe options, the Chicago Board of Trade withdrew them in 2000 due to limited take up.

A parametric trigger refers to a trigger based on the occurrence of a specific event with certain pre-defined parameters, for example the location and strength of a hurricane. To the extent that uncertainty exists as to the costs associated with the trigger event, basis risk arises. The advantage of a parametric trigger however is that it is easier for investors and ratings agencies to evaluate, and in the event of a catastrophe the verification costs are low, and the payout is relatively quick

Alternatively, a cat bond can use an industry loss trigger – whereby the trigger is specified in terms of industry wide losses. Since each individual primary insurer is only a fraction of the industry losses, this reduces the moral hazard problem, and to the extent that a given primary insurer is similar to the “average” primary insurer this reduces basis risk. However, in the event of a catastrophic event, this type of trigger takes the longest time to verify, since it is based on realised losses rather than simply the occurrence of catastrophe itself.

A third option is a modelled loss trigger. In this setup, observed parameters of an event are run through a model. Again, this should in theory eliminate ex post moral hazard, since the payout is non indemnity based, and the better the model, the lower the basis risk. Cummins et al (2004) demonstrate that for the case of hurricane losses in Florida, contracts based on an index of state losses offer a very good hedge for the primary insurers own losses. One disadvantage however, is that this type of trigger may be difficult for investors to understand and price correctly.

Finally, a hybrid trigger can be used – which combines elements of different triggers.

Recent work has identified two additional benefits of catastrophe bonds. First, for the primary insurer, they provide a better protection against counterparty risk because the capital for the bond is deposited in advance (Lakdawalla and Zanjani, 2006). This removes the possibility that a primary insurer is denied a payout because the counterparty’s capital is wiped out by losses elsewhere. Second, they reduce the ability of reinsurers to use private information about primary insurers in order to extract rents from them (Brandts and Laux, 2007).

However, both these insights relate to catastrophe bonds issued by the primary insurer and then sold to investors – i.e. without the involvement of a reinsurer. One striking feature of catastrophe bond issuance up to now is that around half of the 2007 issues were sponsored by reinsurers rather than primary insurers.<sup>15</sup> If investors are willing to purchase catastrophe bonds, then the puzzle is why primary insurers do not issue them directly. There must be some reason why reinsurers can profitably intermediate between primary insurers and holders of catastrophe bonds.

---

<sup>15</sup> Source: Guy Carpenter (2007). In 2006, capital of \$7,346 bn was posted in primary insurer sponsored cat bonds, versus \$7,823 bn in reprimary insurer sponsored bonds.

Part of the explanation for this may lie with the fact that for the primary insurer, any non-indemnity based cat bond will contain a basis risk. For moral hazard and other reasons, capital markets may be unwilling to hold an indemnity based cat bond issued by a primary insurer. By taking on this basis risk themselves, the reinsurer is thus able to reduce the basis risk for the primary insurer, and give the capital markets the instrument they want. There are several reasons why reinsurers may be more willing or more able to take on this basis risk than primary insurers.

First, reinsurers are typically larger in size than primary insurers, and so the relative size of the basis risk from any policy is lower for the reinsurer than for the primary insurer. Thus the “deeper pockets” of the reinsurer means they are better able to manage this basis risk than a primary insurer.

Second, the reinsurer may be able to pool the basis risk of individual primary insurers. Suppose for example that a reinsurer issues a catastrophe bond based on industry losses. For each individual primary insurer, there is a basis risk that their losses are proportionally greater than those across the whole industry. But by construction, these aggregate basis risks cancel out and thus the reinsurer can pool these basis risks. Thus the reinsurer could provide indemnity based reinsurance to the primary insurers, but then hedge this risk using an industry losses catastrophe bond.<sup>16</sup>

Third, if the trigger is based on modelled or parametric loss, a model based “basis risk” arises, to the extent that the model parameter incorrectly captures the realised losses. Unlike the previous example – where basis risks sum by construction to zero, this type of risk (henceforth model risk) may not sum to zero across primary insurers – a given disaster may lead to higher payouts across all primary insurers than the model predicts. It may be that financial markets are unable or unwilling to evaluate the accuracy of reinsurers loss models and hence prefer not to expose themselves to model risk. Evaluating the probability of a given parametric trigger is one thing, but to then evaluate the likely insurance losses from that event is an additional, and perhaps difficult task. In that case, markets are happy to take a position on the specific event parameters, but do not wish to bear any risk from the calculations of the losses stemming from that event (the model risk). In such a case, the reinsurer has to bear the model risk themselves. Thus the reinsurer issues a catastrophe bond with a parametric trigger, meaning that the capital is provided externally, and most of the risk is borne externally, except for the model risk which resides with the reinsurer.

---

<sup>16</sup> This would however, open the reprimary insurer up to potential moral hazard issues – specifically, they may have a reduced incentive to monitor claims after a catastrophe. To get round this, a parametric trigger could be used.

Finally, the importance of liquidity in the event of a catastrophe may be an important factor. In the aftermath of a catastrophe, primary insurers may place great value on being able to pay out claims quickly. Although an indemnity based instrument offers a good hedge, it may take many months or years to accurately verify insured losses, and hence there will be a long delay before the instrument “pays out”. That delay may make it difficult for a primary insurer to pay out promptly in the aftermath of a catastrophe. By contrast, if they obtain reinsurance cover from a reinsurer, which then in turn issues an indemnity based catastrophe bond, then the costs of these settlement lags are borne by the reinsurer. Since the reinsurer is larger, they may have deeper pockets and hence be more able to bear these liquidity shortages. Thus there is scope for an intermediary to exist to take on these liquidity costs and be suitably rewarded for doing so.

Taken together, the emergence of reinsurer sponsored cat bonds can also be explained in terms of the literature on financial intermediation. In the same way that a bank performs a transformative function in terms of divisibility, term and risk transformation, a reinsurer performs a repackaging of risk – taking on the risk of primary insurers and turning it into another asset which is attractive for financial market actors to hold.

## Concluding remarks

Reinsurers provide primary insurers with the means to smooth over time, risks which are not possible to pool within a single a time period across their policy holders. This paper seeks to explain why this reallocation of risk takes place via a financial intermediary – the reinsurer – rather than by primary insurers themselves hedging via portfolio of appropriate assets.

The lack of appropriate hedging instruments is explained partly by the impossibility of simultaneous deep and complete financial markets, which stems from high informational costs as well as potential moral hazard and adverse selection issues hinder the operation of a market in standardised instruments. As Benston and Smith (1976) write “the *raison d’être* for this industry is the existence of transactions costs”.

This paper borrows several insights from the banking literature to explain the existence of reinsurers as means of improving on imperfect markets and overcoming transactions costs. First, the informational advantages conferred by the process of providing the reinsurance motivate the emergence of a relationship based system, rather than a system based on the anonymous trading of financial contracts. Secondly, asymmetric information issues suggest the need for close monitoring of primary insurers. The reinsurer can therefore be thought of as a delegated monitor which avoids free riding or the wasteful duplication of monitoring effort. Thirdly, the reinsurer may be able to profitably intermediate by transforming and repackaging risk. If markets prefer to hold indemnity based catastrophe bonds, but primary insurers seek an instrument which is quick to verify and has no basis risk, then the reinsurer can intermediate between the two by performing a transformational role.

Collectively these insights are able to explain several stylized facts about reinsurers which are otherwise puzzling – they explain the limited entry and exit into the market, the cycles in the price of reinsurance, the fact the reinsurers enter with their own capital (rather than acting as paid monitors) and the fact that where cat bonds are issued, they are often issued by reinsurers rather than primary insurers.





## References

- Akerlof, G. (1970), The Market For Lemons, *Quarterly Journal of Economics*, 84:3, pp 488-500.
- Allen, F. and Gale, D. (2000), *Comparing Financial Systems*, MIT Press, Massachusetts.
- Benston, G., and Smith, C. (1976) A Transaction Cost Approach to the Theory of Financial Intermediation, *Journal of Finance* 31, pp 215-231.
- Brandts, S. and C. Laux (2007) Cat Bonds and Reinsurance: The competitive effect of Information-Insensitive Triggers, *Journal of Risk and Insurance*, 76(3), pp 579-605.
- Black, F. (1975), Bank Funds Management in an Efficient Market. *Journal of Financial Economics* 2, pp 323-339.
- Coase, R. (1935) The Nature of the Firm, *Economica* Vol 14:16 pp 386-405.
- Cutler, D., and Zeckhauser, R. (1997), *Reinsurance for Catastrophes and Cataclysms*, NBER Working Paper 5913.
- Cummins, J., Lolonde, D. and Phillips, R, (2004) The Basis Risk of Catastrophic Loss Index Securities, *Journal of Financial Economics* 71, pp 77-111.
- Dell'Arriccia, L. Friedman, E., Marquez, R. (1999) Adverse Selection as a Barrier to Entry in the Banking Industry, *RAND Journal of Economics*, 30:3, pp 515-334.
- Diamond (1991) Monitoring and Reputation: The Choice Between Bank Loans and Directly Placed Debt, *Journal of Political Economy*, 99:4, pp 689-721.
- Dia,, E. (2004), *Imperfect Information and Monopolistic Pricing in the Banking Industry*, Working, Department of Economics Working Paper, University of Milano Bicocca.

Doherty and Richter (2002) , Moral Hazard, Basis Risk and Gap Insurance, Journal of Risk and Insurance, Vol 69, pp 9-24.

Doherty, N. and Smetters, K. (2005), Moral Hazard in Reinsurance Markets, Journal of Risk and Insurance 72(3), pp 375-391.

Fama, E. (1985) *What's Different About Banks*, Journal of Monetary Economics 15, pp 30-57.

Froot, K., (2001) The Market for Catastrophic Risk: A Clinical Examination, Journal of Financial Economics, 60:2, pp 529-571.

Froot, K., and O'Connell, P. (2008), On the Pricing of Intermediated Risks: Theory and Application to Catastrophe Insurance, Journal of Banking Finance 32, pp 69-85.

Guy Carpenter (2006), The World Catastrophe Reinsurance Market, Guy Carpenter Reinsurers.

Guy Carpenter (2008a) Global Reinsurance Highlights.

Hoyt, R. and McCullough, K. (1999) Catastrophe Options: Are They Zero Beta Assets?, Journal of Insurance Issues 22, pp 147-163.

International Monetary Fund (2008), Global Financial Stability Report, <http://www.imf.org/external/pubs/ft/gfsr/2008/01/index.htm>

Jaffee, D.M. and Russell, T. (1997) Catastrophe Insurance, Capital Markets and Uninsurable Risks, Journal of Risk and Insurance, 64:2, pp 205-230.

Jean-Baptiste, E. and A. Santomero (2000), The Design of Private Reinsurance Contracts, Journal of Financial Intermediation, 9 pp 274-297.

Kashyap, A., Rajan, R., and Stein, C. (2002) Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit Taking, Journal of Finance, 57, pp 33-73.

Lakdawalla, D. and Zanjani, D. (2006), Catastrophe Bonds, Reinsurance, and the Optimal Collateralization of Risk-Transfer, NBER Working Paper 12742.

Malgrem, H. (1961) Expectations and the Theory of the Firm, The Quarterly Journal of Economics, Vol. 75, No. 3, pp 399-421.

McGhee, C. (2004). The Catastrophe Bond Market at Year-End 2003: Market Update, Studies Paper. Guy Carpenter & Company, Inc.

Niehaus, G. (2002), The Allocation of Catastrophe Risk, *Journal of Banking and Finance* 26, pp 585-596.

Plantin (2006), Does Reinsurance Need Reinsurers, *Journal of Risk and Insurance*, 73:1, pp 153-168.

Sharpe, S (1990) “ Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships,” *Journal of Finance*, , vol. 45(4), pp 1069-1087.

Stiglitz, J. (1995) *Whither Socialism?*, MIT Press, Cambridge, Massachusetts.



**Publications in this series as from January 2003**

- Vol.1/No.1 (2003) Requirements for successful currency regimes:  
The Dutch and Thai experiences  
*Robert-Paul Berben, Jan Marc Berk, Ekniti Nitihanprapas,  
Kanit Sangsuphan, Pisit Puapan and Piyaporn Sodsriwiboon*
- Vol.1/No.2 (2003) The blurring of distinctions between financial sectors:  
fact or fiction?  
*Annemarie van der Zwet*
- Vol.1/No.3 (2003) Intermediation, integration and internationalisation:  
a survey on banking in Europe  
*Jaap Bikker and Sandra Wesseling*
- Vol.1/No.4 (2003) A Survey of Institutional Frameworks for Financial Stability  
*Sander Oosterloo and Jakob de Haan*
- Vol.2/No.1 (2004) Towards a framework for financial stability  
*Aerdt Houben, Jan Kakes and Garry Schinasi*
- Vol.2/No.2 (2004) Depositor and investor protection in the Netherlands:  
past, present and future  
*Gillian Garcia and Henriëtte Prast*
- Vol.3/No.1 (2005) Labour market participation of ageing workers  
Micro-financial incentives and policy considerations  
*W. Allard Bruinshoofd and Sybille G. Grob*
- Vol.3/No.2 (2005) Payments are no free lunch  
*Hans Brits and Carlo Winder*
- Vol.4/No.1 (2006) EUROMON: the multi-country model of  
De Nederlandsche Bank  
*Maria Demertzis, Peter van Els, Sybille Grob and Marga Peeters*
- Vol.4/No.2 (2006) An international scorecard for measuring bank performance:  
The case of Dutch Banks  
*J.W.B. Bos, J. Draulans, D. van den Kommer and B.A. Verhoef*
- Vol.4/No.3 (2006) How fair are fair values?  
A comparison for cross-listed financial companies  
*Marian Berden and Franka Liedorp*
- Vol.4/No.4 (2006) Monetary policy strategies and credibility – theory and  
practice  
*Bryan Chapple*
- Vol.4/No.5 (2006) China in 2006: An economist's view  
*Philipp Maier*
- Vol.4/No.6 (2006) The sustainability of the Dutch pension system  
*Jan Kakes and Dirk Broeders*
- Vol.5/No.1 (2007) Microfinanciering, deposito's en toezicht: de wereld is groot,  
denk klein!  
*Ronald Bosman en Iskander Schrijvers*

- Vol.5/No.2 (2007) Public feed back for better banknote design 2  
*Hans de Heij*
- Vol.6/No.1 (2008) Towards a European payments market: survey results on cross-border payment behaviour of Dutch consumers  
*Nicole Jonker and Anneke Kosse*
- Vol.6/No.2 (2008) Confidence and trust: empirical investigations for the Netherlands and the financial sector  
*Robert Mosch and Henriëtte Prast*
- Vol.6/No.3 (2008) Islamic Finance and Supervision: an exploratory analysis  
*Bastiaan Verhoef, Somia Azabaf and Werner Bijkerk*
- Vol.6/No.4 (2008) The Supervision of Banks in Europe: The Case for a Tailor-made Set-up  
*Aerdt Houben, Iskander Schrijvers and Tim Willems*
- Vol.6/No.5 (2008) Dutch Natural Gas Revenues and Fiscal Policy: Theory versus Practice  
*Peter Wierds and Guido Schotten*
- Vol.7/No.1 (2009) How does cross-border collateral affect a country's central bank and prudential supervisor?  
*Jeanette Capel*
- Vol.7/No.2 (2009) Banknote design for the visually impaired  
*Hans de Heij*
- Vol.7/No.3 (2009) Distortionary effects of crisis measures and how to limit them  
*Jan Willem van den End, Silvie Verkaart and Arjen van Dijkhuizen*
- Vol. 8/No.1 (2010) The performance of EU foreign trade: a sectoral analysis  
*Piet Buitelaar and Henk van Kerkhoff*
- Vol. 8/No.2 (2010) Reinsurers as Financial Intermediaries in the Market for Catastrophic Risk  
*John Lewis*



