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The Shareholder Wealth Effects of Insurance Securitization: The Case of Catastrophe Bonds*

Bjoern Hagendorff[a, †], Jens Hagendorff[b], Kevin Keasey[a]

[a] *University of Leeds, UK*
[b] *University of Edinburgh, UK*

Abstract

Insurance securitization has long been hailed as an important tool to increase the underwriting capacity for companies exposed to catastrophe-related risks. However, global volumes of insurance securitization have remained low to date raising questions over its benefits. In this paper, we examine changes in the market value of firms which announce their engagement in insurance securitization by issuing catastrophe (Cat) bonds. Using a unique sample which consists of the near population of Cat bond issues by listed companies so far, we report some limited evidence that Cat bonds have positive performance effects as captured by wealth gains for shareholders in the issuing firm. More important, however, gains from Cat bonds appear to be linked to issuers optimizing the cost of catastrophe risk underwriting. Thus, abnormal returns are particularly large for issues by firms whose risk-profile will make it difficult to obtain competitively-priced reinsurance coverage as well as for issues during periods when prices for catastrophe coverage (including Cat bonds) are low.

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† Corresponding author. Leeds University Business School, Maurice Keyworth Building, LS2 9JT, Leeds. Tel: +44 (0)113 225 4359, e-mail addresses: bn08bh@leeds.ac.uk (B Hagendorff), jens.hagendorff@ed.ac.uk (J Hagendorff), kk@lubs.leeds.ac.uk (K Keasey).

1. Introduction

Firms underwriting catastrophe risks have experienced a remarkable increase in underwriting losses from natural catastrophes over the past decade. Exceptional events such as severe U.S. hurricanes or the terrorist attacks on the World Trade Center have severely hampered the ability of firms to underwrite risks linked to catastrophe events. While firms underwriting catastrophe events pool the resulting risks across their portfolios, the potential underwriting losses linked to catastrophe events are too large relative to capital reserves to diversify them fully (Froot, 2001; Froot and O'Connell, 2008). As a result, the global risk-financing capacity of large catastrophe events by the insurance and reinsurance industries remains limited. This leaves open the prospect of widespread insolvencies and instability in global insurance markets in the event of severe catastrophes (Cummins et al., 2002; Cummins and Trainar, 2009).

Catastrophe (Cat) bonds have long been hailed as securitization vehicles that can markedly increase global risk financing capacity by transferring catastrophe risks to capital markets (e.g. Jaffee and Russell, 1997; Froot, 2001). Cat bonds are insurance derivatives whose payoffs depend on the occurrence of a catastrophe loss event by letting the issuing firm forfeit on principal and/or coupon payments. Despite the potential benefits linked to Cat bonds, the overall volume of insurance securitization has been underwhelming to date. This has led commentators to argue that the benefits of Cat bonds for the issuing firm are limited (Lakdawalla and Zanjani, 2006; Finken and Laux, 2009).

Given the importance of Cat bonds to the insurance industry, uncertainty over whether and how firms with catastrophe-related underwriting exposure benefit from securitizing the resulting risks is an important issue. In this paper, we empirically address this issue by analyzing the performance effects of Cat bonds on the issuing firm. For a unique sample which consists of the near population of Cat bond issues by listed companies up to May 2010, we compute changes in the market value realized by firms which announce their intention to issue a Cat bond.

This paper makes three important contributions. First, we present the first empirical investigation into the benefits of Cat bonds by providing some limited evidence that the announcement to issue Cat bonds on average leads to wealth gains for shareholders in the issuing firm. Previous work on Cat bonds is mostly theoretical (e.g. Bantwal and Kunreuther, 2000; Lakdawalla and Zanjani, 2006) with empirical work lagging behind. This has led to considerable uncertainty as to the actual effects of Cat bonds on the issuing firm. Second, our study also helps to understand the motivations for why firms issue Cat bonds. While the motivations for banks to engage in asset securitization have been analyzed (e.g. Ambrose et al., 2005; Martin-Oliver and Saurina, 2007), much less is empirically known about the reasons why firms engage in insurance securitization. Jointly, our results support the notion that firms issue Cat bonds less as a means to hedge catastrophe risks and more as a means to realize cost efficiencies relative to other forms of catastrophe risk management. For instance, we find that the value effects linked to Cat bond issues are particularly pronounced for firms with low and less volatile losses from their insurance business. We argue that this group of firms tends to be locked into expensive catastrophe-based reinsurance contracts and has much to gain from using Cat bonds to bypass reinsurance markets (see Froot, 2001; Finken and Laux, 2009). In the same vein, we find that issuer abnormal returns are particularly high during periods of low catastrophe insurance prices when the costs of raising capital via Cat bonds will be lower.

Third, the study adds to the literature which attempts to explain the hitherto low share of Cat bonds as compared to catastrophe coverage via insurance and reinsurance markets (e.g. Gibson et al., 2007; Barrieu and Louberge, 2009). Our results show that the market valuation effects linked to Cat bond issues are driven by measures of financial performance of the issuing firm. By contrast, the design of Cat bonds appears to be virtually irrelevant in determining the expected performance gains for Cat bond issuers. We, therefore, argue that our results point to continued investor uncertainty over the benefits linked to insurance securitization as investors are more likely to place trust in Cat bonds issued by highly performing companies.

The remainder of the paper is organized as follows. Section 2 surveys the literature on how firms may benefit from issuing Cat bonds and develops the propositions to be tested in the paper. Section 3 discusses the data and empirical strategy. Section 4 and 5 then present the results of the univariate and multivariate analysis, respectively. Finally, Section 6 concludes and discusses the implications of the findings.

2. Theory and Literature: Do Firms Benefit from Issuing Cat bonds?

Most of the diverse sources of firm gains from issuing Cat bonds can be summarized into two main arguments. First, Cat bonds allow firms to hedge against catastrophe-related underwriting losses. Second, Cat bonds can help firms with catastrophe exposure to realize costs savings on catastrophe-related risk management.

The first argument is that Cat bonds allow the issuer to hedge against catastrophe-related underwriting losses by transferring catastrophe risks to capital markets (e.g. Niehaus, 2002; Harrington and Niehaus, 2003; Cummins et al., 2004). The argument is based on the fact that Cat bonds typically let the issuing firm forfeit on principal and/or coupon payments subject to a catastrophe event occurring. Cat bonds can, therefore, be viewed as a form of subordinated debt which, once forgiven, free up funds to absorb underwriting losses caused by a specified catastrophe.

In practice, however, the payoff structure of Cat bonds rarely makes them a perfect hedge against underwriting losses. This is because triggers which permit forfeiture do not necessarily match the specific loss experience of the issuer. Instead, triggers tend to be defined in terms of industry losses (e.g. via loss indices). While index-based triggers disincentivize issuers to transfer the highest risks of their portfolios to unsuspecting investors (Doherty, 1997), any mismatch between the payoffs from issuing Cat bonds and the losses experienced by the issuer in a catastrophe event give rise to so-called basis risk. Simulation analyses conducted by Harrington and Niehaus (1999) and Cummins et al. (2004) show that the basis risk linked to index-based triggers is manageable for U.S. homeownwer insurers and the large Hurricane insurers in Florida, respectively. Nonetheless, it is important to bear in mind that these results are based on simulations. The risk that the payoffs from index-based Cat bonds do not cover the issuer's catastrophe losses remains a valid concern for issuing firms.

While the presence of basis risk diminishes the usefulness of Cat bonds as a perfect hedge, there are also questions over the extent to which Cat bonds help diversify catastrophe exposures more generally. Cat bonds feature full collateralization of risk exposures, because the funds reserved for principal payment are placed in special trusts and cannot be used to offset losses caused by events other than the trigger event (Niehaus, 2002; Lakdawalla and Zanjani, 2006). Generally, insurers economize on capital and realize diversification gains by protecting insured value in excess of the capital held against it. In that respect, capital provision via Cat bonds is inefficient and does not permit the same diversification benefit as traditional insurance and reinsurance.

The second argument for why firms could benefit from issuing Cat bonds is that firms may engage in insurance securitization to realize costs savings on catastrophe-related risk management. The traditional risk management approach for firms exposed to catastrophe risks is to either raise capital or purchase reinsurance which indemnifies them from all or part of underwriting losses caused by a catastrophe event. However, raising capital to absorb catastrophe losses is costly for both insurance and reinsurance companies (e.g. Jaffee and Russell, 1997; Froot, 2001; Niehaus, 2002). For insurance companies, raising equity capital to absorb catastrophe losses is costly because it is tax-inefficient, while using traditional forms of debt to finance catastrophe risks increases the probability of financial distress (Niehaus, 2002). For reinsurance companies, raising capital to increase their capacity to underwrite catastrophe risks will lead to higher costs of capital, because catastrophes are large correlated loss events which reinsurers cannot fully diversify (see Froot and Stein, 1998; Froot and O'Connell, 2008). Since the costs of obtaining reinsurance for catastrophe risks are high relative to actuarial loss estimates (Lane and Mahul, 2008), most insurers opt to retain catastrophe risks on their balance sheets rather than purchase reinsurance coverage (Froot, 2001). As a result, insurers will typically have to raise costly capital if they wish to increase their catastrophe underwriting capacity.

Cat bonds could provide a cheaper alternative to managing catastrophe risks. Froot and O'Connell (2008) argue that because catastrophe risks are both quantifiable and diversifiable for investors, the required rate of return from holding Cat bonds should equal the risk-free rate in a frictionless world. This argument stands in contrast to the findings of applied work which shows that while spreads on Cat bonds have fallen in recent years they remain well above risk-free levels (Lane and Mahul, 2008) and are comparable to reinsurance premiums for catastrophe coverage (Cummins et al., 2004).[1] However, comparing the pricing of Cat bonds with reinsurance is unlikely to convey an accurate picture of the net costs and benefits linked to insurance securitization compared with reinsurance coverage. Among other things, such comparisons do not take into account that Cat bonds (vis-à-vis reinsurance contracts) carry lower counterparty risk (Cat bond principals are fully collateralized), provide liquidity benefits for the issuer (Cat bond premiums are paid at the end of each quarter rather than upfront as in the case of reinsurance) and result in more predictable cost management for the issuer (Cat bonds provide fixed costs coverage over a multiyear period).

Also, there remain good reasons to believe that some issuers should realize cost savings from issuing Cat bonds compared with obtaining reinsurance. Theoretical arguments propose that informational asymmetries between insurers and reinsurers over the true loss functions of risks for which an insurer seeks indemnity mean that reinsurance premiums are generally set at high levels. As a result, low-risk insurers are unlikely to be offered premiums which reflect their low-risk status when switching reinsurers (Kunreuther and Pauly, 1985). Once an insurer-reinsurer relationship has been established, a lock-in problem exists which allows reinsurers to charge high premiums, because low-risk insurers will not find it optimal to switch reinsurers (see Finken and Laux, 2009). Since the payoffs from Cat bonds are often independent of the issuer's realized losses, Cat bonds are insensitive to such informational asymmetries. Cat bonds, thus, are a less costly alternative for low-risk insurers to either reinsurance or to raising equity.

[1] One frequently advanced explanation for the high spreads on Cat bonds is that investors are unfamiliar with insurance securitization and, therefore, demand a return premium (see Bantwal and Kunreuther, 2000; Habib and Ziegler, 2007; Barrieu and Louberge, 2009).

3. Data and Methodology

3.1. Data

We obtain data on insurance securitizations before May 2010 from Hannover Re. We select all Cat bonds defined as bonds where coupons and/or principal payments are contingent on the occurrence of catastrophe-related property and casualty risks or catastrophe-related mortality risks.[2] Also, we stipulate that Cat bond issuers need to be listed firms which have equity and accounting data available on the Datastream-Worldscope database.

For an initial sample of 143 Cat bond issues, we verify the Cat bond data from Hannover Re by matching them with public information on insurance securitizations in AON Capital Markets (2010) and Guy Carpenter (2008). Where discrepancies between proprietary and public data are identified (e.g., as regards the issue date, value and risks underlying an issue), we tried to resolve these by conducting searches on various news sources available on LexisNexis and Factiva. Where the discrepancies remain unresolved, we omit the issue from our sample (this affects a total of seven issues).

We then omit issues for any of the following reasons. First, we drop so-called follow-up transactions from shelf offering programs. Shelf offering programs allow firms to issue further Cat bonds at any time. Follow-up transactions tend to be very small and have only a limited amount of information available. This affects 29 issues. Second, when a firm issues more than one Cat bond on the same trading day, the transactions were consolidated into a single issue. This leads to 15 individual transactions being consolidated into 3 deals.[3] Third, a further 15 transactions were excluded because the news coverage indicates that confounding events such as earnings announcements, dividend payments or equity and debt

[2] Catastrophe mortality risks result from events which lead to sharp increases in mortality rates such as terrorist attacks or pandemics. Bonds which securitize such risks are referred to as 'mortality (Cat) bonds'. By contrast, we do not include longevity bonds in the sample, because these securitize longevity risk (due to increased life expectancy) and are not linked to catastrophe events (for more details, see Cowley and Cummins, 2005).

[3] When Cat bond transactions are consolidated, we summed up the risk capital of the individual transactions. For all cases where Cat bonds are consolidated, the trigger types of the individual transactions are identical.

issues occurred around the event date. Finally, 7 transactions were excluded because no press release and issue date can be found or no stock price information was available.

[Table 1 near here]

The final sample used in this study consists of 80 Cat bond issues. The issuing firms are insurance and reinsurance firms—most of them large and well-known firms such as Travelers Companies, Axa and Swiss Reinsurance. The data from Hannover Re indicate that our sample corresponds to 80% of the total Cat bond risk capital (i.e. the total of bond principal and coupon payments at risk) issued by listed companies up to May 2010.

Table 1 provides sample descriptives by year (Panel A), trigger type (Panel B) and country (Panel C). It is evident from Panel A that the majority of Cat bond transactions (by both number and total risk capital) took place in 2006 and 2007. The following decrease in the number of new issues in 2008 and 2009 is mostly ascribed to the recent financial crisis and investors' reluctance to invest in securitized assets. Panel B reveals that the vast majority of Cat bonds exhibits an index-linked trigger (i.e. the Cat bonds' payoffs are largely independent of the issuers' realized losses). Finally, Panel C illustrates that that most Cat bonds were issued by companies listed in Switzerland, the U.S. and Germany, respectively.

3.2. Methodology

In this paper, we analyze the stock market valuation effects linked to a firm's announcement to issue a Cat bond. In an efficient capital market, changes in the market valuation of the issuing firm provide an assessment of the net benefits which issuer's will realize from a Cat bond issue. We estimate market-adjusted abnormal returns (AR) for an event window of up to [-25; +25] days relative to the announcement date (t=0):

$$AR_{it} = R_{it} - R_{mt} , \qquad (1)$$

where R_{it} is the return for issuer i on day t and R_{mt} is the return on a value-weighted market index. Equity return and index data are from Datastream. For market return data, we employ national Datastream insurance indices (which also include reinsurers) for the country of the issuing firm.[4] We then average AR across days and firms to yield cumulative abnormal returns (CAR). Finally, to test for the statistical significance of cumulative abnormal returns, we employ a two tailed *t*-test as well as the non-parametric Mann-Whitney-Wilcoxon test which is robust to the effects of outliers.

We do not estimate market model-adjusted return data (which yield risk-adjusted abnormal returns) for two reasons. First, the market model approach assumes that the estimation period over which market model parameters are estimated is free of the type of event under investigation. Since our sample contains a high number of repeat issues by identical firms, we do not have the clean time series of return data necessary to implement this approach. By contrast, computing risk-adjusted abnormal returns with contaminated estimation periods makes the estimates unreliable. Second, Brown and Warner (1980) show that over short-time periods risk-adjusted return values do not significantly improve the quality of estimation results relative to the type of market-adjusted values we employ in this study.

One challenge in determining the market reaction to new Cat bond issues is the lack of an official announcement date. The issue date of a Cat bond is unlikely to be a suitable announcement date, because Cat bonds are sold on a book-building basis where investment banks contact potential investors in advance of an issue to gauge their interest as regards the size and structure of a new issue. It is, therefore, highly likely that market investors are informed about a firm's intention to issue a Cat bond before this intention is announced by the firm. We follow Thomas (1999) and define the event date as the earlier date of either the issue date of a Cat bond or the date an issue was first announced. For each Cat bond, we identify the day that an issue was first announced by conducting searches on LexisNexis and Factiva, as well the issuing firm's website and ARTEMIS (www.artemis.bm) an online practitioner portal for insurance securitization. For 64 issues in our sample, press announcements of Cat bond issues preceded the issue

[4] This market return index is appropriate given the composition of our sample which consists of insurance and reinsurance firms.

date (on average by 13 days). This confirms the importance of employing our hand collected announcement dates (rather than the issue date) as event dates.

4. Univariate Results

4.1. The Shareholder Wealth Effects of Cat Bond Issues

Table 2 reports abnormal returns linked to new Cat bond issues for selected event windows. Panel A shows that CAR[-15; +15] and CAR[-20; +20] are positive and statistically significant above the 10%-level (yet only according to the *t*-test). While Cowan and Sergeant (1996) argue that non-parametric tests may struggle to detect small levels of abnormal share price performance, the insignificant *z*-statistic means we cannot exclude explanations according to which our finding of value gains is driven by outliers. Also, the fact that we do not find significant revaluation effects linked to Cat bond issues for shorter event windows confirms that there is information leakage before the announcement (e.g., when investment banks contact potential clients about the structure and size of new issues). In these cases, the period immediately surrounding the announcement date does not display statistically significant revaluation effects, while slightly longer event windows do.[5]

[Table 2 near here]

To further confirm the validity of our event study specification, Panel B reports abnormal returns around the issue date of Cat bonds. Since any press coverage has preceded the issue date for the vast majority of Cat bond issues, we do not expect to find any statistically significant valuation effects around the issue. Our results in Panel B are consistent with this expectation and confirm our rationale for centering the event study around announcement dates rather than issue dates.

[5] The use of multi-week event periods is consistent with studies examining the shareholder wealth effects of asset securitization in the banking sector. For instance, Thomas (1999, 2001) uses a 50-day event window.

In sum, we report some limited evidence of positive returns around the announcement of new Cat bond issues. However, Table 2 also reports that the sample is nearly split in half as regards sample firms experiencing gains and losses from Cat bond issues. This points to considerable uncertainty as regards the net benefits of Cat bonds for issuing firms. The next sections, therefore, identify factors which determine the market reaction to Cat bonds. This will lead to a better understanding of the conditions under which issuing firms benefit from Cat bonds.

4.2. Value Effects and Trigger Events

As previously argued, one reason why firms could benefit from Cat bond issues is that Cat bonds allow firms to hedge against catastrophe-related underwriting losses by transferring catastrophe risks to capital markets. Since we are unable to measure the hedge efficiency of Cat bonds by matching Cat bond payoffs with issuer losses, we use the different triggers underlying Cat bonds as proxies for hedging benefits to the issuer.

Our sample contains three types of triggers. (i) Indemnity based triggers, where the conditions for principal and/or coupon forfeiture are defined in terms of the underwriting losses of the issuer, (ii) index based triggers, where payouts are based on a loss index, and (iii) hybrid triggers, which blend more than one trigger in a single bond. Indemnity-based triggers provide a perfect hedge against catastrophe-related losses of the issuing firm (i.e. indemnity-based triggers involve no basis risk) and should, therefore, provide the greatest diversification benefits to firms issuing Cat bonds. Further, because indemnity-based Cat bonds are a perfect hedge against underwriting losses, they are more likely to lead to the issuing firm receiving solvency credit by national insurance regulators which means that issuers may achieve regulatory capital savings.

By contrast, indemnity-based Cat bonds suffer from well-defined moral hazard costs. Since issuers are better informed about the loss functions linked to particular risks than market investors, they may issue high-risk bonds to unsuspecting investors (Doherty, 1997). Furthermore, indemnity-based Cat bonds display higher transaction costs resulting from higher disclosure requirements on the part of the issuer as regards the risks being securitized. On the other hand, while index-linked and hybrid triggers are subject to a lower degree of moral hazard (and, thus, carry lower transaction costs), they may both involve substantial basis risk, because the Cat bond payoffs will largely be independent of the losses realized by the issuer. A priori it is, therefore, not obvious which trigger type will bring the larger benefits to the issuer. We propose, however, that if the main benefit of Cat bonds lies in hedging catastrophe-related risks, indemnity-based Cat bonds should lead to higher abnormal returns, whereas if the prospect of costs savings on catastrophe-related risk management is the main source of gains, we expect that Cat bonds with index and hybrid triggers are associated with higher expected performance gains.

[Table 3 near here]

Table 3 examines the market valuation effects linked to Cat bond issues by trigger type for different event windows. We distinguish between indemnity-based triggers as well as index and hybrid triggers (whose payoffs are not directly tied to the underwriting losses of the issuing firm). Overall, the results show that abnormal returns surrounding the announcement to issue Cat bonds do not differ by the type of trigger. Differences in the abnormal returns for indemnity-based Cat bonds compared with non indemnity-based Cat bonds are generally not statistically significant at customary levels (based on either a *t*-test or the non-parametric Mann-Whitney-Wilcoxon test). While we find statistically significant abnormal returns according to a *t*-test for non indemnity-based Cat bonds over [-15, +15] (at 10%-level of significance), Table 3 provides no further evidence that the value effects linked to Cat bond issues differ by the type of trigger event underlying an issue.

4.3. Value Effects and Underwriting Risk

Next to hedging benefits, firms may also benefit from Cat bonds by realizing costs savings on catastrophe-related risk management. The issuers' exposure to underwriting risk is likely to determine the pricing of Cat bonds relative to reinsurance coverage. Theory predicts that the presence of imperfect and asymmetric information in reinsurance markets means that low-risk clients overpay when purchasing reinsurance (see Rothschild and Stiglitz, 1976; Kunreuther and Pauly, 1985). Owing to information asymmetries, reinsurers will set premiums at high levels (to price high-risk clients) meaning that only high-risk firms will find it optimal to switch reinsurers. Low-risk firms, by contrast, are locked into reinsurance agreements with premiums well above levels justified by the actuarial loss functions of the risks for which they seek coverage (Froot, 2001). Non-indemnity based Cat bonds whose payoffs are largely independent of the issuer's realized losses (i.e. the vast majority of Cat bonds in our sample) are insensitive to informational asymmetries (see Finken and Laux, 2009). We, therefore, propose that firms with low risk-profiles will benefit most by issuing Cat bonds as insurance securitization offers relatively greater cost savings as compared to reinsurance coverage or raising equity to absorb catastrophe-related losses.

Table 4 tests this proposition. We use two proxies to distinguish between high and low-risk issuers based on the underwriting activities of the firm. The loss ratio (defined as claim and loss expenses plus long-term insurance reserves scaled by premium income (all in *t*-1)) and the volatility of the loss ratio (measured by the standard deviation of the loss ratio in the four fiscal years before the announcement date). Table 4 reports abnormal returns for different event windows surrounding the announcement to issue Cat bonds in the lowest (Q_1) and highest (Q_5) quintile of the distribution of both proxies.

[Table 4 near here]

In line with our proposition, Table 4 documents that firms with low risk-profiles benefit more from issuing Cat bonds than high-risk issuers. Panel A of Table 4 shows that low-risk issuers (located in Q_1) realize higher abnormal returns than high-risk issuers (in Q_5). Similar results hold over most event windows (significant above 10% for both *t*-test and *z*-test) irrespective of whether we examine loss ratios (Panel A) or the standard deviation of loss ratios (Panel B) to distinguish between high and low risk insurers.

4.4. Value Effects and the Reinsurance Cycle

Another indicator which may provide valuable insights into whether firms issue Cat bonds to realize costs savings on catastrophe-related risk management is the relationship between the reinsurance underwriting cycle and the expected gains from issuing Cat bonds. The reinsurance underwriting cycle is characterized by periods when reinsurance prices are relatively low and coverage is readily available (soft market), and periods when reinsurance prices are high and coverage supply is restricted (hard market). Hard markets tend to follow time periods of natural catastrophes (Froot and O'Connell, 2008). Lane and Mahul (2008) show that the spreads on Cat bonds are positively related to the reinsurance underwriting cycle. During hard reinsurance markets, Cat bond spreads peak indicating that when the costs of reinsurance are high, the costs of issuing Cat bonds are high as well. If the costs of obtaining catastrophe coverage are an important driver of the benefits linked to Cat bond issues, we propose that the value effects linked to issuing Cat bonds during hard reinsurance markets will be lower than the value effects generated by issuing Cat bonds during soft reinsurance markets.

In order to distinguish between soft markets and hard markets, we use the Guy Carpenter (2010) World Catastrophe Rate On Line Index. The index is derived by dividing global catastrophe reinsurance premiums by the global catastrophe reinsurance limit. Table 5 reports abnormal returns for different event windows surrounding the announcement to issue Cat bonds for both the lowest (Q_1) and highest quintile (Q_5) of the distribution of the Rate On Line index.

[Table 5 near here]

Table 5 confirms our proposition. Over all event windows we examine, Cat bond issues during soft markets lead to higher abnormal returns for issuing firms compared with issues during hard markets (when the prices of issuing Cat bonds will be high). This result is statistically significant according to the *t*-test for all event windows and also according to a *z*-test (for [-20; +20] and [-25; +25]), suggesting that lower costs of obtaining catastrophe coverage for issuers are an important source of gains linked to Cat bonds.

5. Determinants of Issuer Expected Performance

5.1. The Model

We use multivariate regression analysis to assess the robustness of our findings in the univariate analysis and to jointly estimate the various factors which affect the market reaction to firms issuing Cat bonds. Specifically, we estimate the following model via OLS with robust standard errors.[6]

$$\text{CAR}[-20; +20] = \alpha_0 + \beta_1\mathbf{IC} + \beta_2\mathbf{BC} + \beta_3\mathbf{MC} + \varepsilon, \qquad (2)$$

where:

- CAR[-20; +20] is the market-adjusted mean cumulative abnormal return over [-20; +20] days relative to the announcement date;
- **IC** is a vector of issuer characteristics in the fiscal year before the issue;
- **BC** is a vector of Cat bond characteristics, and
- **MC** is a vector of market specific characteristics.

Table 6 includes descriptions and summary statistics for the vector of variables described below. All accounting data (unless stated differently) refer to one fiscal year prior to the announcement of the Cat bond issue (*t*-1) and are from Worldscope.

[Table 6 near here]

The vector of issuer characteristics contains firm size (**SIZE**) which is measured by the logarithm of total assets of the issuer. We argue that large companies possess the financial sophistication and

[6] Given the sample size of 80 observations we also implemented the bootstrapping pairs procedure (see Efron and Tibshirani, 1993) with 1,000 bootstrap replications to evaluate the statistical significance of estimated coefficients to test the robustness of the results. We find that our main conclusions are not affected by using the bootstrapping pairs procedure as results remain statistically significant at customary levels. Results of the bootstrapping pairs procedure are available upon request.

adequate mass to produce transactions of sufficient size to amortize the high structuring costs of Cat bonds (Cummins and Trainar, 2009). Further, it is conceivable that larger firms are more likely to boast sizable asset management divisions to facilitate access to potential Cat bond investors (Li et al., 2009). Finally, basis risk involved in the transaction is likely to decrease with the size of the issuing firm (Harrington and Niehaus, 1999). Thus, we expect firm size to enter the model with a positive coefficient.

Another issuer characteristic is the issuer's leverage (**LEV**; defined as total liabilities over total assets) which measures a firm's exposure to financial distress. Harrington and Niehaus (2003) argue that Cat bonds reduce the costs of financial distress to issuers. Thus, we expect that firms with higher leverage will generate positive announcement returns, because securitization is a means to free up capital that can then be used to absorb losses and avoid financial distress in the event of a Cat event (Cummins and Trainar, 2009). We also follow Staikouras (2009) and control for accounting performance in the insurance industry using return on equity (**ROE**; defined as pre-tax profits over book value of equity). Further, we control for pre-issue market performance by using buy and hold abnormal returns (**BHAR**) over [-252; -20] days relative to the announcement date. We expect to find a positive association between the performance measures and announcement returns indicating that investors place more confidence in the performance effects of Cat bonds issued by highly-performing firms.

FIRSTMOVE is a dummy variable which equals one in the case of the issuer's first Cat bond and 0 for follow-up issues.[7] Evidence from the banking sector shows that frequent securitizations are rewarded with higher excess shareholders returns (Thomas, 2001). These findings are explained by potential knowledge and reputation gains as well as greater bargaining power vis-à-vis investors when structuring follow-up issues. Especially against the background of the novelty of insurance securitization and shareholder's unfamiliarity with Cat bonds, we expect that the announcement by a firm to issue a Cat bond for the first time is associated with negative abnormal returns.

[7] As an alternative measure to FIRSTMOVE we also used the number of previous Cat bond issues as a proxy for the issuer's experience, as suggested by Thomas (2001). We find that regression results did not change by using the latter proxy.

We also include indicators of low and high risk issuers. In line with the univariate tests above, we include measures of the riskiness of the issuer's insurance business by using the loss ratio (**LOSSRATIO**; defined as claim and loss expenses plus long-term insurance reserves scaled by premium income) and its standard deviation in the four fiscal years before the announcement date (**UWRISK**). We expect both measures to have a negative effect on abnormal returns, meaning that low risk issuers will benefit most by issuing Cat bonds as insurance securitization offers them relatively greater cost savings as compared with reinsurance coverage.

The vector of Cat bond controls contains the following variables. The size of the issue (**ISSUESIZE**) is computed as the ratio of total risk capital issued to the book value of equity. Since Cat bonds issues display a high proportion of fixed transaction costs, larger issues should be more cost efficient (Cummins and Trainar, 2009) and should, therefore, generate higher abnormal returns. Also in line with the univariate tests, we control for the type of trigger event underlying Cat bonds. **INDEM** is a dummy variable which is equal to one when an indemnity trigger is used (and 0 otherwise). As explained in Section 4.1, we hold no a priori propositions regarding the coefficient on INDEM. A positive coefficient would be consistent with firms using Cat bonds to hedge, while a negative coefficient would reflect the higher costs for the issuing firm associated with indemnity-based Cat bonds. Furthermore, since Cat bonds can be used to securitize a variety of different perils from all over the world, we also control for the location of the securitized risk by adding **USRISK**. USRISK takes a value of one if the securitized risk is located in the U.S. (and 0 otherwise). Lane and Mahul (2008) empirically show that U.S. catastrophe risks demand the highest prices as compared to catastrophe risks in other countries. As a result, if Cat bonds provide a cost advantage over reinsurance, the savings should be highest for U.S. risks. Cat bonds securitizing U.S. risk should, therefore, have more positive value implications for the issuing firm.

Finally, moving to the vector of market characteristics, we consider the Guy Carpenter Rate On Line Index as a measure of reinsurance prices (**REPRICES**) and the inflation-adjusted national GDP growth rates (**GDP**). Since Cat bond spreads are positively related to the reinsurance underwriting cycle (Lane and Mahul, 2008), we expect to find in line with our univariate tests a negative association between

REPRICES and announcement returns. Also, we expect the coefficient on GDP to enter the regression with a negative sign. Investors are more likely to achieve higher returns on traditional asset classes when GDP growth is high and, consequently, will demand higher spreads on Cat bonds compared to periods of lower GDP growth. As a result, when GDP growth is high, Cat bond issues will be more expensive compared to issues completed during periods of low GDP growth.

5.2. Regression Results

Table 7 presents the results of regressions on the announcement period returns (CAR[-20; +20]) around the announcement of a Cat bond issue. The results confirm our main findings from the univariate tests above. First, INDEM does not enter with a statistically significant coefficient, suggesting that indemnity-based Cat bonds do not impact on the value effects linked to insurance securitization. Second, both LOSSRATIO and UWRISK enter the model with negative coefficients (significant at the 5% level). This is consistent with issuers that exhibit lower loss ratios and more stable loss ratios realizing large cost savings from Cat bonds vis-à-vis reinsurance coverage. This is because low-risk insurers tend to accept disproportionately higher premiums or deductibles for traditional insurance cover as a result of imperfect and asymmetric information in reinsurance markets. Third, reinsurance prices affect the benefits which issuers expect to extract from the issue of a Cat bond. REPRICES enters with a negative and statistically significant coefficient, indicating that Cat bond issues during periods of low reinsurance prices (soft markets) lead to higher abnormal returns for issuing firms. Overall, these results confirm that the source of performance gains for firms engaging in insurance securitization lie in realizing cost efficiencies compared with reinsurance or by timing issues to coincide with soft reinsurance markets.

[Table 7 near here]

Further, the control variables show that highly-performing firms (both in terms of ROE and BHAR) realize higher abnormal returns (significant at the 5% level). Also firms with lower leverage realize higher abnormal returns (significant at the 5% level). The negative coefficient on leverage (LEV) is contrary to our proposition that less leveraged firms benefit most from Cat bond issues. Jointly, we interpret this and the results on the other control variables as market investors assigning higher performance gains to better performing issuers. This could be interpreted as consistent with explanations according to which investors who are unsure about the performance implications of Cat bonds, employ measures of the issuer's recent performance to gauge the expected performance effects of a Cat bond.

Also, and consistent with the last point, it is also interesting to note a general lack of control variables linked to Cat bonds which enter the regressions with a statistically significant sign. Consequently, it could be argued that shareholders are either indifferent about the design of Cat bonds (with respect to how they benefit an issuer) or, alternatively, this could also be due to considerable uncertainty about the effects of Cat bond design on the issuing firm.

6. Summary and Conclusions

Cat bonds let firms exposed to catastrophe-related risks engage in insurance securitization by transferring catastrophe-related risks to capital markets. For firms with catastrophe-related exposures, there should be a number of potential benefits associated with issuing Cat bonds. However, many of the arguments made in favor of Cat bonds do not take into account supply-side or demand-side frictions in the market for catastrophe risks. Over the years, this has led to considerable uncertainty over whether Cat bond actually benefit the firms which use insurance securitization to transfer catastrophe-related risks. In this paper, we empirically examine the shareholder wealth effects of companies that issue Cat bonds. For this purpose, we analyze the shareholder wealth effects of firms which announced their intention to issue Cat bonds.

Using a unique data set which consists of the near population of Cat bond issues by listed companies, we find some limited evidence of wealth gains for shareholders in firms which issue Cat bonds. We interpret this as consistent with the issuers of Cat bonds realizing net benefits from insurance securitization. Further examination reveals that the value effects linked to insurance securitization appear to be driven by explanations according to which Cat bonds offer cost savings versus other forms of catastrophe risk management (and less by their potential to hedge exposure to catastrophe risk). Issuers with low and stable loss ratios (which are likely to overpay in reinsurance markets for catastrophe coverage) as well as issues during time periods in which the premiums for catastrophe coverage are low (and coverage via Cat bonds less expensive) experience large value gains linked to Cat bond issues. When analyzing the drivers of abnormal returns linked to Cat bond issues, we find that indicators of issuer performance, rather than the design of individual Cat bonds, determine the value created. We interpret this as consistent with shareholders being uncertain about the potential benefits of Cat bonds and, hence, placing trust in Cat bond issues by highly performing companies.

Overall, our results draw a positive picture of the expected performance effects of Cat bonds on the firms which issue them. Arguably, Cat bonds may well have additional positive effects on firms with catastrophe-related risks which our empirical approach is unable to detect. For instance, Cat bonds may have increased competition for catastrophe reinsurance and thereby lowered catastrophe reinsurance premiums (see Froot, 2001). Therefore, even though the present paper tries to gauge the effects of Cat bonds on issuing firms, Cat bonds may have benefited firms beyond those which have issued them.

Future empirical work on the effects of Cat bonds on issuing firms should do more to address the risk effects of insurance securitization on issuing firms. Even though our results point to the benefits of Cat bonds to issuers being linked to the pricing of catastrophe coverage and less to Cat bonds as a means of hedging catastrophe-related risk, little is known to date about the effects that Cat bond issues have on the riskiness of issuing firms. Theoretical work continues to posit that Cat bonds are a means for firms to hedge catastrophe-related risks which should therefore have measurable risk effects on the issuing firm. Future work should, hence, investigate the risk effects of Cat bond issues, for instance, by examining the impact that insurance securitization has on market measures of issuer risk.

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Table 1
Sample Characteristics

Panel A: Distribution of Cat bond Issues by Year

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Number	1	1	3	4	6	3	2	1	5	12	17	10	9	6	80
Risk capital $ (millions)	112	45	322	604	797	356	605	248	1,007	3,344	4,043	1,638	1,290	850	15,261
% Value	0.73	0.29	2.11	3.95	5.21	2.33	3.95	1.62	6.58	21.86	26.42	10.71	8.43	5.56	100.00

Panel B: Distribution of Cat bond Issues by Trigger Type

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Indemnity	0	1	1	0	0	0	0	0	1	2	2	3	1	0	11
Index	1	0	2	4	6	3	2	1	3	9	12	5	6	5	59
Hybrid	0	0	0	0	0	0	0	0	1	1	3	2	2	1	10

Panel C: Distribution of Cat bond Issues by Country

	France	Germany	Japan	Switzerland	UK	U.S.	Total
Number	9	18	3	24	3	23	80
Risk Capital $ (millions)	2,164	2,944	748	5,215	408	3,782	15,261
% Value	14.15	19.24	4.89	34.08	2.67	24.72	100.00

Notes: The sample consists of 80 Cat bonds in the period 1997 to May 2010. This is approximately 80% of total Cat bond risk capital (defined as the total of bond principal and coupon payments at risk) issued by listed companies during that time period.

Table 2
Abnormal Returns for Selected Event Windows

	N	mean (%) (*t*-stat)	median (%) (*z*-stat)	CAR>0% N	CAR>0% %
Panel A: Distribution by Announcement Date					
CAR[-5;+5]	80	0.38	-0.20	37	46.3
		(0.77)	(-0.11)		
CAR[-10;+10]	80	1.01	0.20	42	52.5
		(1.50)	(0.56)		
CAR[-15;+15]	80	**1.55**	0.85	43	53.8
		(2.00)**	(1.25)		
CAR[-20;+20]	80	**1.45**	0.11	43	53.8
		(1.67)*	(0.93)		
CAR[-25;+25]	80	0.78	0.41	44	55.0
		(0.94)	(0.47)		
Panel B: Distribution by Issue Date					
CAR[-5; +5]	80	0.08	-0.20	39	48.8
		(0.14)	(-0.10)		
CAR[-10;+10]	80	0.97	0.52	44	55.0
		(1.39)	(1.26)		
CAR[-15;+15]	80	0.93	-0.33	39	48.8
		(1.10)	(-0.47)		
CAR[-20;+20]	80	0.88	-0.02	40	50.0
		(0.96)	(-0.08)		
CAR[-25;+25]	80	0.41	0.05	41	51.3
		(0.47)	(0.33)		

Notes: The table reports cumulative abnormal returns (CAR) for both the announcement date (Panel A) and the issue date (Panel B) of Cat bond issues during the period 1997 to May 2010 for different event windows. In both cases, abnormal returns are estimated using a market model:

$$AR_{it} = R_{it} - R_{mt}$$

where R_{it} is the observed arithmetic return for issuing firm *i* at day *t* and R_{mt} is the value-weighted market index return for day *t*. Also included are *t*-statistics (two tailed) and the non-parametric Mann–Whitney–Wilcoxon *Z*-scores.*, ** indicate significance at the 10 % and 5% levels, respectively.

Table 3
Value Effects by Trigger Event

		CAR[-5;+5]	CAR[-10;+10]	CAR[-15;+15]	CAR[-20;+20]	CAR[-25;+25]
Indemnity	mean	-0.42%	-0.04%	1.03%	1.27%	-0.58%
N=11	(*t*-stat)	(-0.37)	(-0.02)	(0.43)	(0.37)	(-0.14)
	median	-0.47%	-0.14%	-0.37%	-0.44%	-0.31%
	(*z*-stat)	(-0.46)	(-0.05)	(-0.15)	(-0.26)	(-0.25)
Other	mean	0.50%	1.16%	**1.62%**	1.47%	0.97%
N=69	(*t*-stat)	(0.91)	(1.58)	**(1.91)***	(1.64)	(1.26)
	median	-0.13%	0.20%	1.13%	0.27%	0.41%
	(*z*-stat)	(-0.06)	(0.64)	(1.36)	(0.85)	(0.64)
$\mathbf{\Delta CAR_{INDEM-OTHER}}$	mean	-0.92%	-1.20%	-0.59%	-0.20%	-1.55%
	(*t*-stat)	(-0.61)	(-0.59)	(-0.24)	(-0.08)	(-0.62)
	median	-0.34%	-0.06%	-1.50%	-0.77%	-0.72%
	(*z*-stat)	(-0.46)	(-0.21)	(-0.62)	(0.10)	(-0.53)

Notes: The sample consists of 80 Cat bonds issued in the period 1997 to May 2010. All firms are publicly traded. We estimate market-adjusted abnormal returns for different event windows relative to the announcement date (*t*=0). We then average abnormal returns over each event window to yield cumulative abnormal returns (CAR). To test for the statistical significance of CAR, we employ a two tailed *t*-test as well as the non-parametric Mann–Whitney–Wilcoxon test. * indicates significance at the 10 % level.

Table 4
Value Effects by Issuer Underwriting Risk

		CAR[-5;+5]	CAR[-10;+10]	CAR[-15;+15]	CAR[-20;+20]	CAR[-25;+25]
Panel A: Loss Ratio						
Low (Q_1)	mean	2.94%	**5.37%**	**7.98%**	**7.80%**	5.71%
N=16	(*t*-stat)	(1.08)	**(1.96)***	**(1.92)***	**(1.91)***	(1.36)
	median	0.70%	**1.48%**	**5.24%**	**4.38%**	4.87%
	(*z*-stat)	(0.88)	**(2.31)****	**(1.72)***	**(1.72)***	(1.36)
High (Q_5)	mean	-0.10%	-0.96%	-0.38%	-0.09%	0.20%
N=15	(*t*-stat)	(-0.21)	(-0.99)	(-0.40)	(-0.08)	(0.17)
	median	0.70%	-0.50%	-0.16%	-0.98%	-0.77%
	(*z*-stat)	(0.51)	(-1.02)	(-0.57)	(-0.80)	(0.11)
ΔCAR_{Q1-Q5}	Δmean	3.04%	**6.33%**	**8.36%**	**7.89%**	5.51%
	(*t*-stat)	(1.40)	**(2.60)****	**(2.46)****	**(2.27)****	(1.55)
	Δmedian	0.00%	**1.98%**	**5.40%**	**5.36%**	5.64%
	(*z*-stat)	(0.74)	**(2.41)****	**(1.96)***	**(1.76)***	(1.16)
Panel B: Standard Deviation of Loss Ratio						
Low (Q_1)	mean	4.43%	**7.02%**	7.98%	6.77%	2.84%
N=16	(*t*-stat)	(1.09)	**(1.75)***	(1.38)	(1.24)	(0.55)
	median	1.26%	**3.19%**	4.37%	2.92%	2.61%
	(*z*-stat)	(1.15)	**(2.31)****	(1.36)	(1.36)	(0.52)
High (Q_5)	mean	0.35%	1.04%	1.30%	1.29%	1.00%
N=16	(*t*-stat)	(0.68)	(1.45)	(1.50)	(1.26)	(1.04)
	median	0.14%	0.45%	0.97%	-0.10%	0.30%
	(*z*-stat)	(0.58)	(0.26)	(1.27)	(0.60)	(0.51)
ΔCAR_{Q1-Q5}	Δmean	**4.08%**	**5.97%**	**6.68%**	5.49%	1.84%
	(*t*-stat)	**(2.07)****	**(2.38)****	**(2.11)****	(1.56)	(0.56)
	Δmedian	1.12%	**2.74%**	3.40%	3.02%	2.31%
	(*z*-stat)	(0.98)	**(1.80)***	(1.16)	(1.13)	(0.27)

Notes: The table reports market adjusted cumulative abnormal returns (CAR) for different event windows surrounding the announcement to issue Cat bonds for the lowest (Q_1) and highest quintiles (Q_5) for both the loss ratio (defined as claim and loss expenses plus long-term insurance reserves scaled by premium income (all in *t*-1), Panel A) and the standard deviation of the loss ratio (in the four fiscal years before the announcement date, Panel B). Also, the differences in CAR between the lowest and highest quintile are reported (ΔCAR_{Q1-Q5}). The sample consists of 80 Cat bonds issued in the period 1997 to May 2010. All firms are publicly traded. To test for the statistical significance of CAR, we employ a two tailed *t*-test as well as the non-parametric Mann–Whitney–Wilcoxon test. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 5
Value Effects by Reinsurance Prices

		CAR[-5;+5]	CAR[-10;+10]	CAR[-15;+15]	CAR[-20;+20]	CAR[-25;+25]
Guy Carpenter Rate On Line Index						
Low (Q_1)	mean	3.78%	4.04%	6.34%	6.91%	3.11%
N=20	(*t*-stat)	(0.98)	(0.99)	(1.29)	(1.23)	(0.67)
	median	0.55%	3.42%	4.15%	7.85%	6.25%
	(*z*-stat)	(0.28)	(0.70)	(1.12)	(1.26)	(0.70)
High (Q_5)	mean	-0.46%	**-1.08%**	-0.93%	**-1.58%**	**-2.17%**
N=13	(*t*-stat)	(-0.97)	**(-1.70)***	(-1.17)	**(-2.17)****	**(-2.77)*****
	median	-1.04%	-0.95%	-0.61%	**-1.12%**	**-1.70%**
	(*z*-stat)	(-1.07)	(-1.48)	(-0.92)	**(-1.85)***	**(-2.41)****
ΔCAR_{Q1-Q5}	Δmean	**4.25%**	**5.11%**	**7.27%**	**8.48%**	**5.28%**
	(*t*-stat)	**(1.96)***	**(2.14)****	**(2.50)****	**(2.69)****	**(1.91)***
	Δmedian	1.59%	4.37%	4.76%	**8.97%**	**7.95%**
	(*z*-stat)	(0.55)	(0.92)	(0.85)	**(1.77)***	**(2.04)****

Notes: The table reports market adjusted cumulative abnormal returns (CAR) for different event windows surrounding the announcement to issue Cat bonds for the lowest (Q_1) and highest quintiles (Q_5) for the Guy Carpenter Rate On Line Index (Source: Guy Carpenter, 2010). We use this index as a measure of the reinsurance price level. Also, the differences in CAR between the lowest and highest quintile are reported (ΔCAR_{Q1-Q5}). The sample consists of 80 Cat bonds issued in the period 1997 to May 2010. All firms are publicly traded. To test for the statistical significance of CAR, we employ a two tailed *t*-test as well as the non-parametric Mann–Whitney–Wilcoxon test. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 6
Summary Statistics

	Variable	Definition	N	Mean	Median	Std. Dev	5 Pctile	95 Pctile
Value effect	CAR[-20;+20]	Market-adjusted mean cumulative abnormal return over [-20; +20] days relative to the announcement date (%)	80	1.45	0.11	7.90	-8.92	17.48
Issuer characteristics	SIZE	Log of total assets	80	18.36	18.87	1.62	14.94	20.84
	LEV	Total liabilities to total assets (%)	80	85.47	89.43	13.03	61.86	95.93
	ROE	The ratio of pre-tax profits to equity (%)	80	16.18	17.59	10.61	-3.19	31.70
	BHAR	Buy and hold abnormal return from -252 to -20 days relative to the announcement date (%)	80	0.25	-2.52	22.25	-27.40	34.72
	FIRSTMOVE	Dummy which equals 1 for the first Cat bond issue by a firm (and 0 otherwise)	80	0.35	0	0.48	0	1
	LOSSRATIO	Loss ratio (%). Defined as (claims and loss expenses + long-term insurance reserves) / premiums earned	80	80.32	82.50	18.86	51.00	117.5
	UWRISK	Standard deviation of loss ratios over a four-year period prior to the announcement date	80	6.45	4.62	6.08	1.24	18.02
Cat bond characteristics	ISSUESIZE	Value of Cat bond issue scaled by the book value of equity (%)	80	2.61	1.45	3.25	0.31	10.60
	INDEM	Dummy which equals 1 if the Cat bond has an indemnity trigger (and 0 otherwise)	80	0.13	0	0.33	0	1
	USRISK	Dummy which equals 1 if the securitized risk is located in the U.S. (and 0 otherwise)	80	0.46	0	0.50	0	1
Market characteristics	REPRICES	Reinsurance cycle. Guy Carpenter World Catastrophe Rate On Line Index. Source: Guy Carpenter (2010)	80	243.56	250.00	39.84	155.00	295.00
	GDP	Inflation-adjusted GDP growth rates	80	1.58	2.12	2.07	-2.44	4.10

Notes: Accounting data (unless stated differently) refer to one fiscal year prior to the announcement of the Cat bond issue (*t*-1) and are from Worldscope. GDP data are from IMF – International Financial Statistics database. Cat bond data (FIRTSMOVE, ISSUESIZE, INDEM, USRISK) are provided by private records by Hannover Re and public records by AON Capital Markets (2010).

Table 7

Regressions on Abnormal Issuer Announcement Returns

Independent Variable	**A**	**B**	**C**	**D**	**E**
SIZE	2.157	2.701		2.092	0.029
	(1.43)	(1.67)		(1.34)	(0.03)
LEV	**-0.178****	**-0.154****	**-0.147*****	**-0.163****	**-0.149****
	(2.39)	**(2.03)**	**(3.11)**	**(2.50)**	**(2.03)**
ROE	-0.127	-0.115	-0.065	-0.115	-0.073
	(1.53)	(1.24)	(1.12)	(1.61)	(1.12)
BHAR	**0.112*****		**0.140*****	**0.111*****	**0.141*****
	(2.73)		**(3.04)**	**(2.68)**	**(2.76)**
FIRSTMOVE	0.129	0.066	0.055	0.168	0.826
	(0.06)	(0.03)	(0.03)	(0.08)	(0.37)
LOSSRATIO	**-0.056****	**-0.080*****		**-0.060*****	
	(2.59)	**(2.70)**		**(2.79)**	
UWRISK	**-0.309*****		**-0.344****	**-0.289*****	**-0.311****
	(2.82)		**(2.27)**	**(3.22)**	**(2.12)**
ISSUESIZE	0.906	1.020	0.270	0.862	
	(1.34)	(1.41)	(0.73)	(1.26)	
INDEM	-0.536	-0.397	-1.608		
	(0.18)	(0.12)	(0.48)		
USRISK	1.381	0.818	1.528		
	(0.56)	(0.35)	(0.66)		
REPRICES	**-0.033****	**-0.053****		**-0.034****	
	(2.02)	**(2.46)**		**(2.03)**	
GDP	-0.592	-0.648		-0.585	
	(1.28)	(1.45)		(1.25)	
Intercept	-8.883	-16.137	15.863***	-8.020	16.363
	(0.35)	(0.60)	(3.21)	(0.30)	(1.19)
No. of observations	80	80	80	80	80
Adjusted R^2	0.21	0.12	0.17	0.23	0.18
p-value of *F*-test	0.00	0.00	0.00	0.00	0.00

Notes: The table reports the results of ordinary least squares regression for CAR[-20;+20] relative to the announcement date (*t*=0). The independent variables are: SIZE = logarithm of total assets; LEV = ratio of total assets to total liabilities; ROE = return on equity; BHAR = one year buy and hold abnormal return; FIRSTMOVE = number of previous issues; LOSSRATIO = the loss ratio (defined as claim and loss expenses plus long-term insurance reserves scaled by premium income); UWRISK = standard deviation of loss ratios; ISSUESIZE = ratio of total risk capital issued to total shareholders' equity; INDEM = dummy variable which equals 1 if the Cat bond has an indemnity trigger (and 0 otherwise); USRISK = dummy variable which equals 1 if the securitized risk is located in the U.S. (and 0 otherwise); REPRICES = Guy Carpenter world catastrophe rate on line index (Guy Carpenter, 2010); GDP = growth rates of GDP. All accounting data (unless stated differently) refer to one fiscal year prior to the announcement of the Cat bond issue (*t*-1) and are from Worldscope. GDP data are from IMF – International Financial Statistics database. The *t*-statistics (two tailed) of the coefficients are reported in the parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.