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SHAREHOLDERS VALUE AND CATASTROPHE BONDS. AN EVENT STUDY ANALYSIS AT EUROPEAN LEVEL

Abstract

Considering that the E.U. based (re)insurance companies are increasingly active within the segment of alternative risk transfer market, the aim of the present paper is to emphasize the impact of issuing cat bonds on the shareholders' value for highlighting the competitive advantages of the analysed (re)insurance companies while pursuing the consolidation of their resilience in a turbulent economic environment.

Eminently an applicative research, the analysis employs an event study methodology whereas adjusting the market model residuals with the aim of accounting for generalized autoregressive conditional heteroskedastic (GARCH) effects through advanced econometric procedures. To account for the shareholders' value, the research employs high frequency financial data (daily returns of stock-exchange listed (re)insurance companies) and the cat bonds' announcement dates as economic events.

Keywords

alternative risk transfer solutions, catastrophe bonds, competitive advantage, event study, GARCH model

1. Introduction

Sustainable economy and, implicitly, sustainable development are more and more influenced by the occurrence of large natural catastrophes as they pose important social and economic consequences both at the level of the society as a whole, and at the level of companies. Furthermore, there is a worldwide consensus that their impact, in terms of financial costs, is growing as the social and economic activity is developing towards areas more prone to catastrophe risks – a fact of great concern at E.U. level, especially in the context of the climate change concerns. As one of the most affected business regarding the natural disasters, the companies within the (re)insurance industry adapted their risk management strategies while accessing the capital markets' capacity through the development of sustainable financial tools and instruments. One of the most prominent examples is the case of the securitization of the disaster risks by issuing catastrophe bonds (cat bonds).

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Considering the growing importance and potential of these innovative risk management instruments, the scope of the present paper is three fold:
(1) to emphasize the impact of issuing cat bonds on the shareholders' value while employing a GARCH enhanced event study methodology
(2) to analyse the market of the catastrophe bonds from a European perspective
(3) to highlight several competitive advantages of the analysed (re)insurance companies while pursuing the consolidation of their resilience in a turbulent economic environment

2. Literature review

2.1. Event studies – selective literature

Although the starting point of the event study methodology is acknowledged to be the research of Dolley (1933) that focuses on the price impact of stock splits (referenced by Cam, Ramiah, 2014, 171; Nageswara Rao, Sreejith, 2014, 41), there are the seminal works of Ball and Brown (1968) and Fama, Fisher Jensen, and Roll – FFJR (1969) that are considered to be the modern inception studies within this field (Bowman, 1983, 561; Corrado, 2011, 207).

Considering the two afore mentioned studies, the specialized literature acknowledges two well-identified typologies of event studies: (a) information impact event studies, as is the one developed by Ball and Brown (1968), in which there are investigated the effects particular events have on the company investors' wealth (b) market efficiency testing event studies, following that of FFJR (1969), where there is investigated the behaviour of the stock prices while adjusting to specific new information (Bowman, 1983, 562; Binder, 1998, 111).

Furthermore, Kothari and Warner (2007, 5), referring to the relevance of the event studies in financial economics, highlight that: (i) the short-horizon oriented event studies show importance of the policy decisions at corporate level while centring on the announcement impact around a particular event and (ii) the long-horizon oriented event studies are significant while testing market efficiency when analysing the persistence of abnormal returns following a specific event. Along with this typologies, Bowman (1983, 573-575) acknowledge a third and fourth typology: (a) model evaluation event studies, in which the core is the expectation model employed in inferring the information content and (b)metric explanation event studies, cantered on finding "variables which explain the excess return metric observed in an information content or market efficiency test" (Bowman, 1983, 574).

2.1.1. Outlining the basics of the event study methodology

There are several studies that outline the design and steps of an event study (e.g. Bowman, 1983; MacKinlay, 1997; Kothari, Warner, 2007), defining, broadly, the following fundamental stages:
(1) Defining the event and the event window. As specified by Bowman (1983), the event specification impacts on the assumptions to be tested, while crucial aspects are also represented by the precision in establishing the occurrence timing or the presence of confounding events. With regard to the event window, this refers to the period of time

established for investigating the assets' price behaviour induced by the analysed event. Prior to the event window, there is also established the so called estimation window which serves for examining the movements of the prices.
(2) Companies sample selection. With respect to this aspect, the specialized literature recommends establishing criteria for including companies within the analysed sample like listing criteria or industry membership (MacKinlay, 1997, 15).
(3) Defining a reference process for the normal returns behaviour. The normal or benchmark returns are those used to determine the abnormal returns through comparing with the assets returns. The most frequently used methods for computing normal returns are: (i) mean adjusted returns (ii) market adjusted returns and (iii) conditional (market and risk) adjusted returns (Brown, Warner, 1980, 207-208; Nageswara Rao, Sreejith, 2014, 45). Mean adjusted returns are based on a benchmark determined as the average return over the estimation window (the pre-event window period). In a market adjusted returns approach, there is assumed that the companies included in the sample yield as the market over the event window. Conditional risk adjusted returns are based on regression models to determine the expected returns, while accounting for the stock return – stock market index nexus (a variety of the Capital Asset Pricing Model).
(4) Determining and cumulating the abnormal returns. In order to infer information on the stock price changes, the abnormal returns are aggregated across time and securities/companies (Henderson Jr., 1990, 285-286; MacKinlay, 1997, 21). Therefore, taking into account that there is an interest in the performance of the price both around the event and on longer periods of time around the event, the abnormal returns can be aggregated: across companies, in correspondence with each event period (AAR – average abnormal returns), across time (CAR – cumulative abnormal returns). MacKinlay, 1997, 21). Further, either AAR or CAR is aggregated to obtain cumulative abnormal average returns (CAAR) – inferring on the abnormal returns' aggregated impact For example, in order to obtain CAAR, average abnormal returns could be cumulated over the days of the event widow.
(5) Employing statistical tests to investigate the significance of the results. In this respect, Henderson Jr. (1990, 297-298) emphasizes that there are main concerns: the choice of a parametric or a nonparametric test and the choice of the test. Generally, the literature recommends the use of parametric tests and, more precisely the student t-test (Henderson Jr., 1990, 298)

2.1.2. Using GARCH models in event studies

Since the inception of the seminal work of Fama et al. (1969), the literature of event studies proved to be prolific. However, as Kothari and Warner (2007, 8) point out, there have been only two pivotal variations from the methodological perspective: the prevalence of daily and intraday returns employment and the advancement in complexity of the abnormal returns' estimation and statistical significance testing.

As mentioned by Corhay and Tourani Rad (1996, 529), the specialized literature acknowledged that eluding the "time dependence in stock return series" can inflict both on the efficiency of the parameter estimates and on the predictability of the test statistics. Furthermore, Mills et al. (1996, 559) affirm that erroneously specified market models could conduct to flawed inferences regarding the effect of a specified event on the stock returns.

Cam and Ramiah (2014), while comparing seven expected returns models (including GARCH and EGARCH) for studying the effects of catastrophic events (terrorist attacks and, also, the subprime crisis) on stock market returns, conclude that different asset pricing models conduct to different results in terms of the magnitude and sign of the effect.

Cosistent with the above findings, several research papers address the issue of autoregressive conditionally heteroskedastic effects (ARCH) of the residuals resulting from the market model by employing the generally acknowledged GARCH models originally developed by Bollerslev (1986).

For example, Brockett et al. (1999), while accounting for the well-known stylized facts regarding the stock returns (e.g. fat tails, autocorrelation in squared returns), improve the market model by employing AR(1) and GARCH(1,1) processes in order to examine the impact of the California's Proposition 103 on the insurance stocks returns.

Sabet et al. (2012) investigate the impact of two events (British Petroleum oil spill and the USA moratorium on exploration) on companies from the oil and gas sector through a GARCH(1,1) enhanced event study after identifying ARCH effects.

Thomann (2013) examines the effect of both the 9-11 attacks and natural catastrophes on insurance stocks volatility by employing multivariate GARCH models (a DCC-GARCH (1,1)) and infer that in order to obtain unbiased results while studying the impact of insured catastrophes with event studies there should be considered the nonstationarity of beta.

2.2. Stock returns reaction to cat bond activity – event studies insights

Mueller (2002) centres on the impact of issuing catastrophe bonds on the stock returns of listed insurance and reinsurance companies. Considering a series hypothesis regarding the stock prices (H1: Issuing cat bonds is value enhancing – positive reaction, H2: Considering the spread of the cat bonds, prices will be negatively affected – negative reaction, and H3: Considering the spread of the cat bonds, prices will not be affected – neutrality) the author runs a market model for the normal returns, using both an aggregate and an individual approach regarding the cat bonds issues. As benchmarks, the author employs MSCI World, the MSCI World Insurance, and the FT All World Insurance index, while also determining an equally weighted price index that tracks the performance of the companies included in the sample. Both the private placement offering memorandum (for 16 issues) and the press/news alerts (for 12 issues) are used to infer the event date. The general conclusion supported hypothesis three, the cat bonds being revealed as a substitute for the reinsurance.

Bierley (2008) and Bierley et al. (2008), focusing on several hypothesis regarding the corporate demand for insurance, examine through both a multi-factor and a single-factor event study the response of the stock market returns to cat bonds issuance, complemented by a cross-sectional analysis. The sample comprises 44 transactions developed between 1997 and 2007 by 20 companies from three sectors: financial, energy, and entertainment. The benchmarks are local stock market indices as well as the MSCI World Index as a proxy of

the world capital markets. The event study is structured to test the semi-strong form regarding the efficient market, while considering the immediate impact of the announcements on the stock returns. In order to test the statistical significance of the results, there are used three tests: two parametric (the Patell z Test and the Standardized Cross-sectional z Test) and one non-parametric (the Generalized z Test). The results regarding the impact of a series of factors on firm value indicate that the event date has a significant positive effect; firm size had a significant negative effect; industry/sector dummy variable (insurer versus non insurer) reflected a positive and significant impact for the non-insurer, while the trigger dummy variable reflected that investors favour modelled loss triggers.

Hagendorff et al. (2012), centring on a 80 cat bond sample issued by 25 companies up to May 2010, examine the wealth effects associated to the issuance and announcement dates of catastrophe securitization. The employed methodology generates market-adjusted abnormal returns, while the benchmark is an insurance index tracking, also, reinsurance companies' performance. In terms of the robustness of the results, the authors employ both parametric (two tailed t-test) and non-parametric (Mann-Whitney-Wilcoxon) tests. The authors, first, develop an univariate analysis through which there are investigated the wealth benefits of announcing the cat bonds issuance, concluding that issuing cat bond does not imply strong wealth increases for the stock investors of the cedent company. Further, the study accounts for value effects while analysing both the hedging benefits (with triggers and initial rating as proxies) and cost savings (with the loss ratio and the underwriting cycle as proxies). The results suggest there are no differences in the abnormal returns around announcements of cat bonds issue when including the trigger type, while lower loss uncertainty and soft market issued cat bonds generates higher abnormal returns. Therefore, the cost savings motivations overcome the hedging ones in terms of wealth effects. The research is complemented by a multivariate analysis that confirms the findings of the univariate one.

3. Development of the empirical analysis

3.1. Data and methodology

Since the aim of the paper is to give a recent outlook on investor value concerning (re)insurance companies within the EU, we have selected all Cat bonds issued by companies with headquarters within EU Member States. As within the other insurance securitization event-studies (Mueller, 2002; Bierley, 2008; Bierley et al. 2008; Hagendorff et al., 2012), we considered within our research those bonds where coupons and/or principal payments are related to a specific set of risks associated property damage or casualties as a consequence of natural catastrophes. However, we excluded transactions that pertain to the life/mortality or to auto/credit insurance risks as we want to capture exclusively the effect of the cat bonds through which natural catastrophe risks are securitized. It is noteworthy to mention that the structure of the bonds is irrespective of the actual risks and, more importantly, there is no difference in the risk related markets. The considered cat bond deals were selected from the well-known www.artemis.bm website.

All companies considered within the study are listed companies with widely available data, and, in this regard, we used daily frequency returns for all 8 major Cat bonds cedents/sponsors (Allianz SE, Hannover Re, Munich Re, AXA, SCOR, Assicurazioni Generali, Amlin and Catlin) from 03-Oct-2005 to 22-Aug-2014 gathered from Thomson Reuters Eikon. Additionally, we used the Euro Stoxx 600 index as the market index for our forecasting model, evidently, using the same frequency and time interval. Minor adjustments were necessary since two companies are listed in Pound Sterling hence, the conversion was made in Euros using the European Central Bank rate.

The highlight of our data gathering effort is materialised in our events sample which is comprised indiscriminately of Cat bond issue announcements for all considered companies within the reference time period. The data sample was compiled from three main sources consisting of AON, Artemis, and Alacrastore. Additional confirmations concerning the announcement dates were also gathered from additional sources. Overall, we have gathered 43 Cat bonds announcement dates which constitute themselves in our events sample.

Part of the reason why we selected multiple sources is the fact that currently available data presents a relative high degree of inconsistency which leaves room for discussion on the actual sample correctness. This uncertainty is currently generalised in the study of Cat bonds and its impact stretches beyond localised result quality. In this regard, it is important to mention the fact that the results of different similar event studies have a relatively lesser degree of comparability due to lack of a common set of announcement dates which induces a bias in results from one study to another. As suggested by Hagendorff, Hagendorff, and Keasey (2013), this issue would not be resolved however, by substituting announcement dates with issue dates due to the fact that Cat bonds are sold on a book-building basis which signifies that issuers already contact potential investors at the time of the issue. Part of the rationale of this behaviour is given by the fact that issuers need to assess investor reactions regarding the size and structure of potentially issued Cat bonds which signifies that investors already adjust their trading behaviour based on a company's intention to issue a Cat bond before the issue date. (Hagendorff, Hagendorff, and Keasey, 2013, 288) In the end, this signifies that announcement dates cannot be substituted with issue dates due to the uniqueness of carry-over information.

In this paper, the basic event study methodology will involve analysing stock market valuation effects as a consequence to a company's Cat bond issue announcement. This is primarily done by statistical significance testing (simple t-test) of market-model adjusted abnormal returns (AR) and cumulative abnormal returns (CAR) across days and firms. Abnormal returns and cumulative abnormal returns are computed for 20 days period before and after each event.

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

where:

r_{it} is the return of company i on day t and

r_{mt} is the return forecasted from an estimation (based on 100 intervals before) of a GARCHX model, where the mean equation uses the market index, and the variance equation is a standard GARCH(1,1) model, which, to our knowledge, stands for an innovative approach within the event studies regarding the effects of the cat bonds issuances on the stock returns as proxy for the wealth of the shareholders. The study was developed in MATLAB.

3.2. Hypothesis development

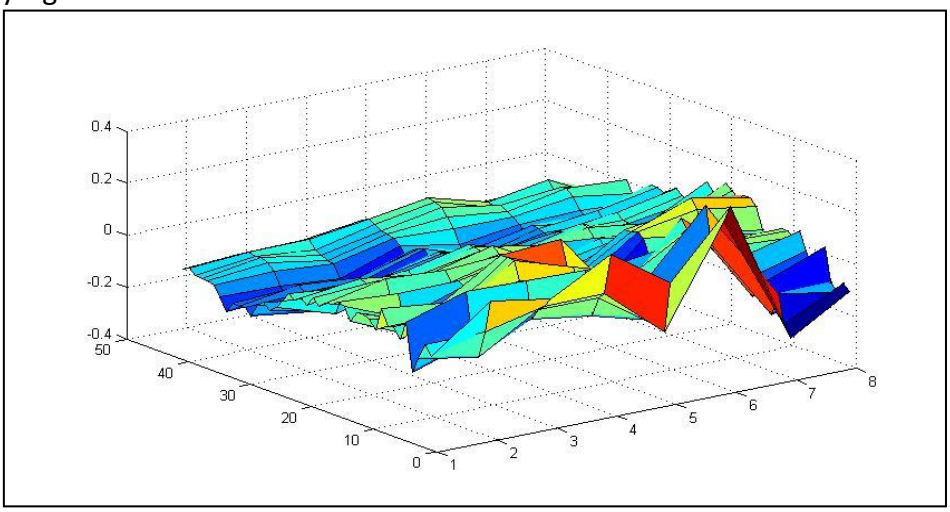
By using the event study methodology we test the abnormality hypothesis of returns from (re)insurance companies which issued Cat bonds starting from the market efficiency hypothesis that signifies that asset returns assimilate new information concerning current and future performance. In essence, if an event has any impact on the market or individual performance, its returns will vary as soon as the information was processed by the market. Cumulative abnormal returns which are statistically significant indicate a strong impact on the company or market while non-significant returns indicate their ability to recover from jolts.

In this regard, we have formulated two work hypotheses:
1. At a market level, individual announcements of Cat bonds issues do not influence the performance of all other companies;
2 At a company level, individual announcements of Cat bonds issues do not influence the performance of the single issuing company

These two hypotheses ensure the fact we keep both an overall market focus and allow us to examine in more detail which of the 8 considered companies is more susceptible to changing investor perception around Cat bonds announcement dates.

3.3. Empirical findings

We first ran our event study to check for the overall market reaction to Cat bonds announcements. After computing our abnormal returns, cumulative abnormal returns and t-statistics we observed that there are no statistically significant cumulative abnormal returns. This signifies that individual Cat bonds issue announcement do not influence the overall market comprised of the 8 EU based (re)insurance companies. This does confirm our first hypothesis and signifies that the market captures in an efficient and unbiased manner information concerning these type of events irrespective of the time frame around the event. As the figure bellow illustrates, the close to 0 t-values leave no room for finding any statistically significant CAR.



Source: authors' contribution (developed in Matlab)

Figure 1. *t-statistics for all 8 companies for the [t-20; t +20] event window*

By further investigating individual company reactions to the events we came to the collusion that for 6 out of 8 companies the individual CARs for their own Cat bond announcements were not statistically significant and consistent with our findings at a market level. However, for two of the companies we have identified three and respectively 6 statistically significant CARs . The tables bellow illustrate the days before or after the announcement in which the statistically significant CARs were identified, the actual computed CARs and associated t-stats and p-values.

Event window	***[t-20; t+20]***		
	CAR	**t-stat**	**p-value**
t-20	-0,015**	-2,119	0,10
t-19	-0,018**	-2,628	0,06
t-18	-0,022**	-2,307	0,08
** statistically significant at 10% *** statistically significant at 5%			

Source: authors' contribution (developed in Matlab)

Table 1. *Value effects of Cat bond announcements on an individual company (AXA)*

Event window	***[t-20; t+20]***		
	CAR	**t-stat**	**p-value**
t+14	-0,102**	-3,942	0,059
t+15	-0,102***	-6,708	0,022
t+16	-0,103***	-30,885	0,001
t+18	-0,093***	-4,678	0,043
t+19	-0,099***	-6,493	0,023
t+20	-0,105***	-6,752	0,021
** statistically significant at 10% *** statistically significant at 5%			

Source: authors' contribution

Table 2. *value effects of Cat bond announcements on an individual company (Amlin)*

Our findings indicate that for two companies in our sample, Cat bonds issue announcement do exert some influence on an individual level. This challenges our second hypothesis and signifies that for some companies the information comprising of Cat bond announcements is captured in a biased manner starting as soon as 20 to 18 days prior the announcement and 14 to 20 days after the announcement. One particularly noteworthy aspect is represented by the negative abnormal returns which implies negative valuation effects on a company level as a consequence to cat bond announcements. However, as one can noticed, in the case of the first company, the abnormal returns are registered before the announcement date and, though negative, have a rather small value. Furthermore, the identified and considered number of transactions is quite low. For the second company, the results, though significant, could be the outcome of a low number of developed transactions while also suggesting that shareholders might be reticent to the initial entry on a rather new alternative risk management market and the associated costs.

4. Conclusions

In recent years, the amount and intensity of natural disasters have led insurance and reinsurance companies to deal with the very complex situation of seeking alternative risk transfer solutions. Cat bonds are regarded as an acceptable solution since these transfer catastrophe-related risks to capital markets and, in this regard, issuing Cat bonds should offer a number of potential benefits. However, current state-of-the-art mentions significant uncertainties on whether or not Cat bonds actually bring these benefits to issuing companies. It is this uncertainty which justifies our endeavour to empirically examine the shareholder wealth effects for a data set consisting of 8 EU based Cat bond issuers from 2005 to 2014.

Specifically, on an individual company level, some evidence of shareholder effects was registered, for two of the companies. Significant CARs were recorded respectively, before and after the events. Very interesting facts are the generalised negative impact of announcements and the overall clustering of statistically significant CARs of two companies. However, provided the relatively low number of Cat bond issues and the overall uncertainty of actual announcements, our results have to be interpreted with due caution and should be regarded as guidelines rather than recommendations. Considering these aspects, we do not interpret the results as conducting to shareholder's value destruction, but rather as a "novelty effect" considering the experience of the cedent/sponsor company on the cat bond market. This could also support the fact that Cat bond issuers should take the responsibility to communicate with investors prior to any issue announcement more seriously in order to give these a better understanding of these bonds. *Therefore, the second hypothesis was partially confirmed, suggesting that, generally, the stock returns of the more experienced companies on the cat bond market have a neutral reaction to the issuance of these financial products.*

On a market level, some interesting results of our study reveal that there is not sufficient evidence to support or disprove performance gains. In this regard, no statistically significant abnormal returns were registered by all 8 companies in relation to individual events. This supports evidence of efficient markets and leads to believe that Cat bond announcements do not generate biased investor reactions. Some conclusions may be drawn, in this regard, concerning the lack of localised contagion where the overall mass of companies is not affected by individually occurring announcements. *Therefore, the first hypothesis is confirmed indicating an unbiased response at the level of the sponsors' stock returns as these issue catastrophe bonds.*

In conclusion, our paper highlights some present shareholder value effects regarding the performance of E.U. headquartered (re)insurance companies that issue Cat bonds. While considering the present state of this market at E.U. level (e.g. the current coverage through these instruments), the results seem to confirm that there is generally a neutral response to the securitization of natural catastrophe risks. Therefore, as in Mueller (2002), at the level of our sample, the results seem to suggest that for the moment the cat bonds stand for alternative to reinsurance. However, we would also add that, considering the resistance of these financial products, especially in turbulent times, nowadays, they stand for a viable alternative.

Therefore, in terms of competitive advantages, at this point, we could infer two statements: (1) Overall, the cat bond market at the level of E.U. based companies, seems to be in a state of equilibrium between costs and benefits of issuing cat bonds, as they are perceived by investors. This state of art, along with further liquidity and more transparency within the cat bond market, could lead to generate shareholders value.
(2) At individual level, companies that have a rather stable presence on the cat bond market, though are not currently recording positive stock returns to the cat bonds' issuance, seem to exhibit a better perception in this respect from their investors when compared with those companies that new or enter rarely on this market.

As further research, at the level of this sample, the research could be complemented by considering a series of improvements encountered in the specialized cat bond literature: accounting for other structural features of the deals while analysing the results of issuing cat bonds for the ceding companies or considering other types of effects (both in terms of financial performance and risk).

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5. Bibliography

1. Ball, R. and Brown, P. (1968). An Empirical Evaluation of Accounting Income Numbers. In P.G. Berger, C. Leuz, and D.J. Skinner (ed.), *Journal ofAccounting Research, Autumn 1968,* (pp.159-178). Location: John Wiley & Sons Inc, USA
2. Bierley, B.E. (2008). *Catastrophe Securitization: A Multi-Factor Event Study on the Corporate Demand for Risk Management* (A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree, Master of Arts, Athens, Georgia, Major Professor: Robert Hoyt, Committee: Jim Hilliard and Steven Pottier). Location: [B.E. Bierley]. Retrieved 2014, September 11 from https://getd.libs.uga.edu/pdfs/bierley_bobby_e_200812_ma.pdf,
3. -----, Hilliard, J.I. and Hoyt (2008). Catastrophe Securitization: A Multi-Factor Event Study on the Corporate Demand for Risk Management. Location: Terry College of Business,University of Georgia. Retrieved 2014, October 8 from http://portal.business.colostate.edu/projects/ARIA/Shared%20Documents/5e_Bierley_Catastrophe%20Securitization.pdf
4. Binder, J.J. (1998). The Event Study Methodology Since 1969. In C.-F. Lee (ed.), *Review of Quantitative Finance and Accounting, Volume 11, Issue 2* (pp. 111–137). Location: Kluwer Academic Publishers, Boston. Manufactured in The Netherlands.
5. Bollerslev, T. (1986), Generalized Autoregressive Conditional Heteroskedasticity, In R.J. Smith (ed.), *Journal of Econometrics, Volume 31, Issue 3* (pp. 307–327). Location: USA
6. Bowman, R. (1983), Understanding and conducting event studies. In P.F. Pope, A. Stark and M. Walker (ed.), *Journal of Business Finance and Accounting, Vol. 10, Nr. 4* (pp. 561-584), Location: John Wiley & Sons Ltd, USA
7. Brown, S. And Warner, J. (1980). Measuring security price performance.. In G. William Schwert (ed.), *Journal of Financial Economics, Volume 8, Issue 3*, 205–258. Location: USA
8. Brown S.J. and Warner J.B. (1985). Using daily stock returns: the case of event studies. In G. William Schwert (ed.), *Journal of Financoal Economics, Volume 14, Issue 1* (pp. 3–31). Location: USA
9. Cam, M.-A., Ramiah, V. (2014). The influence of systematic risk factors and econometric adjustments in catastrophic event studies. In C-F Lee (ed.), *Review of Quantitative Finance and Accounting,Volume 42, Issue 2* (pp 171-189). Location: USA, DOI 10.1007/s11156-012-0338-4

10. Corhay A and Tourani Rad A. (1996). Conditional Heteroskedasticity Adjusted Market Model and an Event Study. In H.S. Esfahani (ed.), *Quarterly review of economics and finance*, *Voume. 36, Issue 4(* pp. 529-538). Location: USA

11. Corrado, C.J. (2011). Event studies: A methodology review. In S. Cahan (ed.), *Accounting and Finance 51 (2011)*, (pp. 207–234). Location: John Wiley & Sons Inc, USA

12. Dolley, J.C. (1933). Characteristics and Procedure of Common Stock Split-Ups, *Harvard Business Review*, 1933 (Vol. 11), pp. 316–326.

13. Fama, E.F., Fisher, L., Jensen, M.C., and Roll, R., (1969), The adjustment of stock prices to new information. In H.L. Cole and M. Aoyagi (ed.), *International Economic Review, Vol. 10, Nr. 1,* (pp. 1-21), Location: USA

14. Hagendorff, B., Hagendorff, J. & Keasey, K. (2013). The Shareholder Wealth Effects of Insurance Securitization: Preliminary Evidence from the Catastrophe Bond Market. In H. Unal (ed.) *Journal of Financial Services Research*, Volume 44, Issue 3 (pp. 281-301). Location:

15. Henderson, Glenn V., Jr. (1990). Problems and Solutions in Conducting Event Studies. In Keith J. Crockerm (ed.), Penn State University, *The Journal of Risk and Insurance, Volume 57,Issue 2* (pp. 282–306). Location: Penn State University, USA

16. Kothari, S. P., and J. B. Warner, 2007, Econometrics of event studies. In: B. Eckbo Espen, (ed.), *Handbook of Corporate Finance: Empirical Corporate Finance Volume 1,* Handbooks in Finance Series, Elsevier, North-Holland, 3–36.

17. Mills, T.C., Coutts, J.A., and Roberts, J. (1996). Misspecification testing and robust estimation of the market model and their implications for event studies, In M.P. Taylor (ed.), *Applied Economics*, Volume 28, Issue 5, 559-566, Location: U.K.

18. Mueller Ph. (2002). *Stock Market reactions to the issue of CAT Bonds* (This paper was prepared as a final thesis for the Masters of Science in Banking and Finance (MBF) program of the University of Lausanne under the supervision of Professor François-Serge L'Habitant). Location: [Ph. Mueller]

19. Nageswara Rao, S.V.D. and Sreejith. U. (2014), Event Study Methodology: A Critical Review. In D. Tokic (ed), *The Macrotheme Review: A multidisciplinary journal of global macro trends 3(1)A, Spring 2014* (pp. 40-53). Location: Macrotheme Capital Management, LLC, Austin, USA

20. Sabet, S.A.H., Cam, M.-A., and Heaney, R. (2012). Share market reaction to the BP oil spill and the US government moratorium on exploration. In B. Sidhu (ed.), *Australian Journal of Management, Volume 37, Issue 1* (pp. 61–76). Location: Australia

21. Thomann, C. (2013). The Impact of Catastrophes on Insurer Stock Volatility. . In Keith J. Crockerm (ed.), Penn State University, *The Journal of Risk and Insurance, Vol. 80, No. 1* (pp. 65-94). Location: Penn State University, USA

22. http://www.aon.com/reinsurance/investment-banking.js

23. http://www.alacrastore.com

24. http://www.artemis.bm

25. https://www.ecb.europa.eu/stats/exchange/eurofxref/html/index.en.html

26. http://www.insuranceinsider.com

27. https://thomsonreuterseikon.com

28. http://www.trading-risk.com/

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