

The Effect of Catastrophic Losses on Insurance Cycle: Case of Croatia

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Abstract—This paper provides an analysis of the insurance cycle in the Republic of Croatia and whether they are affected by catastrophic losses on a global level. In general, it is considered that insurance cycles are particularly pronounced in periods of financial crisis, but are also affected by the growing number of catastrophic losses. They cause the change of insurance cycle and premium growth and intensification and narrowing of the coverage conditions, so these variables move in the same direction and these phenomena point to a new cycle. The main goal of this paper is to determine the existence of insurance cycle in the Republic of Croatia and investigate whether catastrophic losses have an influence on insurance cycles.

Keywords—Catastrophic loss, insurance cycle, premium, Republic of Croatia.

I. INTRODUCTION

INSURANCE cycle is characterized by peaks and troughs that reflect the rise and fall of the insurance process. Alternating between periods of soft market conditions, when the premiums are stable or declining, and insurance is available, and the period of hard market conditions, when premiums rise, coverage is harder to find and insurer's profit grows. As the market becomes softer to the point that profits completely disappears, the capital that is required to overtake a new job is exhausted and insurers who were not careful during underwriting could lose millions.

The causes of these phenomena are natural and man-made disasters, competition among insurers and other financial institutions, yields on financial markets, the development of new techniques and methods of management and transfer of risk, and overall economic and business environment.

Insurance companies are under the influence of a number of changes that are currently taking place in the economic system. The most pronounced effect of these changes is reflected in the cyclicity of the insurance and reinsurance industry, the increased number and value of the catastrophic losses caused by natural or man-made activities, demographic changes in the age structure of the population, and increasing range of risks that are present in the financial environment. The losses caused by catastrophic events had the strongest impact on the financial statements of the reinsurance companies which imposed the issue of long-term stable and

profitable business activity. Therefore, this category of risks and adverse events can be defined as a procyclical variable and leading variable that causes the cycle and is moving in the same direction as the cycle. Natural disasters or human factor in the adverse event causes a change in the cycle, premium growth and intensification and narrowing the coverage conditions and these variables are moving in the same direction. Such phenomena are announcing a new cycle.

The issue of insurance cycle is particularly pronounced in periods of financial crisis in general, such as the recent crisis, but also because of the growing number of catastrophic losses (e.g. Hurricane Katrina in 2005 and earthquake in Japan in 2011).

The basic goal of this paper is to determine the existence of insurance cycle in the Republic of Croatia and its length. Also it will be analyzed whether catastrophic losses on global level have impact on insurance cycles keeping in mind that the insurance market is relatively shallow and underdeveloped and as such is not significantly influenced by global insurance cycle.

Following the introduction, the second part of the paper gives an analysis of some general issues and a short review of relevant literature concerning insurance cycles. The third part of the paper includes an overview of types of catastrophes and analysis of total economic losses on global level. The fourth part of this paper brings the results of empirical analysis and the fifth part brings the conclusion.

II. INSURANCE CYCLES: GENERAL ISSUES AND SHORT LITERATURE REVIEW

Soft markets are characterized by excess supply of insurance coverage of insurance companies that compete among each other with premium size and width of coverage. Excess supply in a competitive environment leads to lower premium rates and taking a broader coverage. In this case the insurer's risk exposure is greater, and the provision of insurance premiums is reduced (due to lack of premiums) what has a long-term effect on the ability of the insurer in loss settlement. Periods of soft market increases competition that is willing to give wider insurance coverage at lower premiums. In the long run such business activity without any major catastrophic losses leads to poor combined ratio and technical result and declining profitability of reinsurance companies.

Hard markets are characterized by less favorable business environment in which only insurance companies which have prolonged nature of business strategy, a strong capital position and well-diversified portfolio can survive. This is a period of narrowing of insurance coverage and rising insurance

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premiums. Hard markets are characterized by shifts in business of reinsurance companies and entering into new profitable business and alternative risk transfer in order to lower exposure to risk and higher profitability [1].

Types of property and liability insurance are extremely susceptible to underwriting cycles, especially the kinds of property insurance and reinsurance associated with the industry. Although cyclicalities are present in the proportional insurance, especially surplus reinsurance, non pro rata and facultative reinsurance contracts are highly cyclical. These cycles do not occur in life insurance and in those markets that are heavily regulated and there is no indication that their appearance is connected with the cyclic character of the economy as a whole [2].

Under conditions of a perfect market with rational expectations, insurers determine the pure premium on the basis of all available data so that it is equal to the present value of expected future damage. So, the price of insurance, or premium, is the best indicator of future losses in the sense that it includes all the information and measures the expected losses.

Insurance cycles are defined as "a tendency of property and liability insurance premiums, insurers' profits, and availability of coverage to rise and fall with some regularity over time. For a cycle it can be said that one has started when insurers tighten their underwriting standards and sharply increase premiums after a period of severe underwriting losses. Stricter standards and higher premium rates often lead to a dramatic increase in profits, attracting more capital to the insurance industry and raising underwriting capacity. On the other hand, insurance companies strive to write more premiums at higher levels of profitability, so premiums may begin to fall and underwriting standards are relaxed in the competition for new business. Profits may fall and turn into losses if more lax underwriting standards generate mounting claims. At this point the cycle can begin again." [3] Cyclicalities of insurance is determined by several factors. These are premium income, underwriting capacity, and asset structure and claim amount arising from insurance policies. Property and liability insurance fluctuate between periods of strict and narrow underwriting standards and high premiums known as hard markets and the broader conditions and periods of coverage and lower premiums known as soft market.

All sectors of the economy have shown cyclical trends to some extent, but the researchers have observed that cycles in property and liability insurance do not coincide with the business cycle, nor are they reliably counter-cyclical. Insurance cycles reflect greater volatility than other business cycles, i.e. they have "multiple peaks" and "lower downs" [4]. The characteristics of the cycle, its length and amplitude vary between market segments e.g. personal lines and commercial lines – between geographical markets and over time. Since there is no regularity in the cycle, one cannot assume that today's cycle will end in 2014, if the cycles are six years in length and started in 2008 [4].

Characteristic description of insurance cycle includes four stages [5]. The first phase is characterized by initially

relatively high profits after which some insurers, to enhance their sales, begin to lower prices and become more lenient when it comes to the risk they underwrite. This behavior causes greater losses or low profitability. In the second phase of the cycle insurers seek to restore profits by increasing premiums and more restrictive underwriting standards, offering coverage only for the "safest" of risks. These restrictions may be so strong that certain types of insurance can become uninsurable. This phase is also called underwriting crisis. In the third phase, profitability remains high, but is no longer growing. During the fourth stage the profitability is gradually reduced as the industry returns in a period of low profitability.

Many studies confirmed the existence of insurance cycles in property and liability insurance market in the U.S. [6]-[10] and in other developed countries [7], [10]. The average cycle length is about six or seven years [6], [7], [11]. Cummins and Outerville argue that insurance cycles, which are found in the United States and other developed countries, will be present in other parts of the world through an increase in international insurance services [7].

The research of Leng and Meier [12] demonstrated that insurance cycles of property and liability insurance industry to a large extent depend on the specifics of the local market and internal influences, than on international developments. Cummins and Outerville in 1987 [7] assumed that expressed cycles of property and liability insurance industry in the U.S. and other developed countries are being transmitted to other markets over the reinsurance. This statement was proven in research of Outerville and Meier [13] through a significant impact of cyclicalities of international price index of reinsurance onto the loss ratio of the primary insurer in France, Germany and Switzerland. Lloyd's Underwriter Annual Survey from 2006 has shown that management of the insurance cycle is the biggest challenge in the insurance industry, which proves the importance of these issues for insurers. Insurance markets in various countries show the insurance cycle in which the ratios of insurance profits and losses alter in the cyclical patterns [14], [7], [8], [10], [6].

Numerous authors cite various causes of insurance cycles. For example, insurance cycles can result from irrational prices affected by past experiences of loss, such as extrapolation of past claims for compensation [6]. Cummins and Outerville [7] state that the delay in the data collection, delays in regulatory bodies, and accounting practices can result in insurance cycles under rational expectations. Changing interest rates may result in changes of insurance premiums and profits, with respect to interest used as the discount rate in determining the price of insurance [8], [15]. However, papers that have attracted the most attention are those about theories of capital shock that are based on the restriction of capital after the occurrence of catastrophic events or unexpected increase in claims. This theory explains the hard market by capital shocks and costly external financing. With a given level of capital, selling insurance is limited in relation to the risk of insolvency and regulation. When insurers cannot raise capital with external financing because of the costs, capital shocks will force the

insurer to raise premiums in order to avoid aggravating the risk of insolvency or to meet regulatory requirements [16], [17]. Doherty and Garven [15] in their work have linked changes in interest rates with a model of capital shock considering that the price of insurance rises when interest rates changes significantly diminishes the value of equity. While these authors in their papers study insurance cycles from the supply side, several papers present a summary of the responses on the demand side [18]-[20]. If the demand for insurance is elastic with respect to price and equity, then the increase of the prices will be lower [21]. Changes of expectations about insurer's profit may contribute to increasing prices with certain capital shock [20]. All these theories are formed on the basis of the assumption of a set of external financing.

Over the past few decades a number of works whose purpose was to explain the cyclical increase and decrease in the price of insurance and profit property and liability insurance have been written. There is no generally accepted opinion on what could have been the causes, but the conclusions of the works can be summarized in three major aspects:

1. disequilibrium between supply and demand,
2. external shocks,
3. general business influences.

The disequilibrium between supply and demand applies to competitively determined prices and quantitative limit. Many authors have suggested that the insurance cycle is mainly caused by competitive prices due to the standardization of property and liability insurance. Competitive prices can be observed as irrational behavior with the goal of maintaining or acquiring market share. Insurers in pricing deviate from the theoretical model by including information on the anticipated behavior of the competition. They at one point decided to cut prices in order to gain a larger market share. Competition in prices leads to poor results and subsequent cuts in supply what pushes the prices up. On the other hand, scientists are skeptical about the assumption that insurers decide to reduce prices or increase rates. They assume that insurance cycles are caused by quantitative restrictions in the supply of insurance. Prices depend not only on the expected future claim payments but also on the current and past values of capital and profits. Due to the asymmetry of information and other market imperfections, capital does not move freely in the insurance market and beyond. When it comes to the reduction of profits, as with unexpected claims, it becomes difficult and expensive for insurers to adapt quickly and raise external capital due to the cost of acquiring new capital. This suggests that capital shocks affect the price and amount of insurance supply in the short term and therefore the supply and demand of capital are moving out of balance.

External shocks include interest rates, regulatory and accounting gaps and catastrophic losses. Since the premiums are the result of discounting future claims, any change in interest rates affects the changes in premiums and therefore interest rates could create external shocks and cause insurance cycle. Some authors explain that the insurance cycle is not

caused by irrational behavior, but external shocks such as gaps in data collection, regulatory gaps and accounting rules. Empirical evidence suggests that insurers may increase premiums more than the discounted value of the expected costs when it comes to the application of large insurance or investment losses in a particular market.

III. CATASTROPHIC LOSSES

Catastrophic losses can be caused by natural forces or may be the result of human activities. The most common natural disasters are the result of floods, earthquakes, droughts, storms, cold weather and other natural forces. Disasters caused by human activity are also called technical or man-made disasters as they are the result of human activity, and unlike natural disasters, they affect mainly smaller areas. This group of catastrophic events includes disaster caused by fire, explosions, traffic accidents political events and other. A special group within the catastrophes caused by human activity is disasters caused by terrorist attacks. They are specific because they cannot be predicted on the basis of some empirical and scientific data, nor on the basis of these data can be predicted the extent of the claims, which further complicates the insurability of that risk. Catastrophic events, especially natural disasters, are adverse events which are causing enormous human and economic losses. In the last thirty years there is a significant upward trend in costs, but also in the frequency of major events that have powerful effects on both property and human lives. The increase in insured losses, mostly because of overall economic loss is not only due to the increase in the number of disasters, but also in an increase of population, their concentration in urban and industrial areas, higher volumes of property insurance, and also with environmental pollution resulting in climate disorders and major natural disasters. Swiss Re defines overall economic loss as all financial losses that are directly derived from major events, or damage to buildings, infrastructure, vehicles, etc. This term also includes any claims arising from business interruption as a direct consequence of damage to property. Insured losses are gross amounts of reinsurance, whether in business or government plans. The term overall economic loss includes all claims: insured and uninsured. Data on overall losses do not include indirect financial losses or loss of earnings due to suppliers' disabled operations, the estimated reduction in GDP, and non - economic losses, such as loss of reputation or reduced quality of life [22].

Movement of the total economic and insured losses is shown in Fig. 1. The effects of catastrophic events are not only short-term as it is stated in models of economic growth, but have negative consequences for the economy and the development in the long-run. This is particularly true in the weaker economies whose financial condition was difficult before catastrophic events which is why the recovery and restoration have been slower. Therefore, the management of fiscal and monetary policy has become more difficult, and structural reforms are delayed or have been canceled. Furthermore, catastrophic events particularly adversely affect the efforts to reduce poverty so the poor become poorer. The

reasons for this is life in remote areas where wealth is concentrated in the material assets which is particularly exposed to disasters, and lack of buying insurance, what would enable higher protection against the risk.

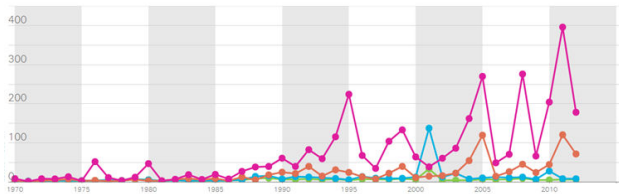


Fig. 1 Insured and overall economic loss from catastrophic events from 1970 until 2012 on global level (Source: [22])

The catastrophic events in the past 15 years had more devastating impact on insurers than in the entire insurance history. Between the 1970s and mid-1980s, annual insured and total economic losses amounted to between six and ten billion dollars. Catastrophic events that have had a single loss of ten billion dollars and more began to line up since the late 1980s. In Fig. 2 the 20 most expensive catastrophic events since 1970 until 2012 are shown and it can be seen that five out of the 20 most expensive disasters happened in the last three years.

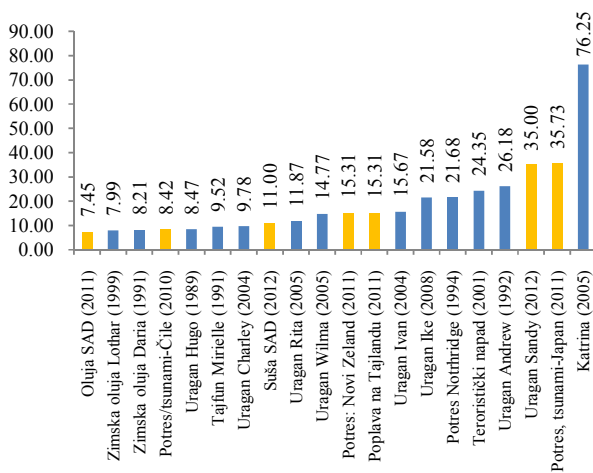


Fig. 2 Twenty most costly world catastrophes (\$ bill) (Source: prepared by authors according to [22])

Key reasons for the sudden increase in claims caused by weather conditions and their changes are rapid population growth and industrialization in the region with a high degree of exposure to these events, and this is due to the fact that modern technology is increasingly vulnerable to losses that can occur, and which are caused by climate changes. Trend analysis shows that the number of natural disasters has increased from an average of three events per year in the early fifties of the twentieth century, at about eight catastrophic events. The economic costs as well as claims for the insurance sector also increased substantially. Six of the ten largest catastrophic losses for the insurance sector took place in the

new millennium, where eight of the ten biggest losses were due to the weather, and climate change.

By the mid-twentieth century trend in the number of natural disasters, regardless of race, was relatively stable. The number of catastrophic events caused by climatic factors did not significantly deviate from the number of other natural disasters. However, since the mid-twentieth century the number of natural disasters was growing rapidly, with the expansive growth of number of natural disasters conditioned by climatic factors. In addition to the 55 geophysical events in the world, in the first half of 2010, occurred 385 catastrophic events associated with weather conditions that caused significant property damage. Natural disasters, including the earthquake and tsunami which hit Japan in March, cost the insurers in the first half of the 2011th about 60 billion dollars, which is about five times more than the average for the period since 2001 until 2010.

TABLE I
TEN MOST SIGNIFICANT CATASTROPHES IN THE WORLD

Date	Event	Country	Insured loss (u mil €)	Total loss (in mil €)
March 2011	Earthquake, tsunami	Japan	25.000	130.000
August 2005	Hurricane Katrina	USA	44.800	89.900
January 1995	Earthquake	Japan	2.200	71.900
May 2008	Earthquake	China	200	61.200
January 1984	Earthquake	USA	11.000	31.700
September 2008.	Hurricane Ike	USA, Cuba, Haiti	13.300	27.600
May-Sep 1998.	Flood	China	700	22.100
February 2010.	Earthquake, tsunami	Chile	5.800	21.600
October 2004.	Earthquake	Japan	600	20.100
August 1992.	Hurricane Andrew	USA	12.200	19.100

Source: [23]

Natural disasters did not miss Croatia, but certainly cannot be measured with the world. The fact is that natural disasters affect mostly farmers because of which they record losses in millions, which still somewhat county and local governments, and in some cases government refund to farmers. Croatia is located in one of the seismically most active areas. It is divided into six zones of risk depending on the degree of severity earthquake occurrence, so, for example, insurance premiums in Dubrovnik, which is the third zone of risk, are higher than in Pula, which is in the first zone.

Although it seems that a number of devastating natural disasters, from earthquakes in Haiti, Chile, New Zealand and Japan, floods in Europe, Pakistan and Australia, grow daily, the main reason for such a drastic increase in claims is in the economic growth. The value of property increases, the population density and insurance penetration are increasing, often in high-risk areas. This trend is united with the rapid growth of some Asian economies in areas prone to natural disasters and the impact was reflected from global climate change.

IV. EMPIRICAL EVIDENCE

Insurance companies generate revenue by selling insurance policies, and providing some financial and other services, and the funds raised are invested in various financial forms. The main income of insurance companies' is premium income that is generated through sales of insurance policies and charging premiums as fees for underwriting. The premium contains important information about the pricing of insurance, and therefore has an important role in determining the insurance cycle. Since according to the definition of insurance cycles, it is represented by fluctuation of insurance rates or premiums, analysis of the existence of the cycle and its length in the Republic of Croatia will be conducted using data on gross written premium. The data are analyzed on a quarterly basis for the years 1998-2012.

In order to determine the impact of catastrophes on the insurance cycle, first of all it needs to be analyzed whether there is a cycle in Croatia and what its length is. In order to test the existence and length of the cycle auto-regression analysis of the second order will be applied. The use of a second-order auto regression model AR (2) was proposed by Venezian [6], and developed by Cummins & Outreville [7] in order to get the appropriate parameters for testing the presence of cycles in terms of competition and rational expectations. This model is useful to determine the existence and the length of the cycle. AR (2) is defined [14]:

$$X_t = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + w_t, \quad (1)$$

where X_t is premium in period t , and w_t is random error. If absolute value of the expression $a_2 < 1$ and if $a_1 < 1 - a_2$, variable X_t is stationary [7]. The cycle is present if $a_1 > 0$, $a_2 < 0$, and if $a_1^2 + 4a_2 < 0$.

The length of the cycle is calculated on the basis of [7]:

$$Period(\Pi) = 2\pi / \cos^{-1}(a_1 / 2\sqrt{-a_2}). \quad (2)$$

Estimation of AR (2) model without trend component does not satisfy all the conditions for the existence of cycles and the existence of cycles was further examined with the presence of the trend component.

Estimated AR (2) with trend component and associated standard errors in parentheses is:

$$\Delta LN_PREM_t = 0,031 + 1,315\Delta LN_PREM_{t-1} - 0,449\Delta LN_PREM_{t-2} - 0,001TRENDR_t. \quad (3)$$

(0,011) (0,138) (0,132) (0,000)

In this case, all conditions for the existence of cycles are satisfied and cycle length is equal to 6.42 years.

In order to test the assumption that catastrophic losses on a global level are not associated with the emergence of insurance cycles in Croatia, it was performed a test of significance of the Pearson correlation coefficient and Granger causality test. The variables that were considered are gross written premium in Croatia expressed in billions of kuna, which is given as an approximation of the insurance cycle and the total economic loss on a global level expressed in billions

of dollars, and they refer to the period from the first quarter of 1998 until the last quarter of 2012.

TABLE II
PEARSON CORRELATION COEFFICIENT

		LREMIUM	LRLOSS
LPREMIUM	Pearson correlation coefficient	1	0,016
	Prob. (two way test)		0,904
	Sample	60	60
LRLOSS	Pearson correlation coefficient	0,016	1
	Prob. (two way test)	0,904	
	Sample	60	60

Source: authors' calculation

The null hypothesis of significance test of Pearson's correlation coefficient assumes that there is no interconnection between the insurance cycle in Croatia and catastrophic losses to the global level. The Pearson correlation coefficient is equal to 0.016 what means that there is no correlation (linear) between the insurance cycle and the world's losses. Since the p-value equal to 0.904, the null hypothesis is not rejected, which means that there is no connection between the two aforementioned variables.

In order of further confirmation of this hypotheses Granger causality test was conducted. The correlation coefficient shows only whether two variables move in the same or opposite direction, and not whether there is causality between them. However, each phenomenon that is causal is correlated and it is expected for Granger tests to indicate that catastrophic losses on a global level do not affect the insurance cycle in Croatia. Under the concept of causality it is implied the possibility of one variable to predict the dynamics of the other variables. Namely, if one wants to examine whether phenomenon X causes the appearance of phenomenon Y, the problem comes down to examining how much of the dynamics of variable Y in the current period can be explained by the dynamics of the variables in the previous period and whether the dynamics of variable Y could be better explained if in the analysis are added previous values of X. This form of causality is called causality in Granger term. That is why Granger causality test is conducted.

Testing causality on the basis of the Granger test is simple to implement and it is often used in empirical research. However, there are numerous criticisms related to Granger causality. Roberts & Nord [24] showed that the test result depends on the functional form of time series. Specifically, if the series are in logarithms, the results showed that there is no causality in the Granger sense, while the series that are not logarithms showed the existence of significant causality. Also, one of the criticisms is associated with stationarity of variables. If the variables are not stationary, the question is whether the test should include differentiated values.

In order to take all the critics into account, three Granger tests were conducted. The first test takes into account the original values of the variables, in the second test logarithmic values were applied, while the third test relates to the variables that are stationary. ADF test results are given in Table III. On the basis of these results catastrophic losses are stationary in

levels, while variable underwriting cycles in Croatia needed to be differentiated to become stationary.

TABLE III

ADF UNIT ROOT TEST FOR SELECTED VARIABLES ON FIRST DIFFERENCE

Variables in levels	ADF test		
	Constant	Constant and trend	Without deterministic component
LPREMIUM	-1,587	-0,704	2,214
LLOSS	-3,989*	-3,706**	-1,115
First difference	ADF test		
	Constant	Constant and trend	Without deterministic component
ΔLPREMIUM	-6,738*	-6,754*	-6.815*

Source: authors' calculation

Note: * means that time series are stationary on the level of significance 1%; ** means that time series are stationary on the level of significance 5%

Granger causality test is conducted on the basis of regression equations defined by the following formula:

$$Y_t = \alpha_0 + \sum_{i=1}^j \alpha_i X_{t-i} + \sum_{j=1}^m \beta_j Y_{t-j} + \varepsilon_t \quad (4)$$

Based on (4) we defined causality as follows: variable X_t does not cause the variable Y_t in Granger sense if all parameter values of α_t in equation are equal to zero, i.e., if $\alpha_1 = \alpha_2 = \dots = \alpha_n = 0$. Thus conducting the test, whether variable X_t is causing a variable Y_t in the Granger sense, comes to testing the collective of significance displacement of variable X_t in the regression equation. The test is performed using the F-test, with a shift $m = 2$ and the results are given in Table IV.

TABLE IV
GRANGER CAUSALITY TEST

Null hypothesis	Sample	F-test	Prob.
VARIABLE: LOSS AND PREMIUM			
Catastrophic losses do not cause change in premium in Croatia	58	0,06733	0,9350
VARIABLE: LLOSS AND PREMIUM			
Catastrophic losses do not cause change in premium in Croatia	58	0,04558	0,9555
VARIABLE: LLOSS I ALPREMIUM			
Catastrophic losses do not cause change in premium in Croatia	57	0,05176	0,9496

Source: authors calculation

Results of Granger causality test show that at the significance level of 5%, irrespective of the transformation of variables, catastrophic losses on a global level have no impact on the insurance cycle in the Republic of Croatia.

V. CONCLUSION

The most emphasized effect of the changes that is taking place in the economy is reflected in the cyclicity of the insurance and reinsurance industry, the increased number and value of the catastrophic losses caused by natural or man-made activities, demographic changes in the age structure of the population, and increasing range of risks that are present in the financial environment. Losses caused by catastrophic events had the strongest impact on the financial statements of the reinsurance companies which has imposed the issue of

long-term stable and profitable business policy. Therefore, this category of risks and adverse events can be defined as a procyclical variable and leading variable which causes the cycle and is moving in the same direction as the cycle. Natural disasters or human factor in the adverse event cause a change in the cycle and premium growth and intensification and narrowing the conditions of coverage, and these variables are moving in the same direction, and such phenomena are announcing a new cycle. Since the insurance market in Croatia shallow, and because of the low level of reinsurance, underdevelopment and closed markets, as well as a small number of major disasters it has been isolated from the influence of external factors.

To test this hypothesis, data on total economic loss on the global and data for the total written premium in the Republic of Croatia for the period from the first quarter of 1998th until the last quarter of 2012th year were used. To test the assumption that catastrophic losses on a global scale have no effect on the occurrence of insurance cycles in Croatia, we carried out a test of significance of the Pearson correlation coefficient and Granger causality test. Test of the significance of the Pearson correlation coefficient found that there is no connection between the insurance cycle and losses on the global level. In order to further confirm hypotheses we conducted three Granger causality test. The first took the original values of the variables, the second test was applied to the logarithms values, while the third test was related to the variables that are stationary. Granger causality test results indicated that regardless of the transformation of variables, catastrophic losses on a global level do not cause the insurance cycle in Croatia.

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