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Underwriting Risks as Determinants of Insurance Cycles: Case of Croatia

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***Abstract*—**The purpose of this paper is to analyze the influence and relative share of underwriting risks in explaining the variation in insurance cycles in subsequent periods. Through the insurance contracts they underwrite, insurance companies assume risks. Underwriting risks include pricing risk, reserve risk, reinsurance risk and occurrence risk. These risks pose major risks for property and liability insurers, and therefore their impact on the insurance cycle is important. The main goal of this paper is to determine the relative proportion of underwriting risks in explaining the variation of insurance cycle. In order to fulfill the main goal of the paper vector autoregressive model, VAR, will be applied.

***Keywords*—**Insurance cycle, insurance risks, combined ratio, Republic of Croatia.

I. Introduction

PAYMENTS of premium, which must be proportionate to the risk that an individual brings to the community, create a fund for coverage of future liabilities. Therefore, the existence of risk and its coverage are a foundation, prerequisite and meaning of insurance. Every situation and business activity, in which someone finds oneself, assumes a certain amount of risk. The risk in its broadest sense represents a certain danger, loss, therefore a future, uncertain event that may have unintended consequences [1]. However, the risk should be distinguished from uncertainty. The uncertainty is dilemma of a person to predict the future and assess the outcome of an event [2]. When as a result of some future event one can expect different mutually exclusive outcomes with known (assumed) probability p then we are talking about risk [1]. Systematization of risks can be done in several ways depending on the subject and objectives of the research and their particularities and characteristics. Except the fact that insurers take a number of risks, they are also subject to a number of risks.

Risks to which insurance companies are exposed and which are necessary to identify, monitor, track and manage appropriately, are numerous. One group of such risks are underwriting risks arising from insurance policies that are taken under coverage and which guarantee payment of claims. The risk of any insurance policy is that an insured event will occur and the uncertainty about the amount of losses which arise from that event. Underwriting risk refers to the risk that could arise if the actual claims and indemnity exceed the net book value of the insurance liability due to the accidents, errors and/or changes in circumstances. It includes the risk of determining the premium (pricing risk), the risk of setting reserves (reserve risk), reinsurance risks and occurrence risk.

The basic goal of this paper is to determine which of these four underwriting risks in greater proportion explains the variation of insurance cycle.

After the introduction, the second part of the paper gives an overview of the determinants and significance of portfolio of risks. In this part of the paper underwriting risks and their management will be analyzed. The third part of this paper gives brief analysis of insurance cycles. The fourth part of the paper brings the results of empirical analysis and the fifth part is the conclusion.

II. The Determinants and Significance of Portfolio of Risks

Risk is the possibility of a situation occurring which may adversely affect the business of an insurance company, which can lead to disturbances in achieving company's goals. The detection and identification of risks and determination of their potential impact on the company's business performance in the future is the responsibility of insurance company management. Different types of risk to which the insurance company is exposed in its business activity, management can reduce, avoid and tumble in order to increase the safety of its business, but also to accept higher risk and thus earn more profits for their shareholders. In developed financial and economic systems, management is provided with a set of different financial instruments that are implemented through a variety of techniques and methods of risk management. For insurance company it is important to recognize the necessity of an effective and efficient risk management system. The main objective when managing risks to which the company is exposed is to maintain capital levels adequate to the scope and types of business conducted.

Risks that insurance companies are exposed to, can be classified in several ways, depending on who defines them and for what purposes. Thus, the working group of the International Actuarial Association - IAA [3] made categorization of risks which must be quantified within the regulatory framework of Solvency II. The main types of risks are listed in this categorization, and they do not include a complete description of the risks for insurers. The main categories within this classification include underwriting risk, market risk, credit risk, operational risk and liquidity risk. Within the Solvency II framework all risks for an insurance

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company should be quantitatively and qualitatively identified and controlled (risk-based model), and exposure and risk management of insurance companies should determine the required level of capital (capital adequacy). The main characteristic of this methodological framework is that it explicitly takes into account the particular risks faced by insurance companies, as well as the mutual interaction of these risks when determining the insurer's required capital.

Management of the Croatian Financial Services Supervisory Agency (HANFA) has, for the purpose of providing a framework for the establishment of a risk management system, adopted Guidelines for identifying, measuring and monitoring risks to which insurance and reinsurance companies are exposed [4]. In the context of these Guidelines risk is considered to be the inability to achieve a goal, or to be more precise, the danger of events, actions or unused potentials having a negative impact on achieving insurance companies' goals. The types of risks that the insurance companies should consider are: underwriting risk, market risk, credit risk (including country risk), operational risk, liquidity risk, concentration risk, strategic risk, or the risk of the business environment, and reputation risk.

Comprehensive review of the risks to which insurance companies are exposed is given in Fig 1. Basic segmentation of business risks is dividing them into internal and external risk. The internal risks include underwriting risks and operational risks. External risks affect the business of insurance companies from the outside and insurance companies can not affect them.

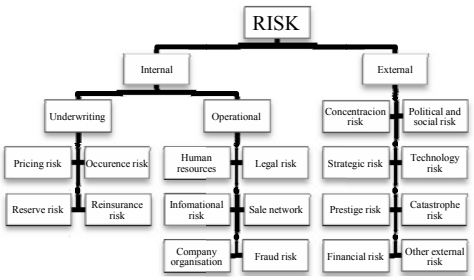

Fig. 1 Risk classification for insurance companies (Source: author according to [3] and [4])

Operational risk is defined as the risk of loss resulting from inadequate or erroneous internal business processes, people and systems or the occurrence of external adverse events [4]. It is characteristic for all activities and levels in an insurance company, processes, products and systems, embedded in all other risks and intertwined with them. Insurance companies should adopt a policy for the operational risk management which defines the basic guidelines and procedures to manage these risks. Operational risks include legal risk, human resources risk, quality resolution of claims (the risk of fraud), quality and disciplined sales network, the organization of insurance company, informational risk (data management, quality and accuracy of IT systems).

External risks are those depicting a source that is located outside of the insurance company, in the environment and can have a significant impact on his business life, business success and development. The external risks include financial risk, concentration risk, political and social risks, strategic risk, technology risk, reputation risk, risk of natural disasters and other external risks. Since these risks are not subject of this research paper, they will not be further analyzed.

A. Underwriting Risks

The business activity of the insurance company exposes it to underwriting risks. The risk of any insurance contract is that an insured event and an unexpected amount of consequential losses will occur. By the nature of insurance contracts, underwriting risk is random and therefore unpredictable and refers to the uncertainty of insurance. The insurance contract is a legal transaction in which the policyholder agrees to pay the insurance premium and the insurer assumes the obligation to pay compensation in the case of the occurrence of the insured event. Underwriting involves the risk of determining the premium (pricing risk), the risk of setting reserves, occurrence risk and reinsurance risks [4].

Pricing risk is present before the insured event occurs because there is a risk that the costs and claims will be higher than the premiums received. It may be called the risk of insufficiency/inadequacy of insurance premiums, since it implies that the rate of loss occurrence has changed contrary to predictions at the time of determining the premiums. Therefore, it is also called premium risk since it is likely that the insurer will not collect revenue from premiums that would be sufficient to cover the claims [2]. Property and liability pricing risk also includes the catastrophes risks that are arising from extraordinary events that are not sufficiently covered by the premium or reserve risk. Life insurance pricing risk includes biometric risk (including mortality, longevity, morbidity and disability) and the risk of withdrawal. Reserve risk is the risk that the total amount of the technical provisions is misstated or that losses will vary around the statistical expected value. It includes risks of insufficiency of technical reserves of property and liability insurance and insufficiency of mathematical provision. The insurance company can manage underwriting risk through the diversification of risks and the insured and through the reinsurance contracts, including contracts for excess of loss reinsurance.

Risks of inadequately calculated insurance premiums include risk of uncertainty in the model and data, the risk of catastrophic events, the risk of changes in legislation, and the risk of giving discount on the premium [5]. When determining the price of insurance there is a risk that the models which are used for the quantification of compensation required, as the most important parameter that affects its height, are unreliable. As a result of uncertainty in the model it is possible to use the wrong statistical distribution that approximates the course of the losses. In this way, the expected value of the loss would be wrongly identified. This usually happens if the assessment is based on unreliable data, in terms of their inaccuracies or their small number, and a small number of accounting periods to which they relate. Therefore, the basic requirement of accuracy of calculation of insurance premiums is adequately

statistical databases in sufficiently long period of time, at least ten years.

The risk of catastrophic losses can also adversely affect the adequacy of insurance premiums. These losses are usually low frequency and high intensity and can significantly distort the allocation of losses by approximating the exact data which are related to the group of risks in which the catastrophic risk has realized. Here is a typical actuarial risk that occurs due to poor predictions of actuaries, who disregarded maximum possible loss when determining premiums, and did not adequately assess the risk for that group. The risk of catastrophic loss is outside the usual volatility, and requires special management methods.

Risk of changes in legislation can also be a cause of inadequately calculated insurance premiums. In some countries in transition, changing regulation and liberalization of pricing in the automobile liability insurance lead to unfair competition and rising prices. Due to that, many insurers have decreased prices far below those specified in actuarial calculation and by doing so they jeopardized not only its financial position and the safety of paying compensations to policyholders, but also the safety of the overall insurance market.

The risk of giving discounts on premium is not always an award for the absence of losses in the previous period. It often happens that the management of insurance companies, in order to retain customers, makes decisions about granting unreasonable discounts that lower premiums under certain actuarial calculations and thus may jeopardize the loss ratio of and lead to a negative technical result. It is primarily characteristic for all-risk insurance of motor vehicles, which includes the risk of theft.

B. Management of Underwriting Risks

Once the insurance contracts are in force, the insurance companies are exposed to a number of risks insured that are transferred to them. One of the underwriting risks which is present at the time the policy is issued and before the insured event occurs is pricing risk. That is a risk that the costs and claims will be higher than the premiums received. When calculating the sufficient premium it may happen that the calculated premium is insufficient for the underwritten risks. It is this risk, the risk that the insurer will not raise sufficient revenues from premiums to cover claims or sum insured, that represents a significant risk for the insurance company, and is called the pricing risk. If the contracted premium is undervalued, it means that at the time of claims liquidation paid premiums will be lower, and the insurer will face a loss on a particular insured event. The other extreme is overrated premium, and also the risk whereupon the insured pays a higher price than the actual value. In this case, the insurance company is uncompetitive in the market due to excessive premiums thereby reducing portfolio and the number of insured. Pricing risk may be primarily generated from the inadequacy of the premiums in the form of underestimation of the premiums or insufficient diversification of insurance portfolio.

The company manages its underwriting risk through underwriting limits, approval procedures for transactions that involve new products or that exceed set limits of underwriting, product design and management of reinsurance. Underwriting strategy seeks diversity in order to ensure a balanced portfolio and is based on a large portfolio of similar risks over several years, which reduces the variability of results. All property and liability insurance contracts are in general annual and contractors have the right to refuse renewal of a contract or to change the terms of the contract at renewal. Underwriting risks in the insurance companies are under supervision of actuaries, and services for risk management, in agreement with them, take the indicators in order to encompass it as a part of risk management.

In order to avoid the pricing risk all employees must abide by the price that is determined by actuarial calculations. Also, the insurance company must insist on quality reinsurance protection, and accept and contract coinsurance with other companies only if it is justified. For the insurance company a more dangerous risk is undervalued premium, that is, that it will not collect sufficient revenues from premiums to cover claims or sums insured and that the insurer will face a loss on a particular insured event.

Since one of the fundamental causes of insolvency of the insurance company is pricing risk it was necessary to find a measurement method. In order to measure pricing risk a quantitative model was used which uses indicators of profitability, loss ratio and cost ratio to determine the solvency margin for property and liability insurance. This system of capital adequacy and solvency margin regulation of the insurance company has been in use since 1973, in the form of the first EU directive for property and liability insurance (73/239/EEC), and was last modified in the year 2002. In the framework of this approach for property and liability insurance, variables loss ratio and cost ratio were formulated. The loss ratio is the ratio of settled claims and collected insurance premiums and the cost ratio is the ratio of operating costs and collected premiums, with all sizes reported on a net basis. The underlying assumption of this approach is that the cost ratio is constant while the loss ratio is a continuous random variable. The required solvency margin was defined in relation to net premiums paid. In the terminology of determining the solvency of property and liability insurer, a percentage of the required solvency margin revenue from premiums is the premium index [6]. The solvency margin is the basic element for providing and maintaining the solvency of an insurance company. It should provide continuous control and monitoring of the functional relationship between the necessary capital and the risk assumed. The calculation of the solvency margin is done separately for life and for property and liability insurance. It can also be defined as the excess of liquid assets over the liabilities of the insurer. It must be set at a sufficiently high level, and adherence to the solvency margin allows the insurer to meet its obligations in time. Despite the simplicity of the application and interpretation of the results obtained, a quantitative approach is often disputed by the actuary. The reason is that the total solvency margin is

determined only in relation to certain insurance risks (pricing risk and partially reinsurance risks), which ignores the entire spectrum of actuarial, financial and operational risks to which the insurance companies business is exposed. The definition of loss ratio is incomplete because it does not take into account the change in reserves for claims, as well as the costs of loss liquidation, and does not accept the concept of earned premiums (the same is true for the costs ratio). The assumption of approach according to which all loss ratios are mutually independent and with the same probability distribution can be applied for individual companies, but not for the overall insurance market. The correct assumption would be that the loss ratios of different companies are mutually independent, but with different probability distribution functions for each of them. Otherwise, the larger the number of companies included in the sample, the variation in the value of the loss ratio between the companies increases, and also the value of calculated required solvency margin [7]. Due to the many shortcomings of this model, European countries have joined in the process of designing a sophisticated, risk- based, model for determining the solvency of the insurer, within the concept of Solvency II. Within the Solvency II all the risks in the business of an insurance company should be quantitatively and qualitatively identified and operated, and exposure and risk management of insurance companies should determine the required level of capital - capital adequacy. The main characteristic of the new methodological framework is explicitly taking into account the particular risks faced by insurance companies, as well as the mutual interaction of these risks, in the determination of the required capital. The simulation of application in the property and liability insurance market may show whether there is a significant difference between the prescribed and the real value of the premium index in the market.

III. Insurance Cycle

Insurance cycles have been defined and analyzed within a number of scientific and professional articles. Mostly used definition states that they are "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 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." [8] Cyclicality of insurance is determined by several factors. These include premium income, underwriting capacity, and asset structure and claim amount arising from insurance policies. Insurance cycles are characteristic for property and liability insurance, especially for the kinds of property insurance and reinsurance associated with the industry. Although cyclicality is 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 which are heavily regulated and there is no indication that their appearance is connected with the cyclic character of the economy as a whole [9].

Property and liability insurance fluctuate 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 [9]. 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 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 [10].

All sectors of the economy have shown cyclical trends to some extent, but 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" [11]. 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 [11].

The existence of insurance cycles can be viewed from two perspectives: the traditional and behavioral [12]. Traditional analysis observes cycles from an economic standpoint, which provides an explanation of their nature and mechanisms of action, and behavioral attempts to track the underlying causes of behavior in cycles themselves.

Most approaches that explain cycles in property and liability insurance are deterministic, which means they observe how the insurance market responds to abstract economic forces [12]. These approaches focus on three

characteristics inherent to insurance industry. The first is that the insurance industry defies basic economic expectations that the market will move quickly to balance the dynamics of supply and demand because insurers cannot easily determine the price "of goods sold" (that is, the total amount of losses and other costs) long after they have determined the cost and sold insurance policy [13]. The inability of the insurer to calculate the price of "sold goods" at the time of product pricing, which is affected by the ultimate cost of future events, is the main factor of distinguishing the insurance market from other markets. It is also the least understood element for the insurance users. Another factor on which analysts put accent is the impact of interest rates on pricing. Due to the fact that investment income accounts for a significant share of the profits of the insurers, the cost of insurance will increase in the period of falling interest rates because insurers want to compensate for reduced income from investments with higher fees for underwriting. Investment income has great importance in determining the success or failure of an insurance company in whose context one examines the question of interest rates. Insurers must create return on invested capital and reserves in order to survive in the long run. Therefore, unforeseen changes in the investment environment can have a disproportionate impact on market behavior. This means that insurers who have declining returns on investments will be forced to raise fees for underwriting through increased rates or narrowing conditions of risk coverage. Therefore, the question of interest rates can be an important factor leading to hard period in a cycle, as well as the significant return on investment can extend the soft period of a cycle.

The third factor is related to the expansion and collapse of the reinsurance capacity on the secondary market, where insurers wish to disperse the risk which they took. Many authors have identified this phenomenon as a powerful force that affects the insurance cycle [12]. The most important support for this hypothesis was given by Harrington and Danzon, whose research suggested that moral hazard, in the form of the primary insurer's ability to transfer losses to reinsurers, may be correlated with lower prices in the primary market [14]. The downside of this hypothesis is the fact that reinsurance markets, as well as primary markets, are cyclical and responsive to the same economic forces that drive the insurance cycle on the primary market. That is, reinsurers are a part of a larger insurance market, and not an independent and external activity. Moreover, insurance cycles in the reinsurance market cannot maintain a consistent relationship with the cycles on the primary market.

For a better understanding of the origin and movement of the insurance cycle, the traditional approach complements the behavioral explanations that provides an answer to the question *Why*?. Although previously explained factors which determine the cost and problem of interest rates can be viewed as direct causes of volatility in the insurance market, there are other forces at the basic, behavioral level, to who is given the opportunity to compensate for unforeseen future losses due to less security in pricing. The first of these is competition for revenue and market share, which forces the underwriter to a new level of decision-making, and not only caring about the final profitability. Underwriters are on the one hand motivated by the desire for financial reward, and on the other side is a fear of losing their jobs or opportunities for advancement. Another factor can be best described as high-tide and low-tide influence of bureaucrats in the insurance company that monitors developments in profitability. The third factor relates to the influence of agents and insurance brokers on pricing by the insurer and the consequences of that impact. Underwriting cycles are hereditary in the insurance business, and they reflect the risks that define this activity. Cycles do not have to be either wide or deep, and uncertainty for customers during a peak of the cycle can be alleviated if the correct lineup of incentives for participants in the insurance market is set.

IV. Empirical Evidence

Four types of underwriting risks whose influence on the insurance cycle will be analyzed are pricing risk, reserve risk, reinsurance risks and occurrence risk. Since the basis for the calculation of the loss ratio and the expenses ratio, and hence their sum, the combined indicators, is premium, it is the combined indicator that will be used to quantify pricing risk. Reserve risk will be quantified on the basis of technical provisions for property and liability insurance. The occurrence risk will be quantified with loss frequency since this is an indicator that actuaries monitor to adequately manage risk. To quantify the reinsurance risk the data for technical result which is calculated as the ratio of the movement of premiums and claims from reinsurance will be used. Therefore, all risks will be approximated with the deviation of combined indicator, technical reserves, frequency and technical results from the expected trend of a single variable. To calculate the expected trend of combined indicators, technical reserves, frequency and technical results, Hodrick-Prescott (HP) filter will be applied. Since in this case the HP filter is applied to the data from the first quarter of 2000 until the last quarter of 2012. Smoothing parameter will be 1600.According to this, risks are calculated as follows:

$$Pricing\ risk_t = \frac{Combined\ ratio_t - Trend_t}{Trend_t}, \quad (1)$$

$$Reserve\ risk_t = \frac{Technical\ provision_t - Trend_t}{Trend_t}, \quad (2)$$

$$Occurence\ risk_t = \frac{Učestalost_t - Trend_t}{Trend_t}, \quad (3)$$

$$Reinsurance\ risk_t = \frac{Technical\ result_t - Trend_t}{Trend_t}, \quad (4)$$

where higher values of calculated indicators point to a higher pricing risk, reserve risk, occurrence or reinsurance risk and vice versa. A variable that is also used in the analysis is the insurance premium in the Republic of Croatia since the premium contains important information about the pricing of insurance, and has an important role in determining the insurance cycle. It is expressed in million HRK, and refers to

the period from the first quarter of 2000 until the last quarter of 2012.

To test the hypothesis vector autoregressive model, VAR, will be applied. It belongs to the group dynamic time series models and is the generalization of dynamic models defined on the basis of a single equation. Based on the VAR model innovation analysis will be implemented. It provides information in a form that is suitable for interpretation and decision-making. Innovation analysis assumes an analysis of impulse response function and decomposition of variance, DVC. The advantage of the innovation analysis is appropriate interpretation of the parameters and ease of drawing conclusions about the dynamics of the variables. Decomposition of variance illustrates the partition of variance (covariance) of forecasting errors of individual variables in the parts assigned to all system variables (including the variable itself). Based on the results it is possible to analyze not only the impact of individual shocks in the variables on the other variables of the model, but also the relative proportion of each of the variables in explaining the variation of certain variables in subsequent periods [15].

Before the implementation of the analysis, the variable premium was deflated by the consumer price index with the base year 2005 =. 100, in order to get a real value, and then logarithmic transformation was conducted with the aim of stabilizing the variance. The initial step was to test the stationarity analysis of variables included in the model, and for this purpose the ADF (Engl. Augmented Dickey-Fuller) test was carried out. The results are shown in Table I.

TABLE I
PEARSON CORRELATION COEFFICIENT ADF UNIT ROOT TEST FOR SELECTED VARIABLES IN LEVELS, I.E. FIRST DIFFERENCE

Variables in levels	**ADF test**		
	Constant	*Constant and trend*	*Without deterministic component*
LN_PREMIUM	-1,212	-0,075	-0,333
R_PRICING	-2,592	-2,268	-2,563*
R_RESERVE	-3,605*	-3,182	-3,623*
R_OCCURENCE	-4,259*	-4,247*	-4,309*
R_REINSURANCE	-3,791*	-3,794*	-3,695*
First difference	**ADF test**		
	Constant	*Constant and trend*	*Without deterministic component*
ΔLN_PREMIUM	-4,824*	-4,753*	-4,560*

Source: authors' calculation

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

At the significance level α = 5%, with respect that the critical value of the ADF test in the model with a constant is equal to -2.941, with constant and trend -3.533 and -1.949 with no deterministic components, it can be concluded that all risk variables are stationary in levels, while variable premium for is insurance stationary in first differences. After this, the VAR model is defined as follows:

$$Z_t = (\Delta LN_{PREMIUM_t}, R_{PRICING_t}, R_{RESERVE_t}, R_{OCCURENCE_t}, R_{REINSURANCE_t}) \quad (5)$$

After testing the stationarity of variables that are included in the model, it is necessary to determine the optimal shift value, k. The shift value k is determined by minimizing the information criteria AIC (Akaike information criterion), SBC (Schwarz information criterion) and HQ (Hannan-Quinn information criterion), and the results are given in Table II.

TABLE II
PEARSON CORRELATION COEFFICIENT
THE VALUES OF INFORMATION CRITERIA FOR LAGS

Lag	**AIC**	**SC**	**HQ**
0	-21,9389	-21,7342	-21,8635
1	-27,4474	-26,2187*	-26,9943
2	-27,8742	-25,6215	-27,0434*
3	-27,4428	-24,1661	-26,2344
4	-27,8871*	-23,5865	-26,3012

Source: authors' calculation

AIC criterion proposed shift length k = 4, the SC suggests a shift k = 1, and the HQ for the optimal length of a shift suggests, k = 2. Since at k = 1 and k = 4 the problem of autocorrelation present, shift, k = 2 was elected. According to the results of VAR model, at the significance level of 5%, statistically significant variables are: $R_{PRICING_{t-1}}$ and $R_{PRICING_{t-2}}$ with t-values of 3.8246 and -1.8749 and $R_{OCCURENCE_{t-2}}$ with a t-value of 1.7827. However, in empirical studies model parameters estimates are not so important as themselves. After estimating the parameters, the assumptions of no correlation and heteroscedasticity were tested. According to the results of LM test there is no autocorrelation problem at the significance level α = 1%. White's heteroscedasticity test with probability equal to 0.1252, showed that heteroscedasticity is not present in the model. Prior to the implementation of innovative analysis model stability was also tested, and as can be seen in Fig. 2. It is evident that all the parameters are inside the unit circle and therefore the VAR model is stable.

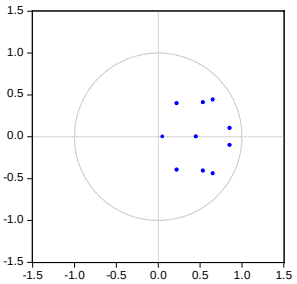

Fig. 2 Stability model analysis

Finally, in order to test the hypothesis which of the underwriting risks has the biggest impact on the insurance cycle, innovation analysis was conducted, that is the decomposition of the variance. The first step consists of orthogonalization innovation and Cholesky factorization, which supposes a certain order variables, was selected. The first variable in factorization order explains in highest proportion itself, and the variables that have the least impact will be positioned at the end. For the correct order of the variables in the implementation of the decomposition of variance, Granger test was performed. According to the results

of Granger test, R_PRICING causes the change in ΔLN_PREMIUM at the significance level α = 1%. Thus, the decomposition of variance is conducted in this order: R_PRICING, R_OCCURENCE, R_RESERVE, R_REINSURANCE. The results are given in Table III.

TABLE III
VARIANCE DECOMPOSITION

Period	ΔLN_PREMIUM	R_PRICING	R_RESERVE	R_OCCURENCE	R_REINSURANCE
1	100,0000	0,0000	0,0000	0,0000	0,0000
2	96,4193	1,6936	0,03668	1,8496	0,0008
3	87,5917	9,5663	0,0286	2,8081	0,0052
4	74,1156	23,4073	0,0230	2,3860	0,0681
8	49,5829	40,4675	0,0877	3,7089	6,1531
12	67,9799	20,1825	2,6509	3,3062	5,8805
16	68,2647	17,0005	4,5071	3,1287	7,0990
20	70,4791	15,5235	4,6296	3,0055	6,3623

Source: authors' calculation

The results of decomposition of variance for the variable ΔLN_PREMIUM show that in the next period (k = 1) variable alone explains 100% of their forecasting errors. In the second quarter, the occurrence risk, in relation to other risks, explains most of the variance of the cycle, arraying from 1.8496% to 3.7089%. However, from the third quarter forward the pricing risk, in comparison with other risks, explain most of the cycle, ranging from 9.566% 3 to 40.4675%. In the first year the smallest part of the variation in the cycle is explained with reserve risk and reinsurance risk. Although their values in the coming years slightly increase, the pricing risk remains a risk that largely determines the movement of the insurance cycle in the Republic of Croatia.

V. CONCLUSION

Insurance companies are exposed to numerous risks which can arise from internal actions or can be caused by external factors. One group of internal risks is underwriting risks which include pricing risk, reserve risk, reinsurance risks and occurrence risk. Pricing risk is present before the insured event occurs because there is a risk that the costs and claims will be higher than the premiums received. It may be called the risk of insufficiency/inadequacy of insurance premiums, since it implies that the rate of loss occurrence has changed contrary to predictions at the time of determining the premiums. Reserve risk is the risk that the total amount of the technical provisions is misstated or that losses will vary around the statistical expected value. The occurrence risk is assessed by actuaries in insurance companies, and it is administered by statistical methods to systematically monitor and assess the frequency of appearance of adverse events. Reinsurance risk refers to reinsurance companies, and stems from their core business, reinsurance, and consequently retrocession.

Since one of the fundamental causes of insolvency of the insurance company is pricing risk it was necessary to test whether this is the risk that in highest proportion determines insurance cycle. Insurance cycle alternate 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. Since the premium contains important information about the pricing of insurance, and has an important role in determining the insurance cycle it was used as a variable which represents insurance cycle in the Republic of Croatia. After quantifying underwriting risks included in the analysis, the hypothesis was tested by applying a vector autoregression model in innovation analysis. It provides information in a format that is appropriate to interpret and draw conclusions about the dynamics of the variables. Results for the decomposition of variance for the variable premium show that variable alone explains 100% of their forecasting errors in the forthcoming period. In the second quarter, the occurrence risk, in relation to other risks, explains the most of the variance of the insurance cycle with value 1.8496%. However, in the third quarter and forward, the pricing risk, in comparison with other risks, explain the most of the insurance cycle, ranging from 9.566% to 40.4675%. Although the value of other risks in the coming years slightly increases, the pricing risk remains a risk that in the highest proportion determines the movement of the insurance cycle.

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