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MODELLING OF THE EFFECTS OF ANNUAL WRITTEN GROSS PREMIUM ON COSTS OF ACQUISITION AND SETTLED CLAIMS IN THE REPUBLIC OF CROATIA'S HEALTH INSURANCE MARKET[1]

Ticijan Peruško Ph.D., Associate Professor
Juraj Dobrila University of Pula,
Faculty of Economics and Tourism "Dr. Mijo Mirković" Pula, Croatia,
tperusko@unipu.hr
Vanessa Šestan, student
Juraj Dobrila University of Pula,
Faculty of Economics and Tourism "Dr. Mijo Mirković" Pula, Pula, Croatia
vsestan@unipu.hr

ABSTRACT

Information that facilitates the recognition of market trends and adaptation of insurance company business to market movements is obtained using insurance market analysis. For that purpose, the method of modelling is used, by which the interactive effect of variables and correlation of movements of the observed phenomena over a period of time are researched. This method is also used to obtain new prognostic information for market prediction and insurance company management. In the conducted research, the Republic of Croatia's health insurance market is analysed. The research was directed towards the annual gross written premium, annual settled claims and acquisition costs as a central focus in insurance company business.

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The aim of the paper is to, by applying accounting information and scientific and research methods, explore the correlation between the annual gross premium and the acquisition costs and damages in the health insurance market of the Republic of Croatia and to shape them using scientific models. By the application of these models, the predicted impact of the gross written premium on the costs of acquisition and the settled claims is illustrated. In this way, the creation of the new prognostic accounting information for the needs of the analysis and planning of business activities in the Republic of Croatia's health insurance market is facilitated.

Key words: *gross written premium, acquisition costs, settled claims, health insurance, accounting information*

1. INTRODUCTION

Successful business performance in the insurance industry consists of a positive financial result, realised from the underwriting operations and investment of the monetary funds obtained from the agreed insurance covers. The success of investment is expressed in the revenue and expenditure created from the investment of monetary funds. There are three components in the underwriting business which considerably affect the business result, namely agreed insurance cover, damages occurring from the insured risk and operational costs.

Costs in the insurance industry are divided into acquisition costs and administration costs. Administration costs are fixed costs and are independent from insurance underwriting, while the acquisition costs are variable costs and are subject to the influence of the scope of sale transactions in the insurance underwriting process. In the competitive insurance market, profitable and financially sound insurance companies are built on cost-effective business operations (Sriram, Shi. & Ghosh, 2016, 178).

Accounting information from the insurance market facilitates the analysis and prediction of the insurance market movements, with the aim of recognition of trends and implementation of innovative business methods. (Bikker, 2016, 75). The costs of acquisition and settled claims are associated with insurance underwriting and that is why the movements of acquisition costs and settled claims in the market have been explored in relation to the annual gross written premium. Gross premium represents the price of insurance which a policyholder pays for the agreed type of insurance. (Andrijašević & Petranović, 1999, 214).

The annual gross written premium affects the annual acquisition costs, as well as the amount of settled claims and we researched whether the correlation can be statistically modelled for the entire Republic of Croatia health

insurance market and, consequently, to predict the amount of costs of acquisition and settled claims in the health insurance market, depending on the predicted value of the annual gross written premium. The goal of the paper arises from the above and is to, based on the annual market movements, model the relationship between the annual gross written premium with the costs of acquisition and annual gross written premium with settled claims. New prognostic information is then formed about the movements of acquisition costs and settled claims with the aim to understand the market legality and advancement of business processes in the Croatian insurance industry.

2. LITERATURE REVIEW

The insurance market research facilitates new knowledge which has scientific and applicative value. Moro and Anderloni (2014) also show new empirical proofs of the determinants of economic performances in the main European insurance markets. For this purpose, they tested the effects of several characteristics, such as the size of insurance companies, Structure and policies of investment on economic results for a group of non-life insurance companies operating in the main European markets.

In his paper, Y. Shiu (2004) explored statistically significant determinants of the United Kingdom insurance companies' market success with application of a regression model during the period from 1986 to 1999. Elinga and Luhnen (2010) researched the efficiency of the international insurance market and proved that the information about movements in the international insurance industry markets facilitates consideration and analysis of cost effectiveness and illustration of market possibilities for insurance companies. Wu et al. (2007) examined the effects in the insurance market which can help reduce insurance companies' operational costs. In their paper, they proposed a new data analysis model which simultaneously can assess sales and investment impacts of the Canadian insurance industry.

Pervan, Pavić and Kramarić (2010) illustrated the determinants of profitability of Croatian non-life insurance companies. The study results show that the ownership, cost ratio and inflation have a negative and significant effect on profitability. Ćurak et al. (2011) directed their research towards the financial success of the Croatian composite insurers. Applying a panel data technique, the authors have proven that the company size, takeover risk, inflation and return of capital significantly affect profitability of the insurance companies in Croatia.

Pervan et al. (2012) researched the profitability determinants in the insurance industry in Bosnia and Herzegovina, while the same author, together

with Poposki and Ćurak (2014) analysed the insurance sector in the Republic of North Macedonia, using a SWOT analysis and the analysis of insurance companies' profitability determinants.

Burca and Batrinca (2014) explored the insurance companies' financial impact at micro and macroeconomic levels, as well as the elements of insurance companies' financial success in the Romanian insurance market during the period from 2008 to 2012 and, in his paper, Lee (2016) studied the relationship of specific macroeconomic factors in the Taiwanese insurance industry.

Daare (2016) researched the factors of general profitability in the insurance market in India, and Kozak (2011), applying a regression model, analysed the profitability determinants of the twenty-five most important insurance companies from Poland while, in his paper, Kaya (2015) focused on the exploration of specific factors which affect the profitability of the companies operating in the Turkish non-life insurance market.

3. RESEARCH METHODOLOGY

In the research, the statistical regression method was used, which is applied in order to explore the relationships between the variables, where they are linked together into the regression model. By the regression model, the changes in dependent variables are described, in relation to the independent variables. The general linear regression model reads (Aczel, Sounderpandian, 2009):

$$Y = f(x) + e \tag{1}$$

If the functional part of the model has this shape:

$$f(x) = a + \beta X \tag{2}$$

The model becomes:

$$Y = a + \beta X + eY = a + \beta X + e \tag{3}$$

The regression analysis is conducted on the basis of n pairs of X and Y values, i.e. pairs (x_1, y_1), (x_2, y_2),…, (x_i,y_i),…(x_n,y_n), so the model is expressed by the n system in the equation,

$$\gamma_i = d(x_i) + e_i\gamma_i = d(x_i) + e_i \tag{4}$$

that is:

$$\gamma_i = a + \beta x_i + e_i, \quad i = 1,2,...,n \tag{5}$$

The linear models are applied in the insurance industry as the phenomena in insurance are observed through specific linear combinations of evaluation variables (Garrido et al., 2019). In this respect, the relationship between gross

premium and settled claims arises from the insurance contract, which obliges the insurance company to compensate the damage for an occurred insured event. From that point of view, in the application of the statistical regression model, the annual gross written premium is an independent variable and annual settled claims a dependent variable.

The movement of the observed phenomena is expressed using statistical models in order to determine the statistical relationships and prediction of movements of the dependent variable of annual claims due to the change in the independent variable of annual gross written premium. The aim of the research is to establish whether there is a value interdependence of the total annual gross premium movements and annual movements of settled claims in the Croatian health insurance market which can be statistically modelled and applied for the prediction of settled claims. The analysed variables are the sum of the total values of all types of health insurance in the market, namely, compulsory health insurance, supplementary health insurance, additional private and other voluntary health insurance. The research results have their application at the national level, which is reflected in the description and modelling of the changes which occurred in the course of the previous annual periods. Furthermore, the research results are applicable in insurance company management, as the research methodology and results represent an additional instrumentation in the prediction of claims in insurance companies.

Acquisition costs are a category which substantially affects the success of business operations in insurance companies and are created during the insurance underwriting. For that reason, the prediction of acquisition costs is important for business performance planning in the insurance industry. Given that those costs are subject to sales activities, the aim of the research is to explore and model the interrelationship between annual movements of the gross premium and acquisition costs and, in this way, to test whether, at the national market level, the annual value interrelationship between the gross written premium and acquisition costs in the national market, can be determined. In the statistical modelling, the annual gross premium from the observed years is an independent variable as, from the planning insurance underwriting process, acquisition costs are created, which are implemented in the dependent variable of the statistical modelling. Due to the importance of the acquisition costs in the insurance industry, the research was conducted within the acquisition cost structure, where the costs of commission and other acquisition costs were also explored.

Following all of the above, the starting point of the set hypothesis is that, with the application of information from the Croatian health insurance market, value interrelations between the total gross written premium and settled claims

can be described and modelled, as well as the gross written premium and acquisition costs and that, on this basis, prognostic information about the impact of the predicted amount of gross premium on the predicted value of the settled claims and the predicted value of the acquisition costs can be formed. The hypothesis testing was carried out for the Republic of Croatia's health insurance market and the tested period was between the years 2005 and 2019.

4. RESEARCH APPLICATION

The initial data, used in the research of the Republic of Croatia market in the period between 2005 and 2019, is shown in the table below

Table 1 Annual gross written premium, settled claims and acquisition costs in the Republic of Croatia's health insurance market in the period from 2005 to 2019.

Year	Gross written premium in 000 kn)	Settled claims (in 000 kn)	Acquisition costs (in 000 kn)	Acquisition costs	
				Commission costs (in 000 kn)	Other acquisition costs (in 000 kn)
2005	187,244	110,783	24,926	15,934	8,992
2006	221,466	126,199	28,205	12,857	15,348
2007	251,855	161,330	28,141	10,166	17,975
2008	281,209	181,430	27,252	7,543	19,709
2009	271,169	206,973	25,121	6,651	18,470
2010	258,703	192,202	25,151	6,901	18,250
2011	255,147	194,947	20,264	5,830	14,434
2012	238,668	184,063	20,184	7,085	13,099
2013	249,438	162,715	36,684	7,573	29,111
2014	278,338	156,484	35,849	12,689	23,160
2015	329,278	200,007	60,607	35,322	25,285
2016	409,206	254,070	72,247	44,103	28,144
2017	487,840	250,078	88,905	50,107	38,798
2018	519,962	294,126	137,536	76,920	60,616
2019	605,981	320,101	119,857	66,886	52,971

Source: HANFA https://www.hanfa.hr/publikacije/statistika and HUO https://huo.hr/hr/statistika (visited on 10.06.2021)

In the first step, the relationship was examined between annual movements of the gross written premium and settled claims using the regression analysis. Annual settled claims represent the sum of all occurred and settled claims from different types of health insurance. In statistical modelling, the relationship was tested between the independent variable of gross written

premium and the dependent variable of annual settled claims in the period between 2005 and 2019.

Table 2 Parameters of the regression model of the relationship between gross premium and settled claims in the Republic of Croatia's health insurance market

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42052845699,928	1	42052845699,928	97,966	,000[b]
	Residual	5580374487,806	13	429259575,985		
	Total	47633220187,733	14			

a. Dependent Variable: VAR00002
b. Predictors: (Constant), VAR00001

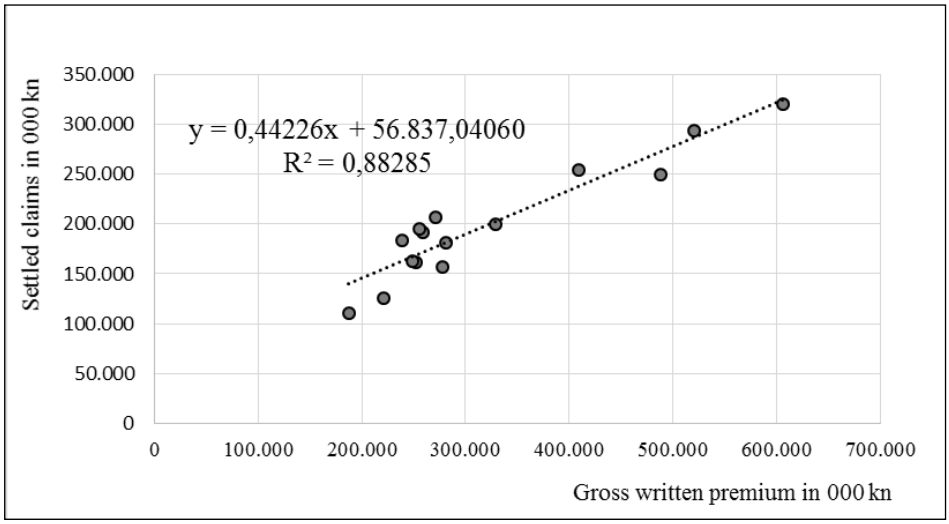
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	56837,04060	15393,331		3,692	,003
	VAR00001	,44226	,045	,940	9,898	,000

a. Dependent Variable: VAR00002

Source: Authors' calculation according to the data from table 1.

Graph 1 Scatter diagram and regression model of the relationship between the annual gross premium and settled claims in the Republic of Croatia's health insurance market in the period between 2005 and 2019



Source: Authors' calculation according to the data from table 1.

The obtained test results prove that, although there is a diversity in the types of health insurance which make up the entire health insurance market, the value of the total gross premium can be statistically linked to the total settled claims and described by the statistical model. By this, prediction is facilitated of total annual settled claims in the market depending upon the predicted annual gross written premium. By inclusion of the predicted amount of gross premium in the statistical model, a predicted value of settled claims is obtained. To illustrate the application of the model, the predicted gross premium of 634,270 thousand kunas will be used. This amount, at the same time, represents the annual gross written premium in the health insurance market in 2020, according to the data from the Croatian Insurance Bureau. By inclusion of the predicted amount of gross premium in the model, the amount of the predicted settled claims is obtained in the amount 337,349 thousand kunas. The ratio between predicted settled claims and gross premium shows the number of damages per unit of coverage so, based on the obtained results, it is expected that on one kuna of gross premium written, 0.53kn will be paid for claims.

On the grounds of the illustrated data, a presumption arises that, in insurance companies which operate in the health insurance market in the Republic of Croatia, prognostic regression models which facilitate the predictability of the annual settled claims on the basis of the annual planned gross premium, can be established. This presumption has its starting point in the fact that the analysed information from the insurance market represents a sum of the realised scales of all insurance companies which operate in the health insurance market.

The acquisition costs are created from the processes of sales and underwriting. By the application of the annual gross written premium and annual acquisition costs, the interrelation is tested in the movements of the observed variables, and the results are shown in both the table and the graph.

Table 3 Parameters of the regression model of the relationship between gross premium and acquisition costs in the Republic of Croatia's health insurance market

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18203418336,630	1	18203418336,630	121,583	,000[b]
	Residual	1946354892,304	13	149719607,100		
	Total	20149773228,933	14			

a. Dependent Variable: VAR00002

b. Predictors: (Constant), VAR00001

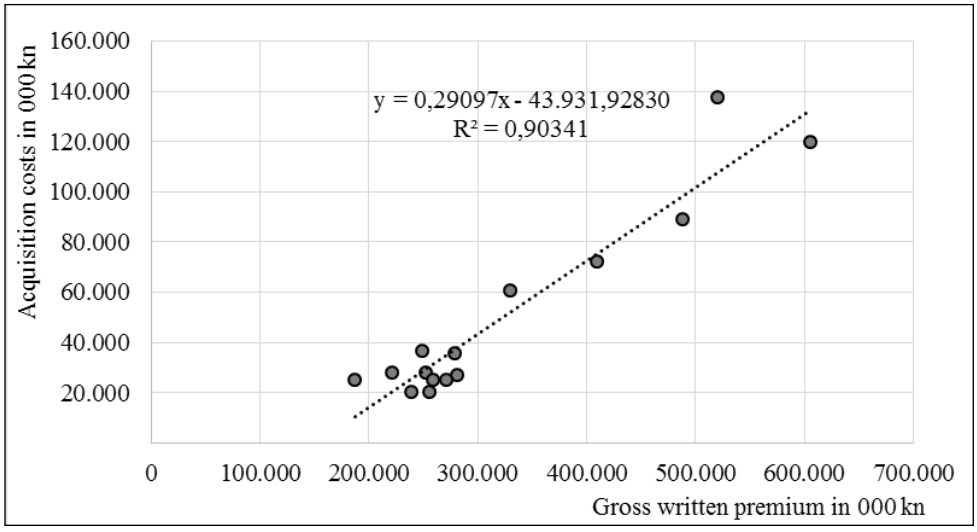
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-43931,92830	9091,006		-4,832	,000
	VAR00001	,29097	,026	,950	11,026	,000

a. Dependent Variable: VAR00002

Source: Authors' calculation according to the data from table 1.

Graph 2 Scatter diagram and regression model of the relationship between the annual gross premium and acquisition costs in the Republic of Croatia's health insurance market in the period between 2005 and 2019

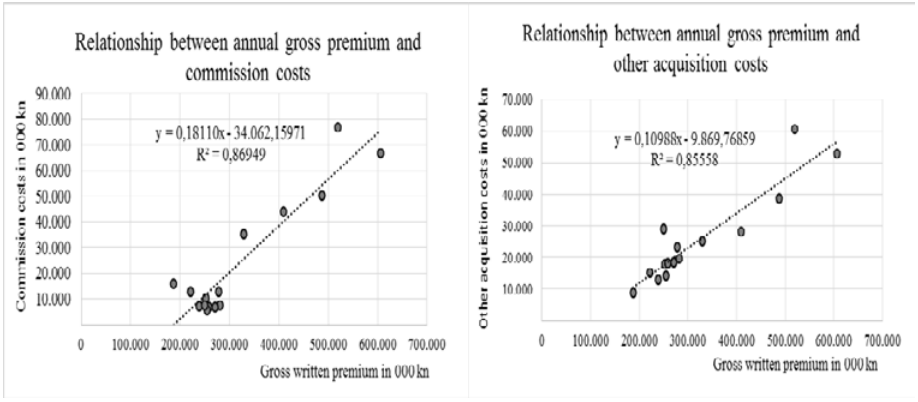


Source: Authors' calculation according to the data from table 1.

The test results show that movements of acquisition costs can be described using the statistical model, as dependent variables in the regression model, in relation to the gross written premium. This proves yet another characteristic of the analysed health insurance market. Apart from proving the statistical connection of movements, by application of the regression model, the movement of acquisition costs in relation to the predicted gross written premium, is also predicted. For the predicted gross premium of 634,270 thousand kunas, the predicted amount of acquisition costs equals 140,622 thousand kunas, i.e. on one kuna of gross premium, acquisition costs of 0.22kn are expected.

The acquisition costs are divided into two groups, namely into commission costs and other acquisition costs. Due to the importance of acquisition costs in the insurance industry, the hypothesis has been additionally tested according to the acquisition cost groups. From the scatter diagrams which illustrate the relationship between the annual gross written premium with commission costs and the relationship between the annual gross written premium with other acquisition costs, interconnections were perceived between the observed variables. The scatter diagram proves the linear movement of both segments of the acquisition cost with annual gross written premium.

Graph 3 Scatter diagram and regression model of the relationship between the annual gross premium, acquisition costs and other acquisition costs in the Republic of Croatia's health insurance market in the period between 2005 and 2019



Source: Authors' calculation according to the data from table 1.

The regression models of the relationship between the annual gross premium, commission costs and other acquisition costs facilitate the delimitation in the predicted amount of acquisition costs. By including the predicted gross premium in the regression model of commission costs, the amount of 80,804

thousand kunas is obtained, which shows that 57% of the total predicted acquisition costs concern commission costs. The same procedure is applied to calculate other acquisition costs, where the regression model is used which shows the relationship between the annual gross premium and other acquisition costs. By inclusion in the regression model, the amount of 59,825 thousand kn is obtained. So, on one kuna of gross premium, a commission cost is expected equalling 0.13 kn, as well as other acquisition costs, in the amount of 0.09 kn.

Summarising the overall research results, the method of modelling the value effect of the annual gross written premium on the value of the annual settled claims and insurance company acquisition costs in the analysed market, has been confirmed. The modelling method is used to calculate new prognostic information about annual settled claims and acquisition costs. The application of the illustrated methodology facilitates additional information to participants in the health insurance market for comprehension of market trends and use of information for improvement of business operations in this insurance segment.

5. CONCLUSION

The health insurance market provides summary data about business performance of all participants in the market. The information from the insurance market is used for the analysis of previous periods and prediction of annual trends. This information is interlinked for analytic market research and formation of business models for the insurance industry.

Prediction of costs in the market has a significant role in the process of insurance company management as it facilitates the comparison and adaption of business operations to market movements. The purpose of such information is to maintain the business acceptable levels of costs which is essential for insurance company business performance and maintenance of a competitive position in the market.

The conducted research proves the existence of a statistical relationship and the effect of the annual gross written premium on the movement of acquisition costs and settled claims in the Republic of Croatia's health insurance market, enabling the modelling and consideration of prognostic movements in the market in a correlation with the predicted annual gross premium. The research results reveal new characteristics of the analysed health insurance market in the covered areas, they widen the information basis for planning and decision making and represent an additional instrumentation for insurance company management in this insurance segment.

With the aim to develop new scientific knowledge, by using the illustrated methodology, research can be conducted according to the groups within health insurances which include compulsory, supplementary, additional private and other voluntary health insurances. In this way, prognostic scales of movement can be formed in the observed categories according to the types of health insurance. The illustrated methodology can be applied in insurance companies for the comparison of movements between insurance companies and health insurance markets.

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MODELIRANJE UTJECAJA GODIŠNJE ZARAČUNATE BRUTO PREMIJE NA TROŠKOVE PRIBAVE I LIKVIDIRANE ŠTETE NA TRŽIŠTU ZDRAVSTVENOG OSIGURANJA REPUBLIKE HRVATSKE

SAŽETAK RADA

Analizom tržišta osiguranja dobivaju se informacije koje omogućuju prepoznavanje tržišnih kretanja i prilagodbu poslovanja osiguravajućih društava tržišnim zahtjevima. U tu svrhu koristi se postupak modeliranja kojim se istražuje međusobni utjecaj varijabli i povezanost kretanja promatranih pojava u vremenskom razdoblju, te za dobivanje novih prognostičkih informacija za predviđanje tržišta i upravljanje osiguravajućim društvima. U provedenom istraživanju obuhvaćeno je tržište zdravstvenog osiguranja Republike Hrvatske. Istraživanje se usmjerilo na godišnju zaračunatu bruto premiju, godišnje likvidirane štete i troškove pribave kao centralan fokus u poslovanju osiguravajućih društava. Cilj rada je primjenom računovodstvenih informacija i znanstveno-istraživačkih metoda istražiti međupovezanost godišnje bruto premije sa troškovima pribave i šteta na tržištu zdravstvenog osiguranja Republike Hrvatske i uobličiti ih putem znanstvenih modela. Primjenom tih modela prikazati prognozirani utjecaj zaračunate bruto premije na troškove pribave i likvidirane štete. Tim putem omogućiti stvaranje novih prognostičkih računovodstvenih informacija za potrebe analize i planiranja poslovanja na tržištu zdravstvenog osiguranja u Republici Hrvatskoj.

Ključne riječi: *bruto premija, troškovi pribave, likvidirane štete, zdravstvena osiguranja, računovodstvene informacije*