ANALYSIS OF NON-LIFE INSURANCE COMPANIES' EFFICIENCY IN THE REPUBLIC OF SERBIA: DEA APPROACH

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Abstract: *The measurement of the efficiency of the insurance industry has become popular in the last years, both at the micro level (comparison of insurance companies), as well as at the macro level (comparison of the insurance systems at the countries level). It gives insights into the competitiveness of various insurance companies, in order to get a more detailed picture of good or bad practices. In this way, the existing problems or shortcomings may at least partially be solved or mitigated, and that will favourably affect not only the insurance system of a country, but also its overall economic development. This paper uses Data Envelopment Analysis (DEA) to examine and evaluate the efficiency of Serbian insurance companies during the period 2014–2016. The analysis will show which of the insurance companies operate efficiently. Also, it will identify the inefficient insurance companies and the reasons of inefficiency.*

Keywords*: insurance companies, data envelopment analysis, efficiency.*

1. Introduction

Insurance is an important segment of the economy of a country and everyday life of its inhabitats. The significance of insurance derives prominently from its socioeconomic function aimed at meeting the needs for financial and material security of the insured. The reason for such requirements originates from the presence of numerous dangers, occurance of various types of damage, both material and immaterial. The purpose of insurance is to reduce the consequences of these damages as much as possible. Also, capital accumulated

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through premiums is a significant driver of the financial sector. The reimbursement of damages incurred, i.e. economic protection of insured persons from harmful activities after the occurrence of the insured event, are the basic function of insurance. Insurance does not reduce the likelihood of damage, but creates an opportunity for compensation and, consequently, creation of economic security. Insurance is a multidisciplinary activity that can be defined as economic protection against damage caused by a certain risk. In the broadest sense, insurance can be understood as the association of all persons exposed to the same risk.

The task of insurance is a redistribution of a number of hazards to which all the insured are exposed to, and payment of the appropriate compensation for the damage suffered or the corresponding amount in accordance with the concluded insurance contract to the insured. In securing property and liability, uncertainty usually refers to something that will happen in the future, wherby the insured event has some negative consequences for the financial situation of the insured or, in other words, leads to some financial loss which requires the insurance coverage.

Insurance companies, besides banks, represent the most important financial institutions, which play a key role in the development of the economy. The task of insurance is to manage risks in the most efficient manner and to ensure a stable development of the national economy (in the first place, establishing social stability), thus stimulating responsible behavior of business entities in relation to their property and citizens, not only in terms of property, but also in terms of their health and securing a peaceful age.

The direct impact and contribution of the insurance institution to the improvement of living and working conditions is fulfilled daily through monetary compensation of incurred losses, i.e. payment of insured sums in all branches of insurance. Therefore, the further development of insurance activity is one of the important factors of economic security and the full protection of the social community (Vojinović, Dukić Mijatović, 2017).

Bearing in mind the aforementioned, an adequate analysis of insurance companies' operations and the identification of factors that cause inefficiency can greatly facilitate the decision-making for managers. In the recent years, one of the most commonly used methods for efficiency evaluation of financial institutions is Data Envelopment Analysis.

For that reason, the main aim of this paper is to examine and evaluate the efficiency of Serbian insurance companies during the period 2014–2016 in order to follow the dynamics of the efficiency of each of the company.

In order to achieve stated aim, the paper, in addition to the introduction and conclusion, contains the following components: (1) Literature review; (2) State of insurance sector in the Republic of Serbia and the role of non-life insurance; (3) Methodology and model formulation; (4) Data and results.

2. Literature review

The efficiency of financial companies has gained a lot of attention in the recent years, given the fact that the efficiency of financial companies is an important determinant of the efficiency of the national economy. Insurance companies' efficiency has been a subject of many researches. Ertgrul et al. (2016) use Data Envelopment Analysis to

investigate efficiency of 12 non-life insurance companies in Turkey based on the data from annual reports. Wanke and Barros (2016) tried to predict the performance of Brazilian insurance companies by proposing an integrative, two-stage approach, which involved the determination of a DEA meta-frontier in the first stage and the use of a number of data mining techniques in the second. Bikker and Gorter (2008) examine the non-life insurance market by measuring scale economies and thick frontier inefficiencies. Their findings show that scale economies appear to be subjected to a firm size: they are larger for smaller firms and vice versa. Biener et al. (2016) use finest frontier efficiency methodologies in order to obtain the efficiency and productivity of Swiss insurance companies in the life, property/casualty, and reinsurance sectors from 1997–2013. Kao and Hwang (2008) used the Data Envelopment Analysis in order to identify the causes of inefficiency of 24 non-life insurance companies in Taiwan. Barros et al. (2010) use Data Envelopment Analysis in order to obtain efficiency score of the Greek insurance companies. Their sample consists of 17 life insurers, 41 non-life insurers, and 10 mixed insurance companies for the period 1994–2003.

Regarding analysis of insurance companies' efficiency in the Republic of Serbia, several researches can be found in the literature. Knežević et al. (2015) analyze efficiency of Serbian insurance companies using input oriented CRS DEA model for the period 2009-2011. Lukic et al. (2018) convey an analysis of the 2016 business efficiency of insurance companies in the Republic of Serbia and their findings show that of the 16 insurance companies, 11 are inefficient. Mandić et al. (2017) examine all companies operating within the insurance sector in Serbia in the period from 2007 to 2014. They used Fuzzy Analytic Hierarchy Process (FAHP) and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) in order to obtain efficiency ranks of insurance companies.

3. State of insurance sector in the Republic of Serbia and the role of non-life insurance

The insurance sector in the Republic of Serbia compared to other countries in the region is underdeveloped and its level of development is under the average of the EU countries regarding the amount of total premium per capita and the ratio of total premium to gross domestic product (GDP). Hence, the level of economic development of a country determines the level of development of its insurance market. However, the deep social and economic crisis is still the main characteristic of the macroeconomic environment in which insurance companies operate, whereby insolvent enterprises and impoverished population includes the largest number of policyholders (Stojaković & Jeremić, 2016). Piljan et al. (2014) state several characteristics of the Serbian insurance sector before the reform in 2004: an absence of good practice in business activities, inadequate management, a lack of safety of investments of insurance funds, no regular reporting, an ineffectiveness of business books and the unreliability of the shown data, irregular payment of liabilities to policyholders and third parties, double policy issuing, setting incorrect goals of insurance company business goals instead of protecting policyholders and clients, a lack of public confidence in the insurance sector, a high level of irregularity in business, a significant number of legal entities which run businesses in the insurance sector without licenses, an insufficiency or inadequacy of company activity, and an absence of effective auditing and actuary work. In order to conduct the reform the National Bank of Serbia has carried out

strategically planned activities in order to provide sector stabilization, increase of public confidence in the insurance sector and creation of conditions for sector development (Piljan et al, 2014).

The insurance mechanism consists of three components (Žarković, 2008): economic, legal and technical. Economic component is expressed by the task of insurance: indirect and direct protection of the insured. Legal component implies the regulation of exceptionally numerous legal relationships arising in insurance, starting from the creation of contract to the payment of compensation of damages or insured sum. Technical part regulates the insurance process and it is in charge of assessing the severity of danger, the premium calculation, all using the most up-to-date statistical, mathematical and other methods (Žarković, 2008).

The impact of non-life insurance on society is multiple (Vojinović, Dukić Mijatović, 2017). A favorable impact on social well-being can be noticed. For example, general liability insurance, where damaged third parties are provided with fair and quick compensation, obviously, is in full social interest. Non-life insurance contributes to the establishment of security and trust. There are numerous cases where an individual can provide the insurance protection. Insurance covers the most serious losses, such as death or permanent loss of working ability of the insured or members of his family. Additionally, insurance helps to achieve business ventures. The business world has an obvious benefit of insurance in terms of a reduction in the uncertainty that it provides. If there was no insurance protection, many business ventures would have never begun, as their carriers would hardly risk financial failure because of, for example, the possibility of fire and interruptions.

Globally observed non-life insurance sector is growing. Premiums have risen moderately in almost all countries/regions in 2017 due to stronger economic growth. Global non-life premiums are up and estimated 3% in real terms, after a 2.3% gain in 2016. Global primary non-life premium growth is forecast to remain steady at around 3% in 2018 and 2019, but could be stronger depending on price increases (Global insurance review 2017 and outlook 2018/19). If we consider the state of non-life insurance in Republic of Serbia, the dominance over life insurance can be observed. At the end of the first quarter of 2018, 21 insurance companies operated in Serbia. Among them, 17 companies exclusively deal with the insurance business, while 4 deal with reinsurance. Considering only insurance companies, four deal exclusively with life insurance, seven deal exclusively with non-life insurance and six companies deal with life and non-life insurance. Regarding premium structure the share of non-life insurance at the end of first quarter of 2018 was 77.5%, while the share of life insurance was 22.5%, wherein the largest share among non-life insurance was generated by motor third party liability (29.1%). Non-life insurance premium rose by 4.0% in first quarter of 2018 relative to the same period in 2017. Motor third party liability insurance premium rose by 6.8%, property insurance premium by 1.3%, premium for full coverage motor vehicle insurance ("kasko") expanded by 12.8%, while accident insurance premium recorded a fall of 34.7% (Insurance sector in Serbia - First Quarter Report 2018).

4. Methodology and model formulation

An adequate analysis of business efficiency is a prerequisite for identifying deficiencies in business operations, as well as opportunities for improvement. Numerous activities can be presented as a transformation of inputs to outputs, wherein the aim is to

create more outputs with fewer inputs. Data envelopment analysis (DEA) represents the most used method for efficiency appraisal. DEA is a mathematical programming method for evaluating the relative efficiency of decision making units (DMUs) with multiple inputs and multiple outputs. A production possibility set is created empirically by enveloping the inputs and outputs data set, where a parametric transformation function is not assumed (Morita & Avkiran, 2009). If a DMU is positioned on the efficient frontier it is considered to be efficient, otherwise, if it is located inside the production possibility set it is considered as inefficient. Mathematical model is formulated as follows: assume that there are n DMUs, and the jth DMU, DMU$_j$, produces s outputs (y_{ij},..., y_{sj}) by using m inputs (x_{1j},..., x_{mj}), then the efficiency score of the observed DMU$_o$ is given as the optimal value to the following linear programming problem (Morita & Avkiran, 2009):

$$\theta_0^* = min\,\theta \tag{1}$$

subject to:

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0}, i = 1,2 \dots m \tag{2}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, r = 1,2 \dots s \tag{3}$$

$$\lambda_j \geq 0, j = 1,2 \dots n \tag{4}$$

This model represents an input oriented constant return to scale (CRS) model. The DMU is considered to be efficient if $\theta_0^* = 1$, otherwise it is considered as inefficient.

The most challenging part of model formulation is a selection of appropriate variables which will represent inputs and outputs. This is a critical step in pursuit to provide valid results produced by DEA and is particularly difficult for insurance companies (Diboky & Ubl, 2007). There are several possible approaches. Considering outputs measurement, three main approaches can be found in the literature (Eling & Luhnen, 2010):

1. The intermediation approach – According to this approach the insurance company is observed as a financial intermediary whose role is to manage assets, collect capital from policyholders, perform their further investment through capital markets and perform payments of claims, taxes, and costs.

2. The user-cost method – The essence of this approach consists in the distinction between input and output based on net contribution to revenues. In other words, if a financial product produces a revenue which is higher than the opportunity cost of funds, or if the financial costs of a liability are less than the opportunity costs, it is considered a financial input. Otherwise, it is considered a financial output.

3. The value-added approach (also called production approach) – Main characteristic of this approach is that it classifies outputs as important if they contribute a noteworthy added value, based on operating cost allocations. According to this approach, the insurer delivers three main services and adequate output proxies should be defined:

- The first service consists of risk-pooling and risk-bearing. Insurers create value added by operating a risk pool, collecting premiums from policy-holders, and redistributing most of them to customers who have incurred losses.

- The second service represents 'real' financial services concerning insured losses. Insurers create added value for their policyholders by providing real services, such as life insurance or property liability insurance.
- The third service refers to intermediation where insurers create added value by acting as financial intermediaries that invest the premiums provided by the policyholders and pay out claims and administrative expenses.

The most used approach in traditional literature in order to assess the efficiency of insurance companies is production approach. According to this approach, claims paid and losses incurred represent possible proxies for outputs. However, such a selection of outputs has attracted a significant criticism primarily having in mind the possibility of unexpected magnification in losses caused by some natural disaster or terrorist attack, which could be interpreted as an increase of output and consequently lead to the disruption of results (Diboky & Ubl, 2007). Berger & Humphrey (1997) suggest that the best approach for efficiency assessment of financial institutions is intermediation approach. According to this approach, outputs should be selected according to the intermediary role of insurance companies and some possible output proxies are return on investment, claims paying ability or solvency scores (Brockett et al, 2005).

Regarding the selection of the inputs there is not so much disagreement. Most of the authors agree that in order to carry out the business process, insurance companies use labour, capital and business services (Zanghieri, 2009). Capital as an input can be further distinguished in three categories: equity, debt and physical capital (Eling & Luhnen, 2010). Insurance is a labor intensive industry, therefore it is justified to include this variable in the analysis of efficiency. Adequate proxies for labor could be a number of employees or salary expenses. The justification for equity capital usage is that insurers should preserve equity capital in order to guarantee promised payments to policyholders and to satisfy regulatory requirements (Huang & Eling, 2013). The justification for debt capital usage is supported by the fact that insurers raise debt capital by issuing insurance and annuity policies and invest the capital as part of the intermediation function (Cummins & Weiss, 1998).

We have accepted the framework of Diboky and Ubl (2007) for selection of output variables. The justification for stated selection is that the whole production process of the non-life insurance industry can be separated into two sub-processes (Kao & Hwang, 2008): gathering of premium and profit creation. Therefore, gross written premium represents a good proxy for services provided by non-life insurance companies. Additionally, the key aim of an insurer is to attain a certain rate of return. Consequently, the investment income is chosen as second output variable. When choosing the inputs, the aforementioned approach has been accepted and variables which will be incorporated into model include: labor costs, equity capital and debt capital.

5. Data and results

The variables included for the input oriented CRS model are obtained from the income statements and balance sheets of the Serbian insurance companies that dealt exclusively with non-life insurance in the period 2014–2016. The following variables have been used: investment income (InvInc) and gross written premium (GWP) as output variables and labour costs (LabCosts), equity capital (EqCap) and debt capital (DebtCap) as input variables. Descriptive statistics of the stated variables is presented in the Table 1.

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Table 1. Descriptive Statistics (in thousands of RSD)

	N	Minimum	Maximum	Mean	Std. Deviation
InvInc	26	1014,00	316167,00	114132,7308	87575,47450
GWP	26	128273,00	4190150,00	1495165,1154	1278100,67263
LabCost	26	8251,00	203243,00	88564,6923	58304,94740
EqCap	26	515919,00	1588474,00	806379,1154	324721,97063
DebtCap	26	236042,00	5830890,00	1881766,3077	1743959,68954

Source: Authors' calculation

Descriptive statistics shows that there is a large dispersion in data (std. deviation from 58.304,95 for labour cost to 1.743.959,69 for debt capital), therefore, it is necessary to solve the problem of data imbalance. In order to solve the problem of data dispersion, mean normalization of the data has been conducted. After the normalization, efficiency scores have been calculated (Figure 1). All efficiency values were obtained by the Efficiency Measurement System (EMS) software developed by Holger Scheel at the University of Dortmund, Germany.

Figure 1. Efficiency scores
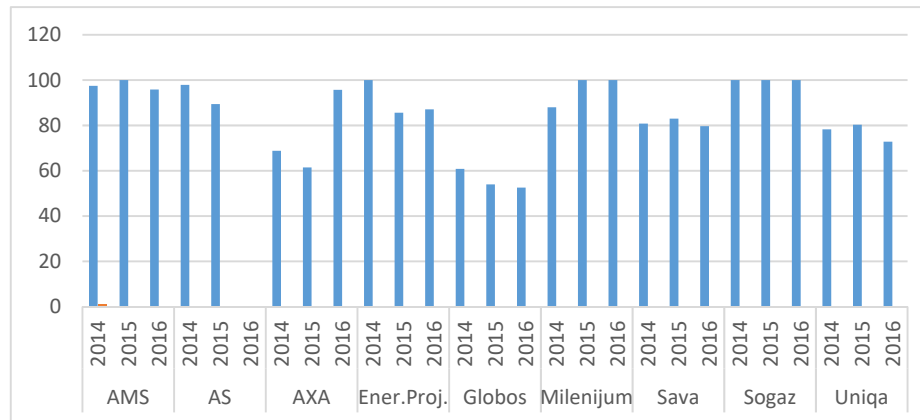
Source: Authors' preview

The obtained results show that in 2014 two companies have operated efficiently, in 2015 three companies have operated on the efficiency frontier, and in 2016 two companies have operated efficiently. As the main source of inefficiency for companies that operated below efficiency, frontier labour costs were identified. During the analysed period, excess in labour costs was the main reason for inefficiency in 64% of cases. In 18% of cases efficiency frontier could be achieved with the enlargement of investment income, while in 18% of cases, the value of equity capital has been found as the source of inefficiency. Our findings show that there would be no improvement of efficiency with enlargement of gross written premium or reduction of debt capital. Regarding the efficiency of a particular

company, it can be observed that there is no company with a constant upward trend in efficiency. Only one company (Sogaz) has achieved efficiency frontier in all observed years. Efficiency of company AS has not been analysed in 2016 since this company withdrew from insurance market. Only one company (Globos) has a constant reduction of efficiency in the observed period, while other analysed companies record fluctuation of efficiency.

DEA can also provide benchmarks for the inefficient companies. According to the results, the efficient model of business operation that can serve as the benchmark for inefficient companies in most of the cases (13 to be exact) is the operation of Sogaz company in 2016, and that is the model the inefficient companies on Serbian insurance market should strive to.

6. Conclusion

The question of insurance companies' efficiency plays a significant role in modern business environment due to the fact that performance of financial sector is one of the principal factors of overall economic development of a country. A suitable analysis of efficiency can deliver significant data to decision-makers in inefficient companies and help them use their resources efficiently and improve their performance.

In this paper, we have assessed relative efficiency of insurance companies in the Serbian insurance market during the period 2014-2016 with the application of Data Envelopment Analysis. The findings of our study indicate that almost three-quarters of insurance companies operated inefficiently in the observed period, while the main cause of inefficiency excess in labour costs was identified.

The paper contributes to the empirical literature in the field of insurance companies' efficiency assessment by providing empirical data regarding the efficiency analysis of non-life insurance companies in the Republic of Serbia.

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ANALIZA EFIKASNOSTI OSIGURAVAJUĆIH KOMPANIJA KOJE SE BAVE NEŽIVOTNIM OSIGURANJEM U REPUBLICI SRBIJI: DEA PRISTUP

Rezime: Merenje efikasnosti industrije osiguranja postaje popularno poslednjih godina, kako na mikro nivou (upoređivanje osiguravajućih društava), tako i na makro nivou (poređenje sistema osiguranja na nivou zemalja). Adekvatna mera efikasnosti pruža uvid u konkurentnost različitih osiguravajućih društava, kako bi se dobila detaljnija slika dobrih ili loših praksi. Na ovaj način, postojeći problemi ili nedostaci mogu se bar delimično rešiti i ublažiti, što će pozitivno uticati ne samo na sistem osiguranja neke zemlje, već i na njen ukupan ekonomski razvoj. Ovaj rad koristi Analizu obavijanja podataka (DEA) za ispitivanje i procenu efektivnosti srpskih osiguravajućih društava u periodu 2014-2016. Analiza će pokazati koja od osiguravajućih kompanija posluje efikasno, identifikovaće neefikasne osiguravajuće kompanije i razloge neefikasnosti.

Keywords: osiguravajuće kompanije, analiza obavijanja podataka, efikasnost.