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Analysing Efficiency of Insurers in Federation of Bosnia and Herzegovina

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ABSTRACT
The main goal of this paper is to estimate the overall and pure technical efficiency as well as returns to scale of insurance companies that operated in 2018 in Federation of Bosnia and Herzegovina while using the input-oriented data envelopment analysis - DEA. The authors employ two input variables including total equity capital and technical provisions as well as one output variable expressed in terms of gross written premium. The obtained results show that higher level of overall technical efficiency is achieved in life insurance segment (86.26%) then in non-life insurance segment (66.13%). The same is true for the pure technical efficiency with values of 89.56% and 84.44% for the life and non-life segment, respectively. Finally, most of the (non)life insurers operate at their sub-optimal scale size.
Keywords: *Efficiency, data envelopment analysis, insurance companies, Federation of Bosnia and Herzegovina*

1. INTRODUCTION

The analysed insurance market of Federation of Bosnia and Herzegovina is rather small and underdeveloped. If observed in terms of number of insurance companies, there were total of 12 insurers that operated in 2018 out of which seven were composites while five insurance companies conducted exclusively non-life insurance activities. Specific feature of the insurance market in Federation of Bosnia and Herzegovina is the domination of non-life insurance business whereas life insurance segment has merely 23% share suggesting its low level of development. Another fact that confirms this statement is domination of motor third party liability insurance class in total non-life market with 59% stake in 2018 [1]. As stated by [2], insurance density as well as share of insurance premium in GDP is the lowest if compared with peers in the region. The same source finds the reasons for this in weak market discipline, illiquid financial markets that limits the investment choice for insurance companies, low financial literacy etc. Having this in mind it would be interesting to examine the level of efficiency obtained by insurance companies operating in life and non-life insurance segment in Federation of Bosnia and Herzegovina.

1.1. Related Work

Efficiency analysis has considerably intrigued the researchers over the last decades which resulted in the growing number of papers relating mostly to the banking and to a lesser extent to the insurance sector. The papers on efficiency in insurance sector in a specific country mostly encompass developed economies such as US (e.g. [3, 4, 5]) or western European countries (e.g. [6, 7, 8, 9]). However, insurers' efficiency analyses focusing on developing insurance markets are rather scarce with [10] focusing on Croatian insurance market, [11] encompassing Macedonian insurance market, and [12] dealing with Czech and Polish insurance markets. Although the paper by [13] deals with efficiency of Bosnian insurers, our paper extends it in a several ways, as described in the segment Contribution.

1.2. Our Contribution

This paper contributes to the existing literature in several ways. First, by conducting the analysis in Federation of Bosnia and Hercegovina, we add to the literature in less developed countries. Second, unlike previous paper that conjointly explored (non)life insurance industry in Bosnia and Hercegovina, we separately analyse life and non-life segment. Precisely, due to the specific nature and characteristics inherent to the (non)life insurance segment and having in mind that the services which life and non-life insurers provide cannot be mutually substituted, it would not be proper to analyse all of them together, therefore we investigate them separately and conduct two distinct analyses, enabling in this way insurers belonging to a particular segment to form a more homogenous group. Furthermore, our paper does not encompass reinsurance companies due to the differences between insurance and reinsurance business, primarily in terms of how these are being used and who uses them. Fourth, besides employing

overall technical efficiency (OTE) and pure technical efficiency (PE), this paper also deals with returns to scale (RTS). Finally, by identifying peers companies, each inefficient insurer has opportunity to observe its benchmark company which can serve as an example of good operating practices that inefficient insurers need to catch up to.

1.3. Paper Structure

The rest of the paper is structured as follows. After the introduction part, giving the grounds for analysing efficiency and literature review, next section briefly describes used methodology as well as inputs and output applied in the research. The findings and discussion of results are reported in section three, while the last section concludes.

2. METHODOLOGY AND VARIABLES

2.1. Methodology

DEA is a nonparametric efficiency measurement method capable of dealing with multiple inputs and outputs while evaluating efficiency of a Decision Making Unit (DMU – an insurance company) and presenting its efficiency in a form of a single index. According to the scale, two types of DEA models can be identified: (1) *CCR model* developed by [14] and based on the constant returns to scale (CRS); and (2) *BCC model* created by [15] and founded on the variable returns to scale (VRS). While the first model evaluates an overall technical efficiency (OTE), a second model provides pure technical efficiency (PE). Due to its more generalised assumption, BCC model is more flexible in approximating the real-world situations and therefore this model serves as a main model in the present research. However, in order to see the efficiency obtained under the assumption of constant scale, a CCR model is also applied.

Depending on the model orientation, an *input oriented* model (in which firm's focus is placed on the input minimization while keeping the output constant) and *output oriented* model (which emphasizes the output maximization while keeping inputs unchanged) can be distinguished. Since insurers have more control over the inputs than outputs, an input model is applied, which is in line with similar research in this field (e.g. [3]).

2.2. Variables and Data Collection

Due to the specific features of insurers it is essential to define services conducted by insurance companies prior to selecting inputs and outputs for estimating their efficiency levels. In this paper, we follow widely used value-added approach that classifies three major insurance services including risk-pooling/bearing services, intermediation and financial services as suggested by [16] and [17].

Despite the ongoing debate among scholars whether the premiums or claims are better proxy for risk pooling/bearing, we have opted for use of premium income since it reflects the ability of an insurer to market products, choose the insured and to underwrite the risks [6]. Besides [6], this is also an approach applied by e.g. [18]. Another reason lies in the fact, as pointed out by [19], that it might be challenging to accept why anyone would try to maximise the value of claims.

Furthermore, two input variables are employed in the analysis comprising of capital and technical provisions representing equity capital and debt capital. Equity is included in the research since capital, as stated by [20], is a significant input for insurers as they are obliged to pay claims even in circumstances when losses exceed expectations. Furthermore, an adequate level of capital is needed to comply with regulatory requirements. Equity capital is employed in several studies including [21] and [22].

Technical provisions are formed in order to meet liabilities arising from insurance contracts. Since they are made of funds borrowed from policyholders they are often referred to as debt capital. Technical provisions are used as an input in papers by e.g. [23] and [24].

All the data necessary for analysis was obtained from the insurance supervisory body of Federation of Bosnia and Herzegovina. The analysis is performed with the application of Performance Improvement Management Software (PIM-DEA).

3. RESULTS AND DISCUSSION

Descriptive statistics for selected inputs and output is presented in Table 1, from which it is clear that insurers are of different size. According to the value of technical provisions, this difference ranges from €6.2 million to €76.8 million within life segment and from €0.4 million to €32.3 million within non-life segment. Differences are also noticeable in equity as well as in gross written premiums, for both life and non-life segments. For example, average value of equity and gross written premiums for non-life insurers is almost double than for those of life insurers. At the same time, technical provisions of non-life insurers are half of those recorded in life segment. Regardless of these differences, each segment of insurance industry (when considered separately life and non-life) encompasses DMUs that are homogenous in their nature since they provide similar insurance services and operate in the same environment.

Table 2 brings correlation analysis between investigated variables. All correlation coefficients have high values, indicating strong relationship between inputs and output. The strongest relationship is recorded among gross written premium and technical provisions (0.973 and 0.875 for life and non-life segment, respectively). All coefficients are

positive, indicating that it is possible to proceed with DEA analysis.

Some authors, e.g. [11], recognize that, as a rule of thumb, the number of analysed DMUs should be at least twice as large as the total number of inputs and outputs used in the analysis. This condition is also fulfilled for our research as the number of insurers (seven and eleven, for the life and non-life segment, respectively), more than twice exceeds the number of analysed inputs and output (three).

In Table 3, efficiency scores (OTE and PE) of life and non-life insurers together with reference sets (Ref. set), peer count and returns to scale (RTS) are presented. According to the OTE, out of seven life insurers only two of them are efficient as their score is equal to 100%. These insurers form benchmarks or reference sets for those inefficient. Average value of overall technical efficiency in life segment is 86.26% meaning that on average an insurer can reduce its resources or augment its outputs by 13.74% in order to become efficient. Due to space savings, in column Ref.set only a number (without DMU notation) of efficient insurer(s) is stated. For example, benchmarks for DMU5 are DMU7 and DMU9 (noted as 7, 9). This means that in order to improve its performance and to become efficient, a DMU5, as the most inefficient insurer, must use a combination of DMU7 and DMU9 (a virtual insurer). With this information managers can gather valuable cognition regarding sources and amounts of their inefficiency and propose improvements that will lead them to achieve a higher efficiency level. Peer count can be used to discriminate among efficient insurers. Higher peer count suggests that particular insurer performs better than other efficient insurer(s) and hence it can be seen as a leader. In this research, DMU9 can be identified as the best performing insurer. Dominance of insurer DMU9 is additionally confirmed with an analysis of superefficiency (not presented here).

When considering pure efficiency, three out of seven insurers seems to be efficient (DMU7, DMU9 and DMU10). It can be observed that DMU10 is CCR technically inefficient while pure technically efficient, meaning that inefficiency of this insurer is due to the scale size. A brief look at the returns to scale of insurer DMU10 shows that it operates under the decreasing returns to scale.

As regards average value of overall technical efficiency obtained for non-life segment, it amounted 66.13% indicating significant potential for further improvement, by 33.87%. According to the CCR model, it seems that only one insurer is efficient. This number increases to four when BCC model is applied. It is interesting to note that most of the insurers, both in life and non-life segment, operate under increasing returns to scale (IRS), suggesting that their inefficiency lies in their small size. Still, there are also those insurers (but they are in minority) that exhibit decreasing returns to scale (DRS). These insurers need to downsize in order to become efficient. On the other hand, efficient insurers demonstrate high input productivity and prosperous managerial performance in assembling of inputs in the production process. The size of these insurers is optimal as they operate at constant returns to scale (CRS). Finally, a higher level of achieved efficiency (both OTE and PE) is recorded in life then in non-life segment.

Table 1 Descriptive statistics

	Life insurers				**Non-life insurers**			
	Minimum	Maximum	Mean	Std. Dev.	Minimum	Maximum	Mean	Std. Dev.
Equity	2,760,782	9,080,223	4,992,103	2,377,162	2,174,861	14,871,718	8,112,477	4,536,628
Tech. provisions	6,154,484	76,790,544	37,587,344	33,855,126	431,739	32,288,342	17,910,777	10,660,936
GWP	1,904,938	14,169,153	7,555,928	5,284,688	185,997	27,838,329	15,847,996	9,104,438

Source: Authors' calculation Note: All values are presented in euros

Table 2 Correlation analysis

	Life insurers				**Non-life insurers**		
	Equity	Tech. prov.	GWP		Equity	Tech. prov.	GWP
Equity	1			Equity	1		
Tech. prov.	0.894**	1		Tech, prov.	0.785**	1	
GWP	0.897**	0.973**	1	GWP	0.837**	0.875**	1

Source: Authors' calculation **. Correlation is significant at the 0.01 level (2-tailed).

Table 3 Efficiency scores, reference set, peer count and returns to scale

	Life insurers						Non-life insurers				
	OTE	Ref. set	Peer count	RTS	PE		OTE	Ref. set	Peer count	RTS	PE
DMU1	96.9	9	0	IRS	96.9	DMU1	82.65	11	0	DRS	100
DMU5	70.16	7. 9	0	IRS	70.16	DMU2	74.84	11	0	IRS	87.01
DMU7	100	7	4	CRS	100	DMU3	58.82	11	0	IRS	100
DMU8	80.32	9	0	IRS	80.32	DMU4	100	11	11	CRS	100
DMU9	100	9	6	CRS	100	DMU5	64.61	11	0	DRS	68.02
DMU10	76.93	7.9	0	DRS	100	DMU6	60.61	11	0	DRS	84.24
DMU12	79.53	7.9	0	IRS	79.53	DMU7	61.09	11	0	IRS	67.13
Average	**86.26**	-	-	-	**89.56**	DMU8	68.25	11	0	DRS	81.45
-	-	-	-	-	-	DMU9	64.16	11	0	IRS	64.39
-	-	-	-	-	-	DMU10	64.93	11	0	IRS	76.56
-	-	-	-	-	-	DMU12	27.5	11	0	IRS	100
-	-	-	-	-	-	**Average**	**66.13**	-	-	-	**84.44**

Source: Authors' calculation

4. CONCLUSION

In this research the relative efficiency of insurance companies operating in life and non-life segment in Federation of Bosnia and Herzegovina is analysed. The study finds that, depending on whether the CCR or BCC model is applied, two (three) insurers are efficient in life and only one (four) insurers in non-life segment. Obtained average results of overall technical efficiency and pure technical efficiency suggest significant potential for further improvement of insurers' efficiency by 13.74% and 10.44% for life segment as well as by 33.87% and 15.56% for non-life segment, with respect to the CCR or BCC model application. Results also revealed that most of the life and non-life insurers operate at increasing returns to scale, suggesting that their inefficiency is closely related to their small size.

In future research, a cross-county efficiency analysis of developing insurance markets that share similar level of political/historical background and similar values of their main insurance market development indicators, can be conducted. Also, a single analysis (e.g. for Federation of Bosnia and Herzegovina) or cross-county analysis of insurers' productivity with the application of Malmquist index can be performed.

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