

TECHNICAL EFFICIENCY AND SUPER-EFFICIENCY OF THE INSURANCE SECTOR IN SLOVAKIA

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Abstract

ZIMKOVÁ EMÍLIA. 2015. Technical Efficiency and Super-efficiency of the Insurance Sector in Slovakia. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 63(6): 2205–2211.

In this paper, the technical efficiency and the super-efficiency of a representative sample of insurance institutions in Slovakia is analyzed with the aid of data envelopment analysis (DEA). This paper differs from the so far published literature, as it extends the application of radial DEA models (the CCR model of Charnes, Cooper and Rodes; the BCC model of Banker, Charnes and Cooper) by a non-radial model (the SBM model of Tone) and a super-efficiency model. The super-efficiency can be used either to rank efficient units or to indicate outliers in the analyzed group of decision making units. Achieved results also reveal that in the year 2013, among 13 Slovak insurance companies under evaluation, the AXA poisťovňa, a. s. was the super-efficient insurance company. The implications of gained results are then drawn for managerial and regulatory purposes. Firstly, it is shown how the management of the insurance institutions with the poorest performances should change their managerial procedures and adopt enhanced-incentive policy. Secondly, the regulatory body of the insurance institutions should utilize the gained technical efficiency of the analyzed institutions for the prediction of their competitiveness in the long run.

Keywords: insurance, DEA, SBM model, super-efficiency model

INTRODUCTION

The productivity and efficiency of the Slovak insurance industry in 2013 was influenced by the global external macroeconomic environment. Global economic growth edged down to 3.0% in 2013 from 3.1% in the previous year with deceleration observed in both advanced and emerging economies. The contraction of the euro area economy moderated to -0.5% in 2013, from -0.7% in 2012. As far as Slovakia's economic performance, according to the Statistical Office of the Slovak Republic (SO SR), the annual growth rate of the gross domestic product at constant prices was 0.9%, down from 1.8% in 2012. Despite of its deceleration, the Slovak economy was among the fastest growing economies in the euro area. External demand was the main driver of its growth, while domestic demand made a negative contribution owing largely to lower investments. In the environment of a sluggish economic growth,

the Slovak insurance sector in 2013 gained profit amounted to €158 million (National bank of Slovakia, 2014, pp. 9–11).

The insurance industry is primarily focused on three business lines:

- 1) protection which consists of property and liability insurance,
- 2) financial security which encompasses life and health insurance and
- 3) investment which is composed of asset management.

In this paper, the technical efficiency and super-efficiency of a representative sample of the insurance institutions entities (also called Decision Making Units, DMUs) in Slovakia is analyzed with the aid of non-radial DEA models of Tone. Two implications of gained results for managerial and regulatory purposes are then drawn. First, the management of the insurance institutions with the poorest performances should change

their managerial procedures and adopt enhanced-incentive policy. Second, the regulatory body should focus its control upon the technically un-efficient insurance institutions.

The paper is organized in four sections, the first of which is introductory and the last is concluding. The second section explains the intermediation approach for measuring efficiency of insurances and provides an overview of some relevant studies on the topic. The third methodological section is accompanied by the fourth section which presents the results and includes their interpretation.

Conceptual Views and an Overview of the Literature

Conceptual views of efficiency of insurance industry differ. Individual theoretical concepts concur that commercial insurances are agents of a transformation process and that during this process they transmute a set of inputs into a set of outputs. These inputs and outputs are linked in operations of insurances through a production function, which specifies the maximum attainable outputs at the given level of inputs.

Traditional literature on efficiency of insurance firms is addressing production approach and intermediation approach (Berger and Humphrey, 1997). The production approach is seeing the insurance firm as manufacturing company. However, especially the use of “claims paid” or “losses incurred” as an output of the production approach has attracted criticism because an unexpected upward change in losses (due to an environmental catastrophe or a terrorist attack) would result in efficiency enhancement of the respective company. Therefore the intermediation approach which treats an insurance company as a financial intermediary and selects inputs and output variables accordingly tries to overcome the shortfalls of the production approach. Diboky and Ubl (2007, pp. 15–17) classified services provided by insurers into risk bearing (assuming risk to decrease potential personal losses), risk pooling (collecting funds from policyholders and redistributing money to those policyholders who incurred losses) and financial intermediation (borrowing funds from policyholder and investing them to financial assets until they

are paid back at policy expiration date). They assume the amount of gross premium provided by a company to be a good proxy for these services, since all of them are related to this key figure. As shown below, the framework of Diboky and Ubl (2007, p. 16) is adopted in this contribution for selecting a combination of output variables. From the shareholder’s point of view, the main objective of an insurer is to achieve a certain profit goal, e.g. a required rate of return. Therefore, the after tax return is selected as output variable as well.

Consistent with traditional efficiency literature, most decisive inputs are specified: labor, business services and capital. The quantity of labor and business services is defined as total operating costs. They consist of both the costs associated with selling and issuing new policies (acquisition costs) and the costs of maintaining existing policies (maintenance costs). The operating costs of life insurance can be classified broadly into labor-related expenses, capital expenses, and materials consisting of all other expenses (Segal, 2000, p. 4). Labor is defined as the total number of employees and agents employed by the company. The total cost of employees is the sum of salaries, contributions for benefit plans, payments under non-funded benefit plans and other employee welfare. Capital is defined as the sum of capital expenses: rent, equipment rental, and depreciation. The third input, materials, consists of all other expenses. Most of the expense items are directly related to selling new policies and servicing existing policies. The total operating expense in our contribution covers labor-related expenses and other expenses (especially asset and liability management expenses), therefore the capital is included as additional input variable.

There has been considerable research on measuring efficiency of commercial insurances and their benchmarking. It is probably not possible to give an exhaustive overview of the relevant literature on this topic. In consequence of this, the scope of the presentation here is limited only to the research that focused on the non-parametric approach of the data envelopment analysis (DEA). Tab. I summarizes empirical studies that are devoted to this topic and lists especially those studies that

I: Empirical studies which applied DEA methodology (in the alphabetical order)

Authors	Countries covered	DEA methodology
Barros <i>et al.</i> (2010)	Greece	Bootstrapped DEA
Barros <i>et al.</i> (2005)	Portugal	Malmquist index
Cummins <i>et al.</i> (1996)	Italy	DEA input distance function, Malmquist index
Cummins <i>et al.</i> (1998)	USA	DEA deterministic cost function, Malmquist index
Cummins <i>et al.</i> (1999)	USA	DEA input distance function, Malmquist index
Diboky, Ubl (2007)	Germany	X-Efficiency
Grmanová, Jablonský (2009)	Czech Republic, Slovakia	CCR, BCC, Super-efficiency
Fukuyama (1997)	Japan	Malmuist index
Mahlberg, Url (2003)	Austria	Malmquist index

have applied the non-parametric approach based on a DEA model.

As it is clear from the above table, studies cover several international insurance markets. However, the Slovak insurance market is researched only by the study of Grmanová and Jablonský (2009). They utilized basic DEA models, the model by Charnes, Cooper and Rhodes addressed conventionally as the CCR model and the model by Banker, Charnes and Cooper addressed conventionally as the BCC model. In this paper, the model by Tone, a more advanced DEA model, is utilized and this model is usually called the SBM (slack-based measure) model. This study also deepens research conducted by the author in collaboration (Boďa and Zimková, 2014; Izáková and Přečková, 2012) or by Boďa (2014). The previous research centered on selected aspects of technical efficiency of the Slovak banking sector and its operating conditions. In their research they applied three main approaches to estimation of efficiency frontier in banking, so called the service-oriented, the intermediation oriented and the profit oriented approach. Moreover, they published research based on the Malmquist index application on the productivity change in the banking industry, which reflects technological changes and technical efficiency changes in the Slovak banking sector. To the best knowledge of the author this is the first study which apply the SBM model and super-efficiency on the Slovak insurance industry, which allows to gain not radial results essential for the efficiency improvement of the technical efficiency of the Slovak insurance sector.

METHODOLOGY AND DATA

DEA is designed for evaluating DMUs that perform similar tasks and for which measurement

of inputs and outputs are available (Thanassoulis, 2005). In order to determine the technical efficiency of organizational units of the Slovak insurance sector under the intermediation approach, the DEA SBM analysis was applied on the data of fifteen organizational units of the Slovak insurance sector characterizing their performance in 2013. The methodological procedure stands on several characteristic points or assumptions that shape the line of research and they are summarized in brief in the following text.

The dataset comprises the data on 13 organizational units (insurances) operating in the Slovak Republic and it covers the great majority of Slovak insurance industry (as the total of included insurances exceeds 80 percent of the Slovak insurance assets). The organizational units considered in the paper are listed in Tab. II. Firms not included into our panel typically represent small insurers. In order to assure consistency of the analysis, insurance institutions which concentrate on life insurance only and decision making units with negative input or output data are subject to exclusion. The source of the data is TREND Holding, s. r. o., Bratislava.

The data used in the empirical analysis are the yearly data of balance-sheet items disclosed by the 13 organizational units of the Slovak insurance sector during 2013.

As explained in the second section, two inputs and two outputs are recognized in the study. The input selected under the intermediation approach is total operating expenses and the capital, while output to be maximized is represented by written premium and after tax result.

Thus the inputs in the contribution reflect the amount of labor, capital, and intermediate inputs used by individual companies. Variables

II: Organizational units of the Slovak insurance sector subjected to the analysis

Organizational unit	
Allianz – Slovenská Poistovňa	Wustenrot Poistovňa
Kooperativa, Vienna IG	Poistovňa Slovenskej sporitelne, Vienna IG
Generali Slovensko Poistovňa	Union Poistovňa
Komunálna poisťovňa, Vienna IG	Poistovňa Cardif Slovakia
MetLife Amslico Poistovňa	AXA Poistovňa
Uniq Poistovňa	Poistovňa Poštovej banky
CSOB Poistovňa	

III: Variables used in the technical efficiency analysis (EUR '000)

Variable	Definition	Abbreviation
Inputs		
Total operating costs	Labour-related expenses and materials consisting of all other expenses	OC
Equity	Equity	E
Outputs		
Premium written	Premium written	PW
After-tax result	After-tax result	ATR

total operating costs include not only labor-related expenses but also other expenses as administration and distribution costs. Therefore together with equity they cover input part of the production process in the insurance industry.

As to outputs, we assume the amount of premium written provided by a company to be a good proxy for insurance services. From the insurance shareholders point of view, the main objective of a running of business is the profit maximization in the long run. Therefore the after tax result is selected as output.

The Employment of the SBM Model

In this paper, the assumption of variable returns to scale is formed (which, of course includes a specific case of constant returns to scale) and combined with a non-oriented SBM model in evaluating the organizational units of the Slovak insurance sector on a comparative basis.

In the exact formulation of the SBM model, it is assumed that the data on n production units are available, where any production unit o , $o \in \{1, \dots, n\}$, produces s desirable outputs out of m inputs. The values of inputs of production unit o are represented by vector $\mathbf{x}_o = (x_{o1}, \dots, x_{om})'$ and the values of outputs by vector $\mathbf{y}_o = (y_{o1}, \dots, y_{os})'$. The elements of both vectors are positive. Individual inputs and outputs have corresponding vectors of potential slacks $\mathbf{s}_o^x = (s_{o1}^x, \dots, s_{om}^x)'$ and $\mathbf{s}_o^y = (s_{o1}^y, \dots, s_{os}^y)'$, which states how individual inputs and outputs must be improved in order that production unit o become efficient (whereas vector of inputs \mathbf{x}_o need be reduced by \mathbf{s}_o^x and vector of outputs \mathbf{y}_o need be increased by \mathbf{s}_o^y). These slacks are to be identified by the DEA and serve as an exclusive basis of efficiency calculation for respective production unit o .

For each production unit o , $o \in \{1, \dots, n\}$, it is necessary to solve the following task of linear programming of the non-oriented SBM model under the assumption of variable returns to scale

$$\min_{\lambda, \bar{s}^x, \bar{s}^y} \rho_o = \frac{1 - \frac{1}{m} \sum_{i=1}^m \frac{s_i^x}{x_{io}}}{1 + \frac{1}{s} \sum_{k=1}^s \frac{s_k^y}{y_{ko}}}$$

with respect to

$$\begin{aligned} \bar{s}^x &= \bar{x}_o - \sum_{i=1}^n \lambda_i \bar{x}_i \geq \bar{0}_{mx1}, \\ \bar{s}^y &= \sum_{i=1}^n \lambda_i \bar{y}_i - \bar{y}_o \geq \bar{0}_{sx1}, \\ \bar{e} \bar{\lambda} &= 1, \bar{\lambda} \geq \bar{0}_{nx1}. \end{aligned} \quad (1)$$

The symbol „ \geq “ denotes at a vector that respective elements of this vector are non-negative and at least one element is non-zero. The restrictions of the optimization task constructs the production

possibility set with respect to n production units and their observed inputs x_1, \dots, x_n and outputs y_1, \dots, y_n as well as their convex linear combinations in \mathfrak{R}_m and \mathfrak{R}_s respectively. The coefficient ρ takes values at interval $[0, 1]$ and it is the SBM score of technical efficiency (in this case of production unit o whose task (1) is subject to optimization). If for some production unit $\rho = 1$ happens to be the case, this production unit is called SBM-efficient, which means that it is technically efficient in the sample of n production units under evaluation.

The optimization task of the super-efficiency SBM model is similar to (1) but there is a slight difference in the constraints. Now the decision-making unit o to be evaluated no longer spans the production possibility set, and therefore

$$\min_{\lambda, \bar{s}^x, \bar{s}^y} \rho_o = \frac{1 - \frac{1}{m} \sum_{i=1}^m \frac{s_i^x}{x_{io}}}{1 + \frac{1}{s} \sum_{k=1}^s \frac{s_k^y}{y_{ko}}}$$

with respect to

$$\begin{aligned} \bar{s}^x &= \bar{x}_o - \sum_{i=1, i \neq o}^n \lambda_i \bar{x}_i \geq \bar{0}_{mx1}, \\ \bar{s}^y &= \sum_{i=1, i \neq o}^n \lambda_i \bar{y}_i - \bar{y}_o \geq \bar{0}_{sx1}, \\ \bar{e} \bar{\lambda} &= 1, \bar{\lambda} \geq \bar{0}_{nx1}. \end{aligned} \quad (2)$$

Now ρ represents the super-efficiency SBM score and is not restricted to interval $[0, 1]$ anymore. Its value is always non-negative and for SBM technically efficient decision-making units it is not smaller than 1. There are two interpretations of this score. The higher its value, the higher is technical efficiency of the respective decision-making unit. It can alternatively be used for finding outliers in the data set under analysis. Large values of super-efficiency (such as 4 or higher) indicate that the respective decision-making unit is of impact on the production possibility set and should be treated without a doubt as an outlier.

RESULTS

The data used in the empirical analysis are the 2013 yearly data of balance-sheet items disclosed by the TREND Holding, s. r. o., Bratislava.

All DEA computation were done by DEA-Solver learning version 3.0 (Cooper *et al.*, 2006) and the results are listed in Tab. IV, which presents information about the non-oriented technical efficiency score, ranking each individual insurance institution under the research.

From the gained results it comes out that transformation of total operating costs and equity into premium written and after-tax result was successfully achieved by nine out of thirteen insurance institution under the research: Allianz –

IV: *Technical efficiency scores and slacks (slacks in EUR'000)*

No	DMU	Score	Excess OC S-(1)	Excess E S-(2)	Shortage PW S+(1)	Shortage ATR S+(2)
1	Allianz – Slovenská poisťovňa	1	0	0	0	0
2	Kooperativa, Vienna IG	1	0	0	0	0
3	Generali Slovensko poisťovňa	0.42	34171	62591	624	0
4	Komunálna poisťovňa, Vienna IG	1	0	0	0	0
5	MetLife Amslico poisťovňa	1	0	0	0	0
6	Uniqa poisťovňa	0.59	15859	0	35197	1654
7	ČSOB poisťovňa	1	0	0	0	0
8	Wustenrot poisťovňa	0.58	2928	0	26665	2501
9	Poisťovňa Slovenskej sporiteľne, Vienna IG	1	0	0	1	0
10	Union poisťovňa	0.47	2988	0	34950	1900
11	Poisťovňa Cardif Slovakia	1	0	0	4	0
12	AXA poisťovňa	1	0	0	0	0
13	Poisťovňa Poštovej banky	1	0	0	3	0

Slovenská poisťovňa, a.s., Kooperativa, Vienna IG, a.s., Komunálna poisťovňa, Vienna IG, a.s., MetLife Amslico poisťovňa, a.s., ČSOB poisťovňa, a.s., Poisťovňa Slovenskej sporiteľne, Vienna IG, a.s., Poisťovňa Cardif Slovakia, a.s., AXA Poisťovňa, a.s., and Poisťovňa Poštovej banky, a.s. The worst results have got Generali Slovensko poisťovňa, a.s., Union poisťovňa, a.s., followed by Wustenrot poisťovňa, a.s., and Uniqa poisťovňa, a.s. In those cases managers should change their procedures and adopt enhanced-incentive policy. The excess slacks of input variables point how much a technically un-efficient insurance company has to decrease its inputs to become technically efficient. On the contrary the shortage slacks of output variables bring out how much a technically un-efficient insurance company has to increase its outputs to become technically efficient.

The super-efficient insurance company in the Slovakia in 2013 was AXA poisťovňa, a.s. Its efficiency score suggest, that the AXA poisťovňa, a.s. should not be treated as an statistical outlier. The French group AXA is a worldwide leader in the financial securities industry. The AXA poisťovňa, a.s. offers life insurance, property and casualty insurance, retirement savings, asset management, counselling, legal protection and others. AXA's mission is to help its clients and their relatives in the long term. Especially to help them live their lives more fully and joyfully and, at the same time, protect their savings and property. In 2013, AXA poisťovňa, a.s. achieved a financial result (profit) of EUR 912,309 which represents a growth of 32.4 percent as compared to the year 2012. The positive financial result was achieved primarily thanks to measures taken with the aim to save costs and the proceeds from the fees collected for the management of pension funds and their appreciation. Based on a decision made by the General Meeting, the profit was paid (after

creating a mandatory reserve fund) to the sole shareholder as a dividend.

The second super-effective insurance, Kooperativa, Vienna IG, a.s. follows a clear strategy of long-term growth on a solid, sustainable foundation, with top-quality products and services, and a conservative investment policy.

Generali Slovensko poisťovňa, a.s. retained its position as the third strongest universal insurance company in Slovakia in 2013, but it appeared to be hugely in-efficient. Comparing to its peers it has to decrease operating costs by more than 34 million EUR. Over the analyzed year the complex rebranding took place. To increase productivity and technical efficiency, the development of more efficient business lines have to be introduced and development of cooperation with VÚB, a.s. the second largest bank in Slovakia, as strategic partner have to be intensively supported. Moreover,

V: *Super-efficiency and rank*

No	DMU	Score	Rank
1	Allianz – Slovenská poisťovňa, a.s.	1.29	5
2	Kooperativa, a.s. Vienna IG	1.43	2
3	Generali Slovensko poisťovňa, a.s.	0.42	13
4	Komunálna poisťovňa, a.s. Vienna IG	1.32	3
5	MetLife Amslico poisťovňa, a.s.	1.02	9
6	Uniqa poisťovňa, a.s.	0.59	10
7	ČSOB poisťovňa, a.s.	1.09	7
8	Wustenrot poisťovňa, a.s.	0.59	11
9	Poisťovňa Slovenskej sporiteľne, a.s. Vienna IG	1.04	8
10	Union poisťovňa, a.s.	0.48	12
11	Poisťovňa Cardif Slovakia, a.s.	1.12	6
12	AXA poisťovňa, a.s.	2.13	1
13	Poisťovňa Poštovej banky, a.s.	1.31	4

in field of internal communication, Generali Slovensko poisťovňa, a.s. introduced Generali Slovensko poisťovňa, a.s. to support their loyalty towards the brand and products as well as all-year

round project of various motivation activities in order to strengthen the relationship to the insurance company as the employer.

CONCLUSION

Overall we can state, that in 2013, a year in which the European sovereign debt crisis and the political efforts towards fighting the crisis were still the predominant issue, the insurance institutions in Slovakia showed satisfactory development. Empirical results of this paper regarding the technical efficiency of the insurance institutions in Slovakia in 2013 under transmission approach show that the technical efficiency differs from one unit to another. Majority of insurance institutions under research were found technically efficient by applying SBM under variable return to scale. The aim of technically efficient insurance institutions is an achievement of stable profitability, mainly through rigorous cost management, and maintenance of a desirable market share. Results also reveal that in year 2013, among 13 Slovak insurance companies under evaluation, the AXA poisťovňa, a.s. was super-efficient insurance company. Its efficiency score suggest, that the AXA poisťovňa, a.s. should not be treated as an statistical outlier. The French group AXA is a worldwide leader in the financial securities industry. The AXA poisťovňa, a.s. offers life insurance, property and casualty insurance, retirement savings, asset management, counselling, legal protection and others.

Main principles for achieving goals in the insurance business should be broadly clustered into best practices policy, conservative investment policy, multi-brand, and multi-channel policy. The best practice policy reflects the transfer of know-how within the international group. At the same time the international companies are employing the local managers to highlight the heading: think globally – act locally. The conservative investment policy is based on emphasis of quality and sustainability of the insurance activities which go along with broad risk diversification. The multi-brand policy in insurance emphasises the retention of established local branches which is a tool to maintain customer and employee loyalty. The multi-channel policy supports strongly customer oriented distribution.

Changes in the external environment would create growth opportunities for insurance companies in Slovakia in order to deliver the shareholders' expectations. The companies will have to balance between growth, profitability and risk as they go forward. This would entail marked changes in the business strategy and the same would be cascaded to operational decisions related to product design, pricing, channel monitoring, and operational effectiveness. Companies with a one-dimensional focus on growth or on profitability would lose competitive power either due to strain on capital or due to insignificance of the scale. This would support the trend of overall profitable growth for the industry. Insurances have to develop complex and sustainable business models. The technical efficiency studied in this contribution in an inevitable part of it.

Acknowledgement

The author wishes to acknowledge financial support of the grant scheme VEGA [1/0757/15 Augmentation of the theoretical construct of the SCP paradigm and of the efficient structure hypothesis in banking and insurance by the aspect of risk and their empirical validation in the conditions of the Slovak Republic] and as a partial fulfilment of the Operational Program Education project [ITMS 26110230082 Mobility – Support of Science, Research and Education at Matej Bel University in Banská Bystrica (Mobility – podpora vedy, výskumu a vzdelávania na UMB) co-financed by the European Social Fund within the bounds of financial subsidy contract No. 018/2012/1.2/OPV].

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