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INSURANCE COMPANIES' EFFICIENCY: DEA AND MULTIVARIATE ANALYSIS

This article aims to analyse the efficiency of commercial insurance companies at the common Slovak and Czech insurance market in 2013 by using an econometric approach. The goal is to specify the regional differences of efficient insurance companies. To specify differences between efficient insurance companies DEA models and multivariate exploratory techniques were applied.
Keywords: *insurance company; efficiency; data envelopment analysis; multivariate exploratory techniques.*

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ЕФЕКТИВНІСТЬ СТРАХОВИХ КОМПАНІЙ: АНАЛІЗ СЕРЕДОВИЩА ФУНКЦІОНУВАННЯ ТА БАГАТОФАКТОРНИЙ АНАЛІЗ

У статті проаналізовано ефективність роботи комерційних страхових компаній на загальному ринку Чехії та Словаччини на прикладі 2013 року. Економетричні засоби застосовано з метою виявлення регіональної специфіки в ефективності страхових компаній. Аналіз середовища функціонування, а також застосовано багатофакторний аналіз використано для відстеження різниці в методах досягнення ефективності.
Ключові слова: *страхова компанія; ефективність; аналіз середовища функціонування; технології багатоваріантного аналізу.*
Табл. 5. Літ. 32.

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ЭФФЕКТИВНОСТЬ СТРАХОВЫХ КОМПАНИЙ: АНАЛИЗ СРЕДЫ ФУНКЦИОНИРОВАНИЯ И МНОГОФАКТОРНЫЙ АНАЛИЗ

В статье проанализированы эффективность работы коммерческих страховых компаний на общем рынке Чехии и Словакии на примере 2013 года. Эконометрические приёмы применены с целью выявления региональной специфики в эффективности страховых компаний. Анализ среды функционирования, а также многофакторный анализ применены для отслеживания разницы в методах достижения эффективности.
Ключевые слова: *страховая компания; эффективность; анализ среды функционирования; технологии многовариантного анализа.*

Introduction. Global financial crisis, recession and following stagnation of economic production and current problems with public finances inevitably change business enviroment (Vojtovic et al., 2014). Economic globalization has eliminated trade barriers, bringing about global cooperation and competition (Ivanova, 2014). The analysis of economic benefits are a relevant object for research and also a subject for many discussions (Balciunas et al. 2014). These current trends have resulted in a less stable business environment and increasing competition, which make insurance companies make greater efforts to maintain their market positions. They are also threatened by different risks. These risks can affect the growth of costs for claims incurred but can also threaten their payments, such as payments of foreign debts. According to E. Vavrova (2014), there are different types of risks that may endanger

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the payment of debts, namely business risks and territorial/political risks. Insurance companies react differently to unfavourable conditions and some of them address these conditions in non-traditional ways.

The main objective of insurance companies is making profit. It is also important for them to perform their business efficiently on a long-term basis. This can be achieved by an appropriate combination of inputs and outputs. Insurance companies strive to minimize their inputs and maximize their outputs. Insurance companies with the best combination of inputs and outputs are considered efficient. Efficiency can be achieved on the basis of different combinations of inputs and outputs and therefore there may be differences or similarities among them. By using a procedure that enables the assessment of similarities and differences among efficient insurance companies it is possible to detect some extreme cases when an insurance company achieved efficiency by an unusual combination of inputs and outputs. Some authors (Cinca et al., 2011) call them "individualists".

Literature review. The first DEA model was developed by A. Charnes et al. (1978). Several authors have dealt with the theory and use of DEA models since the publication of this first work. In 1997 A.N. Berger and D.B. Humbhrey described the results of 130 studies from 21 countries all over the world, including those dealing with the efficiency of insurance companies. Most studies analyzing the efficiency of insurance companies were carried out by the authors from the USA. DEA models are used to measure the efficiency of insurance companies at national insurance markets as well as to evaluate the efficiency of insurance companies at common insurance markets. N.M. Saad et al. (2006) measured the efficiency of insurance companies in Malaysia. S. Diacon (2001) evaluated the efficiency of insurance companies from 6 European countries – France, Germany, Italy, the Netherlands, Switzerland and the United Kingdom.

These studies focused on the efficiency of all insurance companies or they concentrate on specific groups of insurance companies, e.g. life insurance companies. D. Lasaite et al. (2004) evaluated the efficiency of insurance companies in Czech Republic and did not distinguish whether they are life insurance, non-life or combined insurance companies. J.D. Cummins et al. (1999) evaluated the efficiency of life insurance companies in the US. The efficiency score in DEA models depends on the number and choice of indicators both on the input and output sides. One approach focusing on the issue of choosing inputs and outputs is combining DEA models with multidimensional exploration techniques, mainly with factor analysis, principal component analysis and cluster analysis. J. Zhu (1998) used a combination of DEA models and PCA to evaluate the efficiency of 18 Chinese cities. He compared the results for 3 sets. The first set was based on two inputs: investment in fixed assets by state owned enterprises; foreign funds actually used and 3 outputs: total industrial output value; total value of retail sales; handling capacity of coastal ports. He applied DEA models and 6 output/input ratios to use PCA. In the second and third set he used 3 inputs: labor; working fund; investment; and 3 outputs: gross industrial output value; profit and taxis and retail sales. He created output/input ratios and used PCA. In each of the sets he compared the resulting DEA scores and PCA scores.

Similarly, C.S. Cinca et al. (2004) applied DEA and PCA to evaluate the efficiency of Chinese cities. They created 21 different combinations of models, in each

model there was at least one input and one output, and they express the level of efficiency using DEA for each city in each model. They applied PCA and cluster analysis on the efficiency score of each city in each model. C.S. Cinca et al. (2011) analyzed the efficiency of the US banks. They used a combination of 3 inputs: number of employees, physical capital, deposits; and 3 outputs: interest and non-interest income, deposits and loans. They applied DEA and exploratory multivariate techniques and stated that the combination of DEA results and multivariate statistical context enables more than just an estimation of efficiency. One of the benefits is that it is possible to identify various paths to efficiency followed by different institutions.

The objective of the analysis. The subject of our analysis was commercial insurance companies in Slovakia and in Czech Republic. Slovakia and Czechia formed a common state and after they split, they followed their own direction of economic and social development (Ivanova et al., 2014). Long joint history of these countries is the prerequisite for the comparison of results in different areas of economic life after their separation, insurance being no exception. In this article we analyzed the efficiency of 15 insurance companies from Czech Republic and 14 insurance companies from Slovakia.

The efficiency score of commercial insurance companies was expressed from the inputs: 1) the cost of claims incurred; 2) operating costs; and from the outputs: a) premium; b) revenues from financial investments. The values of the indicators of insurance companies in Slovak Republic were gathered from the Annual Report of Allianz – Slovenska poist'ovna, a.s., Annual Report of CSOB Poist'ovna, a.s., Annual Report of Generali poist'ovna, a.s., Annual Report of ING Zivotna poist'ovna, a.s., Annual Report of KOMUNALNA poist'ovna, a.s., Annual Report of KOOPERATIVA poist'ovna, a.s., Annual Report of MetLife Amslico poist'ovna, a.s., Annual Report of Poist'ovna Cardif Slovakia, a.s., Annual Report of Poist'ovna Postovej banky, a.s., Annual Report of Poist'ovna Slovenskej sporitel'ne, a.s., Annual Report of Rapid life zivotna poist'ovna, a.s., Annual Report of Union poist'ovna, a.s., Annual Report of UNIQA poist'ovna, a.s., Annual Report of Wustenrot poist'ovna, a.s.

Values of the indicators of insurance companies in Czech Republic were from the database of Czech Insurance Association for 2013.

The objective of this paper was to analyse the efficiency of commercial insurance companies at the common Slovak and Czech insurance market in 2013 with the aim to specify differences between efficient insurance companies. We expressed efficiency scores for all the analyzed insurance companies using a model with all inputs and all outputs (basic model), as well as using the models with different combinations of inputs and outputs, each model having at least one input and at least one output.

Methodology. DEA models express the efficiency score of all the subjects analyzed. DEA models enable the differentiation between efficient and inefficient subjects. There are several types of DEA models. Basic DEA models include BCC models based on the assumption of variable returns to scale. DEA models use linear programming for the transformation of multiple inputs into multiple outputs. They construct a nonparametric data envelopment that is convex in BCC models. DMUs that are part of the data envelopment are efficient. DMUs that are not part of data envelopment are inefficient. The efficiency of inefficient DMUs is expressed by the efficiency score in relation to data envelopment (Cooper et al., 2006). Efficient subjects

have an efficiency score equal to 1. Inefficient DMUs have an efficiency score different from 1. BCC models can be oriented on inputs or outputs. In input-oriented BCC models, DMUs have an efficiency score less than or equal to 1. The efficiency score of an inefficient DMU in the input-oriented model reflects how much inputs must be reduced so that DMU becomes efficient. The lower the value of DMU is than 1, the more distant DMU is from data envelopment.

As mentioned above, the number of inputs and outputs and their selection is not clear. In our analysis we followed (Zhu, 1998; Cinca et al., 2004) and we created the models that was the result of the combination of all inputs and outputs, each model had one input and at least one output.

J. Zhu (1998) and C.S. Cinca et al. (2004) showed one possibility of using the expression of the efficiency score in all models. It is the possibility to compare whether an efficient insurance company is not efficient only because of an excellent result for one of the indicators. For example, if an insurance company has low value of the efficiency score only in models that do not include the first input, than it can be concluded that insurance company had a good performance with respect to the ratios that measure the input utilization by the first input (Cinca et al., 2004). The principal component analysis and factor analysis are used to determine extreme values, respectively similarities between efficiency scores. Efficiency scores in various models are considered to be variables and DMUs are considered to be cases.

Factor analysis reduces variables to common factors (latent variables), which are fewer in number. They are a linear combination of original variables. At the same time they are mutually uncorrelated. The first major common factor expresses the greatest amount of information of original variables. The second common factor expresses the greatest amount of information of original variables that were not expressed by the first factor etc. The factors are normalized, i.e. their arithmetic mean is 0 and their standard deviation is 1. Interpretation of common factors requires values and correlations marks between common factors and original variables, i.e. factor loadings. Based on the values of factor loadings, variables that correlate most closely with the factor are determined for each factor. Values acquired by the factors for individual objects are called factor scores. The factor score for each object is the combined score of each factor. Several techniques are used to determine the number of factors. In our analysis we will use the threshold value for our own numbers. We will choose only the factors with their own number greater than one. Factor extraction can be made using several methods. In our analysis we will use the method of principal components. This method considers common variance and looks for latent variables containing small specific variance and error variance (Meloun et al., 2012). Factor analysis will be carried out in "Statistica".

Key research findings. At the beginning of the analysis we expressed descriptive statistics of the indicators and descriptive statistics of the efficiency score in the basic model. Several comparisons result from the descriptive statistics of the analyzed parameters are shown in Table 1. Insurance premium had the highest value of the arithmetic mean; revenues from financial investments had the lowest value. Insurance premium had the greatest variability expressed by standard deviation. Revenues from financial investments had higher standard deviation than operating costs. The median of all the indicators was lower than the arithmetic mean.

Czech insurance company "Kooperativa pojist'ovna", a.s. had the highest value of the indicator insurance premium at the common Slovak and Czech insurance market. The second was "Ceska pojist'ovna", a.s. In Slovakia the highest value of the insurance premium had the insurance company "Allianz-Slovenska poist'ovna", a.s. It is ranked third at the common Slovak and Czech market. The minimum insurance premium had the life insurance company "Rapid life zivotna poist'ovna", a.s. The second was "Poist'ovna Postovej banky", a.s.

Table 1. **Descriptive statistics, 2013,** *authors' presentation using* "Statistica"

	Mean, ths EUR	Median, ths EUR	Min, ths EUR	Max, ths EUR	Standard deviation
Cost of claims incurred	135465.7	73187	2287.0	668899.0	174675.1
Operating costs	54807.3	27651.0	2147.0	231064.0	62288.6
Insurance premium	201089.5	119984.0	3852.0	991726.0	241977.6
Revenues from financial investments	45119.8	17225.0	349.0	322772.0	70912.7

The highest values of the indicator revenues from financial investments got "Ceska pojist'ovna", a.s. from Czech Republic. "Kooperativa pojist'ovna", a.s. was the second. In Slovak Republic "Allianz-Slovenska poist'ovna", a.s. reached the highest value. It was ranked third at the common Slovak and Czech insurance market. "Cardif Slovakia", a.s. had the lowest values of revenues from financial investments.

In the next step we expressed the estimated efficiency score of commercial insurance companies at the common market in 9 models using DEA. We used the EMS program. Model characteristics: The efficiency score was expressed in the input-oriented BCC model considering variable returns to scale. Models were designated according to the inputs and outputs used. For example, model designation 12a indicates that the input 1) cost of claims incurred 2) operating costs and the output a) insurance premium were used. The efficiency score expressed in EMS of all insurance companies was analyzed using 9 models, Table 3. 8 out of 29 companies were efficient in the basic model, which is 27.6%, out of which 6 insurance companies were from Czech Republic, which is 40% of the number of insurance companies in Czech Republic, and 2 insurance companies were from Slovakia, which is 14.3%. Descriptive statistics of the efficiency score in the model with all inputs and outputs is listed in Table 2.

Table 2. **Descriptive statistics of efficiency score,** *authors'*

	Mean	Median	Standard deviation
Slovak and Czech Republics	0.70717	0.73930	0.24751
Czech Republic	0.79001	0.82370	0.24577
Slovak Republic	0.61841	0.51665	0.22471

The arithmetic mean of the efficiency score in the basic model for Czechia was greater than the arithmetic mean of the efficiency score of insurance companies in Slovakia. Variability in the efficiency score of insurance companies expressed as a standard deviation was smaller in Slovak Republic. The share of efficient insurance companies in the basic model at Czech insurance market was higher than the share of efficient insurance companies at Slovak insurance market. In the next step, we

Table 3. **Efficiency scores,** *authors' presentation using* EMS

		12ab	1ab	2ab	12a	12b	1a	1b	2a	2b
1	Allianz pojist'ovna, a.s.	1.0000	1.0000	1.0000	0.7443	1.0000	0.7443	1.0000	0.4278	1.0000
2	AXA zivotni pojist'ovna, a.s.	0.7950	0.7950	0.2412	0.7950	0.2495	0.7950	0.2054	0.2412	0.1002
3	BNP Paribas Cardif Pojist'ovna, a.s.	1.0000	1.0000	0.1935	1.0000	1.0000	1.0000	1.0000	0.1851	0.1935
4	Ceska pojist'ovna, a.s.	0.8237	0.7754	0.8237	0.8237	0.3202	0.7754	0.2356	0.8237	0.3202
5	Ceska podnikatelska pojist'ovna, a.s.	0.9732	0.9570	0.6764	0.4848	0.9732	0.4848	0.9570	0.2123	0.6764
6	CSOB Pojist'ovna, a.s. clen holdingu CSOB	0.4220	0.3745	0.4220	0.4220	0.1418	0.3745	0.1264	0.4220	0.1305
7	ERGO pojist'ovna, a.s.	0.7273	0.5106	0.4563	0.6886	0.6966	0.3785	0.5106	0.4556	0.4563
8	Hasicska vzajemna pojist'ovna, a.s.	1.0000	0.7821	0.5889	0.8566	1.0000	0.4256	0.7821	0.5392	0.5889
9	ING Zivotni pojist'ovna N.V., pobocka pro Ceskou republiku	0.2914	0.2813	0.2549	0.2454	0.2914	0.2432	0.2672	0.2199	0.2549
10	Kooperativa pojist'ovna, a.s.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	Komercni pojist'ovna, a.s.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9209	1.0000	1.0000
12	MAXIMA pojist'ovna, a.s.	1.0000	0.8546	0.3835	1.0000	0.9375	0.8546	0.7233	0.3835	0.3257
13	MetLife pojist'ovna a.s.	0.4169	0.3763	0.2860	0.3931	0.4169	0.3763	0.3575	0.2801	0.2860
14	Pojist'ovna Ceske sporitelny, a.s., Vienna Insurance Group	0.7393	0.5669	0.7393	0.7393	0.3316	0.5669	0.3048	0.7393	0.3300
15	UNIQA pojist'ovna, a.s.	0.6613	0.6447	0.2836	0.4644	0.6613	0.4624	0.6325	0.2071	0.2836
16	Allianz-Slovenska poist'ovna, a.s.	0.8479	0.8479	0.3706	0.8479	0.2653	0.8479	0.2646	0.3706	0.0862
17	CSOB Poist'ovna, a.s.	0.7416	0.7257	0.2309	0.7416	0.4028	0.7257	0.3399	0.2309	0.1491
18	Generali poist'ovna, a.s.	0.4058	0.4058	0.1451	0.4058	0.2377	0.4058	0.2037	0.1451	0.0959
19	ING Zivotna poist'ovna, a.s.	0.3874	0.3528	0.2625	0.3820	0.3828	0.3528	0.3110	0.2625	0.2552
20	KOMUNALNA poist'ovna, a.s. Vienna Insurance Group	0.4051	0.3135	0.4051	0.4051	0.1573	0.3135	0.0702	0.4051	0.1573
21	KOOPERATIVA poist'ovna, a.s. Vienna Insurance Group	0.6290	0.5196	0.6290	0.6290	0.1268	0.5196	0.1103	0.6290	0.1176
22	MetLife Amslico poist'ovna, a.s.	0.4149	0.4045	0.1989	0.4108	0.4143	0.4045	0.3746	0.1982	0.1989
23	Poist'ovna Cardif Slovakia, a.s.	0.8420	0.7403	0.3396	0.8420	0.6417	0.7403	0.4342	0.3396	0.2621
24	Poist'ovna Postovej banky, a.s.	1.0000	1.0000	0.3175	1.0000	1.0000	1.0000	1.0000	0.3175	0.2795
25	Poist'ovna Slovenskej sporitel'ne, a.s. Vienna Insurance Group	0.4688	0.2926	0.4688	0.4688	0.3371	0.2926	0.1632	0.4688	0.3371
26	Rapid life zivotna poist'ovna, a.s.	1.0000	0.5371	1.0000	1.0000	1.0000	0.4784	0.5371	1.0000	1.0000
27	Union poist'ovna, a.s.	0.4819	0.4467	0.2168	0.4819	0.2853	0.4467	0.2275	0.2168	0.1492
28	UNIQA poist'ovna, a.s.	0.5129	0.4994	0.1206	0.5129	0.3274	0.4994	0.3001	0.1206	0.0899
29	Wustenrot poist'ovna, a.s.	0.5204	0.4903	0.1855	0.5204	0.1767	0.4903	0.1366	0.1855	0.0929

express the efficiency scores in all the models for all insurance companies analyzed. The efficiency score we expressed by J. Jablonsky et al. (2004: 84). We used the EMS program. We can derive several conclusions from the values of efficiency scores in all the models. "Kooperativa pojist'ovna", a.s. was efficient in all models. "Komercni pojist'ovna", a.s. had a value less than 1 only in model 1b. Its value was 0.92. "BNP Paribas Cardif Pojist'ovna", a.s. had a very low value of the efficiency score in models 2a, 2b and 2ab. In other models, its efficiency score equalled to 1. It can be concluded that "BNP Paribas Cardif Pojist'ovna", a.s. only had good performance with respect to the ratios that measure input utilization by the first input – claims incurred. Similarly, "MAXIMA pojist'ovna", a.s. had a very low value of the efficiency score in models 2a, 2b and 2ab. In Slovak Republic, low efficiency scores in models 2a, 2b and 2ab had "Poist'ovna Postovej banky", a.s. "Rapid life zivotna poist'ovna", a.s. had low efficiency scores in 1a, 1b and 1ab. It can be concluded that "Rapid life zivotna poist'ovna", a.s. only had a good performance with respect to the ratios that measure input utilization by the second input – operating costs.

In the next step we looked for similarities, respectively differences among insurance companies based on their efficiency scores. The correlation matrix of the values of the efficiency score in individual models is presented in Table 4. The correlation coefficients were not small. The highest value of the correlation coefficient had models 12b and 1b. The lowest value of the correlation coefficient had models 2a and 1b.

Table 4. **Correlation matrix,** *authors' presentation using* "Statistica"

	12ab	1ab	2ab	12a	12b	1a	1b	2a	2b
12ab	1.00	**0.92**	**0.58**	**0.91**	**0.81**	**0.77**	**0.78**	**0.47**	**0.61**
1ab	**0.92**	1.00	**0.43**	**0.80**	**0.72**	**0.88**	**0.80**	0.27	**0.48**
2ab	**0.58**	**0.43**	1.00	**0.49**	**0.49**	0.30	**0.43**	**0.88**	**0.86**
12a	**0.91**	**0.80**	**0.49**	1.00	**0.66**	**0.85**	**0.59**	**0.55**	**0.46**
12b	**0.81**	**0.72**	**0.49**	**0.66**	1.00	**0.51**	**0.95**	0.33	**0.76**
1a	**0.77**	**0.88**	0.30	**0.85**	**0.51**	1.00	**0.59**	0.31	0.28
1b	**0.78**	**0.80**	**0.43**	**0.59**	**0.95**	**0.59**	1.00	0.23	**0.69**
2a	**0.47**	0.27	**0.88**	**0.55**	0.33	0.31	0.23	1.00	**0.69**
2b	**0.61**	**0.48**	**0.86**	**0.46**	**0.76**	0.28	**0.69**	**0.69**	1.00

In bold are correlations the significant at 0.05.

We expressed our own numbers by applying factor analysis and extracting principal components. The first and second own value was greater than 1. Two factors explain 84.39% of variability. The first factor explains 66.47% of the total variability and the second factor explains 17.92%. In the interpretation of the factors identified it is important to assess correlations between the factors created and original variables – factor loadings. Factor scores for all the insurance companies enabled us to identify similarities between them and also identify extreme values. The factor scores for both factors are in Table 5. Insurance companies are indicated by the order in Table 3.

The lowest score of the first factor and high score of the second factor had insurance company ranked 10, i.e. "Kooperativa pojist'ovna", a.s. and also ranked 11 "Komercni pojist'ovna", a.s. The highest value of the factor score of the first factor had the insurance company ranked 9 (Table 3), i.e. "ING Zivotni pojist'ovna" N.V.

Table 5. **Factor scores,** *authors' presentation using* "Statistica"

	Factor 1	Factor 2
Allianz pojist'ovna, a.s.	-1.48800	0.46855
AXA zivotni pojist'ovna, a.s.	0.17346	-1.18512
BNP Paribas Cardif Pojist'ovna, a.s.	-0.99172	-2.32916
Ceska pojist'ovna, a.s.	-0.45215	0.79102
Ceska podnikatelska pojist'ovna, a.s.	-0.75793	-0.17203
CSOB Pojist'ovna, a.s. clen holdingu CSOB	1.03307	0.68581
ERGO pojist'ovna, a.s.	0.01152	0.47291
Hasicska vzajemna pojist'ovna, a.s.	-0.84971	0.24652
ING Zivotni pojist'ovna N.V., pobocka pro Ceskou republiku	1.31537	0.55932
Kooperativa pojist'ovna, a.s.	-1.99972	0.95753
Komercni pojist'ovna, a.s.	-1.96447	0.99053
MAXIMA pojist'ovna, a.s.	-0.89252	-1.16903
MetLife pojist'ovna a.s.	0.87375	0.29918
Pojist'ovna Ceske sporitelny, a.s., Vienna Insurance Group	-0.08437	1.03932
UNIQA pojist'ovna, a.s.	0.27086	-0.48359
Allianz - Slovenska poist'ovna, a.s.	-0.08384	-0.99909
CSOB Poist'ovna, a.s.	0.17825	-1.04932
Generali poist'ovna, a.s.	1.18123	-0.28482
ING Zivotna poist'ovna, a.s.	0.99151	0.29925
KOMUNALNA poist'ovna, a.s. Vienna Insurance Group	1.14299	0.82958
KOOPERATIVA poist'ovna, a.s. Vienna Insurance Group	0.46386	0.80360
MetLife Amslico poist'ovna, a.s.	0.93264	-0.12062
Poist'ovna Cardif Slovakia, a.s.	-0.24646	-0.80724
Poist'ovna Postovej banky, a. s.	-1.13288	-1.85226
Poist'ovna Slovenskej sporitel'ne, a.s. Vienna Insurance Group	0.83752	1.12607
Rapid life zivotna poist'ovna, a.s.	-1.24181	2.20589
Union poist'ovna, a.s.	0.92787	-0.18883
UNIQA poist'ovna, a.s.	0.88312	-0.71925
Wustenrot poist'ovna, a.s.	0.96857	-0.41471

The values of the factor score and graphical representation show that 1 insurance company had significantly different values of the factor score. It was "Rapid life zivotna poist'ovna", a.s. This insurance company reached low values of efficiency in models 1ab, 1a, 1b. It was efficient in other models. When adding variable 2 to models 1ab, 1a, 1b. This insurance company became efficient. Thus, operating costs of this insurance company are extremely low as compared to its other inputs and outputs. No other efficient insurance company in Slovakia or Czechia had extremely different values of the factor score. Based on this finding we can conclude there are differences between efficient insurance companies. Unusual values of combinations of inputs and outputs were found for the efficient insurance company "Rapid life zivotna poist'ovna", a.s. Similar conclusions can be drawn on the basis of cluster analysis in "Statistica". We also see that the most similar values had "Kooperativa pojistovna", a.s. and "Komercni pojistovna", a.s. The second most similar values had "MetLife Amslico poist'ovna", a.s. and "Union poist'ovna", a.s. Both achieved low values of the efficiency score in all the models.

Conclusions. Combination of DEA and multivariate exploration techniques can be used in various analyses of practical significance. One of its appliations is specification of differences between efficient companies. At the common Slovak and Czech insurance market in 2013 there was a bigger share of efficient insurance companies from Czech Republic. There were also insurance companies that are efficient only because of an excellent result of one of the indicators as well as insurance companies that reached efficiency by an unusual combination of inputs and outputs.

The results presented here have some limitations. The data were gathered from a variety of sources that may have minor differences in the methodology of expressing the indicators. The values used are for one year only. It would be of great importance to carry out long-term observation. The results for individual years could be compared with each other or it could be identified whether it is possible to apply them in benchmarking or to predict the development of insurance companies efficiency.

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