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APPLICATION OF WASPAS METHOD IN THE PERFORMANCE ANALYSIS OF COMPANIES IN SERBIA LISTED ON THE BELGRADE STOCK EXCHANGE

Abstract
Recently, as is well known, various methods of multi-criteria analysis are increasingly used in the evaluation of the performance of companies from all sectors. They can be successfully used in the ranking of companies - issuers (sellers) of securities (shares) according to stock market indicators, as criteria used on effective stock exchanges. This feature enables them to gain a better insight into the competitiveness of companies – issuers of

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acacia shares on effective stock exchanges. Likewise, potential investors (buyers) are able to understand better the economic profitability of investing in the shares of certain companies. In the current paper, this fact is illustrated and confirmed on the example of applying the WASPAS method in the ranking of companies in Serbia from financial and insurance sector, which are listed on the Belgrade Stock Exchange, according to stock indicators as criteria used. The obtained results of the empirical research unequivocally showed that the application of the WASPAS method, compared to ratio analysis, gives far more reliable results for purposes of making decisions on investments.

Key words: *market capitalization, earnings per share (EPS), price to earnings per share (P/E), market to book value (P/B), return on equity (ROE), effective stock market.*

JEL classification: D40, G21

Introduction

In recent times, various developed methods of multi-criteria analysis are used to an increasing extent in the evaluation of the performance of contemporary companies from all sectors. They can be quickly used to evaluate the performance of companies listed on effective stock exchanges. Bearing that in mind, this paper is focused on the ranking of companies in Serbia from financial and insurance sector listed on the Belgrade Stock Exchange according to relevant stock indicators. At the same time, for this purpose, we employed the WASPAS method as unique criteria for ranking them. The aim and purpose of this action is to show that the application of the WASPAS method provides a better insight into the competitive position of companies – issuers of shares on effective stock exchanges, compared to classical ratio analysis. Based on this, potential investors might be able to better assess the profitability of investing in certain shares.

As is well known, recently there has been an increasingly rich literature dedicated to the analysis of the performance of companies from different sectors based on the WASPAS method [1-33]. In the relevant literature in Serbia, as far as we know, there is not a single

comprehensive work dedicated to the ranking of companies in Serbia from financial and insurance service branch listed on the Belgrade Stock Exchange according to stock indicators as criteria for using the WASPAS method [9-23], [29]. This article fills that gap to some extent, and in doing that, among other things, its scientific and professional contribution is reflected.

The research hypothesis in this paper is based on the fact that the continuous evaluation of the performance of financial and insurance companies in Serbia listed on effective stock exchanges (in the specific case on the Belgrade Stock Exchange) is a basic precondition for efficient (profitable) investing in certain shares. At the same time, the application of the WASPAS method plays a significant role in this activity. It provides an answer to two key questions: (1) what is the competitive position of the acacia issuer on the effective stock exchange?, and (2) which issued stocks are the most profitable to invest in?

Empirical data for the purposes of researching the specific problem in this paper were collected from the Belgrade Stock Exchange. Data are harmonized with the relevant international standards, and therefore there are no limitations regarding their comparability at the national and international level.

1. Methodology

Zavadskas et al. [30] proposed using the WASPAS (Weighted Aggregates Sum Product Assessment) method. It presents the unique combination of two well-known approaches of Multi-Criteria Decision Making (MCDM) process: the method of weighted sums (WS - Weighted Sum), and the method of weighted products (WP - Weighted Product). The WASPAS method is used to solve various complex problems in multi-criteria decision making (for example decision-making on production) [1], [31]. An advanced fuzzy WASPAS method was developed for solving complex problems under uncertainty.

The procedure of the WASPAS method consists of the following steps [28]:

Step 1. Determining the optimal performance rating for each criterion.

The optimal performance rating is calculated as follows:

$$x_{0j} = \begin{cases} \max\limits_{i} x_{ij}; & j \in \Omega_{max} \\ \min\limits_{i} x_{ij}; & j \in \Omega_{min} \end{cases}, \quad (1)$$

where:

x_{0j} denotes the optimal performance rating of the *i*-th criterion,

Ω_{max} indicates the benefit criterion (the higher the value, the better it is),

Ω_{min} means a set of cost criteria (the lower the value, the better it is),

m denotes the number of alternatives (*i*= 0,1,..., *m*), and

n indicates the number of criteria (*j*= 0,1,..., *n*).

Step 2. Determination of the normalized decision matrix.

The normalized rating of performance is calculated as follows:

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{x_{0j}}; & j \in \Omega_{max} \\ \dfrac{x_{0j}}{x_{ij}}; & j \in \Omega_{min} \end{cases}, \quad (2)$$

where:

r_{ij} denotes the normalized performance rating of the *i*-th alternative in relation to the *j*-th criterion.

Step 3. Calculation of the relative importance of the *i*-th alternative based on the WS method.

The relative importance of the *i*-th alternative, based on the WS method, is calculated as follows:

$$Q_i^{(1)} = \sum_{j=1}^{n} w_j r_{ij}, \qquad (3)$$

where:

$Q_i^{(1)}$denotes the relative importance of the *i*-th alternative in relation to the *j*-th criterion, based on the WS method.

Step 4. Calculation of the relative importance of the *i*-th alternative, based on the WP method.

The relative importance of the alternative, based on the WP method, is calculated as follows:

$$Q_i^{(2)} = \prod_{j=1}^{n} r_{ij}^{w_j}, \qquad (4)$$

where:

$Q_i^{(2)}$denotes the relative importance of the *i*-th alternative in relation to the *j*-th criterion, based on the WP method.

Step 5. Calculating the overall relative importance for each alternative.

The total relative importance (common generalized criterion of weighted aggregations of additive and multiplicative methods) [30] is calculated as follows:

$$Q_i = \lambda Q_i^{(1)} + (1-\lambda) Q_i^{(2)} = \lambda \sum_{j=1}^{n} w_j r_{ij} + (1-\lambda) \prod_{j=1}^{n} r_{ij}^{w_j} \quad (5)$$

where:

λ is a coefficient and $\lambda \in [0, 1]$.

When decision-makers have no specific preferences, the coefficient value is 0.5, and in such circumstances Equation (5) can be expressed as:

$$Q_i = 0.5 Q_i^{(1)} + 0.5 Q_i^{(2)} = 0.5 \sum_{j=1}^{n} w_j r_{ij} + 0.5 \prod_{j=1}^{n} r_{ij}^{w_j} \quad (6)$$

2. Results and Discussion

As a part of the ranking of financial and insurance companies in Serbia listed on the Belgrade Stock Exchange using the WASPAS method, the following stock indicators were taken as criteria: C1 - market capitalization, C2 - EPS, C3 - P/E, C4 - P/B, and C5 - ROE. Alternatives are represented by selected Serbian companies from financial and insurance industry listed on the Belgrade Stock Exchange. Table 1 shows the initial data.

Table 1. Initial Data

	Serial numbers: 2022, 12, 29						
	Publisher	A symbol	Market capitalization (in thousands of dinars)	EPS	P/E*	P/B	ROE
			C1	C2	C3	C4	C5
A1	ALTA bank ad, Belgrade	JMBN	1081237500	0.00	0.00	0.27	0.28
A2	AMS Osiguranje ad, Belgrade	AMSO	629100000	1260.92	1.59	0.28	17.88
A3	AMS Osiguranje ad, Belgrade	AMSOPB	90000000	1260.92	0.71	0.13	17.88
A4	Dunav osiguranje ad, Belgrade	BOTTOM	16237256938	165.90	6.44	0.88	13.61
A5	Dunav Re ad, Belgrade	DNREM	1960234000	358.82	5.57	0.78	13.95
A6	Energoprojekt holding ad, Belgrade	ENHL01	0.00	0.00	0.00	0.00	0.00
A7	Energoprojekt holding ad, Belgrade	ENHL	3563601192	88.99	3.66	0.35	9.64

A8	Metalac ad, Gornji Milanovac	MTLC	3423120000	124.64	13.46	0.95	7.03
A9	Ratko Mitrović ad, Belgrade	RMBG	0.00	0.00	0.00	0.00	0.00
A10	Tigar ad, Pirot	TIGER	163124720	0.00	0.00	-0.05	0.00

Note: *Applies to ordinary shares only (CFI code: ESVUFR). Ratio indicators - Indicators used in the ratio analysis of securities, obtained based on data from the company's prospectus. **Market capitalization of the Stock Exchange** - The product of the number of securities and their market price, a measure of the size of the market. **EPS** (Earnings Per Shares) - A stock ratio used to value companies. It is calculated by dividing the company's profit by the total number of shares. **P/E** – A stock ratio number used when valuing stocks. The letter "P" stands for "prices", i.e. the price of the company on the stock exchange. The letter "E" stands for "earnings". The company's profit. The ratio shows how much an investor is willing to pay for one unit of profit in the future. This ratio number is calculated in two ways: 1) For one share: P/EPS – Share price/Profit per one share, 2) For the whole company: P/E – Market value of the company/Profit. **P/B** – Stock ratio number used in stock valuation. The letter "P" stands for "prices", i.e. the price of the company on the stock exchange. The letter "B" stands for "book". The book value of the company's capital. There is also a synonym M/B, where the letter "M" stands for "market value", i.e. the market value of the company. **ROE** (Return on equity) - Return on equity is a measure of a company's profitability and is calculated by dividing the company's profit by shareholders' equity. Statistics were calculated using the SPSS software.
Source: Belgrade Stock Exchange, https://www.belex.rs/trgovanje/racia

Weighting coefficients (weights) were determined using the AHP (Analytic Hierarchical Process) method (Saaty, 2008).

The obtained empirical results of the ranking of companies in Serbia from financial and insurance sector, listed on the Belgrade Stock Exchange, according to stock indicators as criteria used in the WASPAS method are shown in the tables below (Tables 2, 3, 4, 5, and 6 respectively).

Table 2. Initial Matrix

Initial Matrix					
weights of criteria	0.2646	0.2252	0.1501	0.1918	0.1683
kind of criteria	1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**
A1	1081237500	0	0	0.27	0.28
A2	629100000	1260.92	1.59	0.28	17.88
A3	90000000	1260.92	0.71	0.13	17.88
A4	16237256938	165.9	6.44	0.88	13.61
A5	1960234000	358.82	5.57	0.78	13.95
A6	0	0	0	0	0
A7	3563601192	88.99	3.66	0.35	9.64
A8	3423120000	124.64	13.46	0.95	7.03
A9	0	0	0	0	0
A10	163124720	0	0	-0.05	0
MAX	16237256938	1260.92	13.46	0.95	17.88
MIN	0	0	0	-0.05	0

Note: Author's calculation using WASPAS Software-Excel software

Table 3. Normalized Matrix

Normalized Matrix					
weights of criteria	0.2646	0.2252	0.1501	0.1918	0.1683
kind of criteria	1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**
A1	0.0666	0.0000	0.0000	0.2842	0.0157
A2	0.0387	1.0000	0.1181	0.2947	1.0000
A3	0.0055	1.0000	0.0527	0.1368	1.0000
A4	1.0000	0.1316	0.4785	0.9263	0.7612
A5	0.1207	0.2846	0.4138	0.8211	0.7802

A6	0.0000	0.0000	0.0000	0.0000	0.0000
A7	0.2195	0.0706	0.2719	0.3684	0.5391
A8	0.2108	0.0988	1.0000	1.0000	0.3932
A9	0.0000	0.0000	0.0000	0.0000	0.0000
A10	0.0100	0.0000	0.0000	0.0000	0.0000

Note: Author's calculation using WASPAS Software-Excel software

Table 4. Weighted Normalized Matrix

Weighted Normalized Matrix						
	C1	**C2**	**C3**	**C4**	**C5**	**Qi1**
A1	0.0176	0.0000	0.0000	0.0545	0.0026	0.0748
A2	0.0103	0.2252	0.0177	0.0565	0.1683	0.4780
A3	0.0015	0.2252	0.0079	0.0262	0.1683	0.4291
A4	0.2646	0.0296	0.0718	0.1777	0.1281	0.6718
A5	0.0319	0.0641	0.0621	0.1575	0.1313	0.4469
A6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
A7	0.0581	0.0159	0.0408	0.0707	0.0907	0.2762
A8	0.0558	0.0223	0.1501	0.1918	0.0662	0.4861
A9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
A10	0.0027	0.0000	0.0000	0.0000	0.0000	0.0027

Note: Author's calculation using WAPASSoftwre-Excel software

Table 5. Exponentially Weighted Matrix

Exponentially Weighted Matrix						

	C1	C2	C3	C4	C5	Qi2
A1	0.4883	0.0000	0.0000	0.7856	0.4968	0.2429
A2	0.4231	1.0000	0.7257	0.7911	1.0000	0.1111
A3	0.2529	1.0000	0.6430	0.6829	1.0000	0.5337
A4	1.0000	0.6333	0.8952	0.9854	0.9551	0.3484
A5	0.5715	0.7535	0.8760	0.9629	0.9591	0.0000
A6	0.0000	0.0000	0.0000	0.0000	0.0000	0.2255
A7	0.6695	0.5504	0.8224	0.8257	0.9013	0.3362
A8	0.6624	0.5938	1.0000	1.0000	0.8546	0.0000
A9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
A10	0.2960	0.0000	0.0000	0.0000	0.0000	0.2429

Note: Author's calculation using WAPASSoftwre-Excel software

Table 6. Ranking

					λ	0.5		
Ranking								
	Alternatives	**Qi1**	**Qi2**	**Qi**	**Qi**			**Ranking**
ALTA bank ad, Belgrade	**A1**	0.0748	0.0748	0.0748	0.0748			**7**
AMS Osiguranje ad, Belgrade	**A2**	0.4780	0.4780	0.4780	0.4780			**3**
AMS Osiguranje ad, Belgrade	**A3**	0.4291	0.4291	0.4291	0.4291			**5**
Dunav osiguranje ad, Belgrade	**A4**	0.6718	0.6718	0.6718	0.6718			**1**
Dunav Re ad, Belgrade	**A5**	0.4469	0.4469	0.4469	0.4469			**4**
Energoprojekt holding	**A6**	0.0000	0.0000	0.0000	0.0000			**9**

ad, Belgrade						
Energoprojekt holding ad, Belgrade	**A7**	0.2762	0.2762	0.2762	0.2762	**6**
Metalac ad, Gornji Milanovac	**A8**	0.4861	0.4861	0.4861	0.4861	**2**
Ratko Mitrović ad, Belgrade	**A9**	0.0000	0.0000	0.0000	0.0000	**9**
Tigar ad, Pirot	**A10**	0.0027	0.0027	0.0027	0.0027	**8**

Note: Author's calculation using WASPAS Software-Excel software

Based on the obtained empirical results of the ranking of companies in Serbia from financial and insurance sector, listed on the Belgrade Stock Exchange, and according to stock indicators as criteria used in the WASPAS method, it can be inferred that the company Dunav osiguranje a.d., Belgrade took first place. The next ranked companies according to the same criteria and model applied appeared to be: Metalac a.d., Gornji Milanovac, AMS Osiguranje a.d., Belgrade, Dunav-Re a.d., Belgrade, AMS Osiguranje a.d., Belgrade, Energoprojekt holding a.d., Belgrade, ALTA banka a.d., Belgrade, Tigar a.d., Pirot, Energoprojekt holding a.d., Belgrade, and Ratko Mitrović a.d., Belgrade.

A comparative analysis of the stock exchange ratio numbers, on one hand, and the results obtained using the WASPAS method, on the other hand, shows that the WASPAS method gives much better results for the purposes of investment decision-making process. This is because it simultaneously integrates all analysed stock market ratio numbers as criteria for decision-making purposes. Due to its simplicity, this model should be used for ranking companies in Serbia from financial and insurance service branch listed on the Belgrade Stock Exchange, according to stock indicators used as criteria.

Conclusion

According to the obtained empirical results of the ranking of companies in Serbia from financial and insurance sector, listed on the Belgrade Stock Exchange, we employed stock indicators as criteria for using the WASPAS method. Based on the applied WASPAS model, it can be concluded that out of 10 analysed companies in the role of acacia issuers, the company Dunav osiguranje a.d., Belgrade, took first place. The next ranked companies according to the same criteria while applying WASPAS method were: Metalac a.d., Gornji Milanovac, AMS Osiguranje a.d., Belgrade, Dunav-Re a.d., Belgrade, AMS Osiguranje a.d., Belgrade, Energoprojekt holding a.d., Belgrade, ALTA banka a.d., Belgrade, Tigar a.d., Pirot, Energoprojekt holding a.d., Belgrade, and Ratko Mitrović a.d., Belgrade.

A comparative analysis between the applied method of ratio numbers, on one hand, and the results obtained using the WASPAS method, on the other hand, shows that the WASPAS method provides much better results for investment decision-making. In the methodological sense, it is a very simple model and should therefore be used to rank companies listed on contemporary stock exchanges according to stock market indicators. At the same time, several methods of multi-criteria analysis (for example, ARAS, TOPSIS, COCOSO, EDAS, COPRAS, ELECTRE, MABAC and others) can be used in order to objectively (realistically) assess the profitability of investing in acacia shares of certain companies, as well as to strengthen the already obtained results of the used model.

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PRIMENA WASPAS METODE U ANALIZI PERFORMANSI PREDUZEĆA U SRBIJI KOTIRANIH NA BEOGRADSKOJ BERZI

Apstrakt
U poslednje vreme, kao što je poznato, sve se više koriste različite metode višekriterijumske analize u evaluaciji performansi preduzeća iz svih sektora. One se mogu uspešno koristiti u rangiranju preduzeća – emitenata (izdavalaca, prodavaca) hartija od vrednosti (akcija) prema berzanskim pokazateljima, u vidu korišćenih kriterijuma na efektnim berzama. To omogućuje bolji uvid u konkuretntnost preduzeća – emitenata akacija na efektnim berzama. Isto tako, potencijalni investitori (kupci) su u mogućnosti da bolje sagledaju ekonomsku isplativost ulaganja u akcije određenenih preduzeća. U ovom radu, to je ilustrovano i potvrđeno na primeru primene WASPAS metode u rangiranju preduzeća u Srbiji iz finansijske delatnosti i delatnosti osiguranja kotiranih na Beogradskoj berzi prema berzanskim pokazateljima kao kriterijumima. Dobijeni rezultati empirijskog istraživanja su nedvosmisleno pokazali da primena WASPAS metode daje daleko pouzdanije rezultate za investiciono odlučivanje u odnosu na racio analizu.

Ključne reči: *tržišna kapitalizacija, profit po akciji (EPS), odnos cene i profita po akciji (P/E), odnos tržišne i knigovodstvene vrednosti (P/B), prinos od kapitala (ROE), efektna berza.*

JEL klasifikacija: D40, G21