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PRIMENA ARAS METODE U EVALUACIJI EFIKASNOSTI OSIGURAVAJUĆIH DRUŠTAVA U SRBIJI

ORIGINALNI NAUČNI RAD

Apstrakt

Problematika evaluacije efikasnosti osiguravajućih društava na bazi višekriterijumske analize vrlo je aktuelna, složena i značajna. Ona pruža osnovu za unapređenje efikasnosti poslovanja osiguravajućih društava primenom adekvatnih mera u budućnosti. Imajući to u vidu, u ovom radu analizira se efikasnost osiguravajućih društava u Srbiji na bazi ARAS (*Additive Ratio Assessment*) metode. Dobijeni rezultati empirijskog istraživanja efikasnosti osiguravajućih društava u Srbiji pomoću ARAS metode pokazuju da je ona bila najbolja u 2020. godini. U poslednje vreme kontinuirano se povećavala efikasnost osiguravajućih društava u Srbiji. Na to su pozitivno uticali brojni faktori: ekonomska klima, životni standard, zaposlenost, savremeni koncepti upravljanja troškovima, prihodima i profitom, elektronska prodaja osiguravajućih usluga, digitalizacija celokupnog poslovanja. Negativan uticaj pandemije koronavirusa na efikasnost osiguravajućih društava u Srbiji je zanemarljiv (u odnosu na druge privredne delatnosti, na primer turizam i ugostiteljstvo) i jednim delom je kompenzovan kako povećanom prodajom osiguravajućih usluga putem interneta i osiguranjem infrastrukture (imovine) tako i samim shvatanjem značaja osiguranja od potencijalnih rizika svih vrsta.

Ključne reči: *efikasnost, osiguranje, ARAS metoda*

Jel klasifikacija: *C2, C6, G1, G2, G22*

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I. Uvod

Sve je veći značaj evaluacije efikasnosti osiguravajućih društava na bazi višekriterijumske analize (Beiragh, 2020). Polazeći od toga, predmet istraživanja u ovom radu jeste analiza efikasnosti osiguravajućih društava u Srbiji na bazi ARAS metode. Cilj i svrha toga je da se data problematika što kompleksnije kvalitativno i posebno kvantitativno obradi u cilju sticanja saznanja o stvarnoj efikasnosti osiguravajućih društava u Srbiji, kao polazne osnove za unapređenje te efikasnosti u budućnosti preduzimanjem odgovarajućih mera. U tome se, pored ostalog, ogleda naučno-stručni doprinos ovog rada.

U poslednje vreme sve je bogatija literatura posvećena evaluaciji efikasnosti svih kompanija, što znači i osiguravajućih društava na bazi višekriterijumske analize (Saaty, 2008; Chatterjee, 2013; Isseveroglu, 2015; Ersoy, 2017; Lukic, 2018, 2019, 2020a,b,c, 2021a, b, c; Beiragh, 2020; Tsolas, Ioannis, 2020; Tsvetkova, 2021). U kontekstu toga sve je veća uloga i značaj ARAS metode (Thakkar, 2021). U relevantnoj literaturi, koliko je nama poznato, ne postoji nijedan celovit rad posvećen evaluaciji efikasnosti osiguravajućih društava u Srbiji korišćenjem ARAS metode (Kočović, 2010; Lukić, 2010, 2016; Mandić, 2017; Rakonjac Antić, 2018). Tu prazninu treba donekle da popuni ovaj rad i u tome se, pored ostalog, ogleda njegov naučno-stručni doprinos.

Osnovna hipoteza istraživanja tretiranog problema u ovom radu zasniva se na činjenici da je kontinuirana analiza i kontrola uticajnih faktora pretpostavka za unapređenje efikasnosti osiguravajućih društava u budućnosti preduzimanjem odgovarajućih mera. U tome značajnu ulogu ima i primena ARAS metode.

Metodologija istraživanja date hipoteze zasnovana je na primeni AHP i ARAS metoda. Radi što kompleksnije kvantitativne analize problema tretiranog u ovom radu, u izvesnoj meri koristi se i statistička analiza.

Za potrebe istraživanja problema tretiranog u ovom radu primenom date metodologije, empirijski podaci su prikupljeni od Agencije za privredne registre Republike Srbije. Oni su proizvedeni u skladu s relevantnim međunarodnim standardima, tako da u pogledu međunarodne komparacije ne postoje nikakva ograničenja.

II. ARAS metoda

ARAS (*Additive Ratio Assessment*) metoda jedna je od tehnika višekriterijumske analize. Razvili su je Zavadskas i Turskis (Zavadskas and Turskis, 2010). Za razliku od ostalih metoda višekriterijumskog odlučivanja, rangiranje alternativa zasnovano je na vrednosti funkcije korisnosti (Chatterjee and Chakraborty, 2013; Sliogene et. al. 2013; Rostamzadeh, 2017; Koc, 2017; Dahooie, 2019; Jovčić, 2020). Procedura ARAS metode sastoji se iz nekoliko koraka (Zavadskas et. al., 2010):

Korak 1: Formulisanje matrice odlučivanja.

Matrica odlučivanja (DMM) formuliše se na sledeći način:

$$X = \begin{bmatrix} x_{01} & \cdots & x_{0j} & \cdots & x_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix}; i = \overline{0, m}; j = \overline{1, n} \quad (1)$$

gde je m – broj alternativa, n – broj kriterijuma koji opisuju svaku alternativu, x_{ij} – vrednost performanse i -te alternative u odnosu na j -ti kriterijum, x_{0i} – optimalna vrednost j -tog kriterijuma.

Ukoliko je optimalna vrednost j -tog kriterijuma nepoznata, tada je

$$\begin{aligned} x_{0j} &= \max_i x_{ij}, \text{ ako je } \max_i x_{ij} \text{ poželjno;} \\ x_{0j} &= \min_i x_{ij}^*, \text{ ako je } \min_i x_{ij}^* \text{ poželjno} \end{aligned} \quad (2)$$

Korak 2: Normalizacija vrednosti kriterijuma

U ovoj fazi se normalizuju inicijalne vrednosti kriterijuma – definisanjem vrednosti $\bar{x}_{ij}$ normalizovane matrice odlučivanja - $\bar{X}$.

$$\bar{X} = \begin{bmatrix} \bar{x}_{01} & \cdots & \bar{x}_{0j} & \cdots & \bar{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \bar{x}_{i1} & \cdots & \bar{x}_{ij} & \cdots & \bar{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \bar{x}_{m1} & \cdots & \bar{x}_{mj} & \cdots & \bar{x}_{mn} \end{bmatrix}; i = \overline{0, m}; j = \overline{1, n} \quad (3)$$

Ako je poželjna maksimalna vrednost, normalizacija je sledeća:

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^m x_{ij}} \quad (4)$$

Ukoliko je poželjna minimalna vrednost, procedura se sastoji iz dve faze:

$$x_{ij} = \frac{1}{x_{ij}^*}; \quad \bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^m x_{ij}} \quad (5)$$

Korak 3: Određivanje težinski normalizovane matrice - $\hat{X}$

Težinski koeficijenti se najčešće određuju metodom stručne ocene. Treba svakako koristiti samo dobro utemeljene težinske koeficijente jer su oni uvek subjektivne prirode i utiču na konačno rešenje. Zbir težinskih koeficijenata je limitiran (tj. jednak je 1):

$$\sum_{j=1}^n w_j = 1 \quad (6)$$

$$\hat{X} = \begin{bmatrix} \hat{x}_{01} & \cdots & \hat{x}_{0j} & \cdots & \hat{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \hat{x}_{i1} & \cdots & \hat{x}_{ij} & \cdots & \hat{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \hat{x}_{m1} & \cdots & \hat{x}_{mj} & \cdots & \hat{x}_{mn} \end{bmatrix}; i = \overline{0, m}; j = \overline{1, n} \quad (7)$$

Težinski normalizovana vrednost kriterijuma utvrđuje se na sledeći način:

$$\hat{x}_{ij} = \bar{x}_{ij} w_j; i = \overline{0, m} \quad (8)$$

gde je w_j težina (značaj) j -tog kriterijuma i $\bar{x}_{ij}$ je normalizovana ocena j -tog kriterijuma.

Funkcija optimalne vrednosti se definiše na sledeći način:

$$S_i = \sum_{j=1}^n \hat{x}_{ij}; i = \overline{0, m} \quad (9)$$

gde je S_i funkcija optimalne vrednosti i -te alternative. Ako je S_i najveća, kriterijum je nabolji.

Izračunavanje stepena korisnosti (K_i) alternative a_i vrši se (korišćenjem prethodne jednačine) na sledeći način:

$$K_i = \frac{S_i}{S_0}, \quad i = \overline{0, m} \quad (10)$$

gde su S_i i S_0 optimalne vrednosti kriterijuma.

Vrednost K_i je u intervalu . Relativna efikasnost (pozicija, rang) alternative određuje se prema vrednosti funkcije korisnosti. Najbolja je ona sa najvećom vrednošću.

III. Metoda analitičkog hijerarhijskog procesa (AHP)

S obzirom na to da se težinski koeficijenti kriterijuma kod primene ARAS metode utvrđuju pomoću AHP metode, ukratko ćemo se osvrnuti na njene teorijsko-metodološke karakteristike.

Metoda analitički hijerarhijskog procesa (AHP) (Analytic Hierarchy Process - AHP) odvija se kroz sledeće korake (Saaty, 2008):

Korak 1: Formiranje matrice parova poređenja

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad (11)$$

Korak 2: Normalizacija matrice parova poređenja

$$a_{ij}^* = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}}, \quad i, j = 1, \dots, n \quad (12)$$

Korak 3: Određivanje relativnog značaja, tj. vektora težina

$$w_i = \frac{\sum_{i=1}^n a_{ij}^*}{n}, \quad i, j = 1, \dots, n \quad (13)$$

Indeks konzistentnosti – CI (consistency index) predstavlja meru odstupanja n od $\lambda_{\max}$ i može se predstaviti sledećom formulom:

$$CI = \frac{\lambda_{\max} - n}{n} \quad (14)$$

Ako je $CI < 0,1$ procenjene vrednosti koeficijenata a_{ij} su konzistentne, a odstupanje $\lambda_{\max}$ od n je zanemarljivo. To znači, drugim rečima, da AHP metoda prihvata nekonzistentnost manju od 10%.

Pomoću indeksa konzistentnosti može se izračunati odnos konzistentnosti $CR = CI/RI$, pri čemu je RI slučajan indeks.

IV. Merenje efikasnosti osiguravajućih društava u Srbiji na bazi AHP-ARAS metoda: rezultati i diskusija

Prilikom merenja efikasnosti osiguravajućih društava u Srbiji na bazi ARAS metode, kao kriterijumi su korišćeni: C1 – broj zaposlenih, C2 – aktiva, C3 – kapital, C4 – poslovni (funkcionalni) prihodi, C5 – neto dobitak. Alternative su posmatrane godine: A1 – 2013, A2 – 2014, A3 – 2015, A4 – 2016, A5 – 2017, A6 – 2018, A7 – 2019, i A8 – 2020. (Obračun je izvršen pomoću softverskog programa ARASoftware-Excel, i dobijeni rezultati su prikazani u niženavedenim tabelama, kao i grafički.)

U Tabeli 1. prikazani su inicijalni podaci za merenje efikasnosti osiguravajućih društava u Srbiji za period 2013–2020.

Tabela 1. Inicijalni podaci za merenje efikasnosti osiguravajućih društava u Srbiji

	Broj zaposlenih	Aktiva	Kapital	Poslovni (funkcionalni) prihodi	Neto dobitak
2013	10918	138052	28617	55424	2009
2014	11295	167768	35177	58747	2900
2015	11252	191796	44795	70572	4625
2016	11043	215589	50816	79017	6009
2017	10894	232968	53981	82209	6634
2018	10649	279227	61703	86850	9072
2019	10917	299739	72147	92194	11680
2020	11164	314197	76871	95274	13003

Napomena: Podaci su iskazani u milionima dinara. Broj zaposlenih iskazan je u celom broju.

Izvor: Agencija za privredne registre Republike Srbije

U Tabeli 2. prikazana je statistika inicijalnih podataka.

Tabela 2. Statistika

Statistics		Broj zaposlenih	Aktiva	Kapital	Poslovni (funkcionalni) prihodi	Neto dobitak
N	Valid	8	8	8	8	8
	Missing	0	0	0	0	0
Median		10980.5000	224278.5000	52398.5000	80613.0000	6321.5000
Std. Deviation		215.52129	63672.36835	16892.16762	14787.73070	3976.85730
Minimum		10649.00	138052.00	28617.00	55424.00	2009.00
Maximum		11295.00	314197.00	76871.00	95274.00	13003.00
NPar Tests						
Friedman test						
Ranks						
Mean Rank		1.75	5.00	3.00	4.00	1.25
Test Statistics ^a						
N		8				
Chi-Square		30.800				
df		4				
Asymp. Sig.		.000				
a. Friedman Test						

Napomena: Autorovo izračunavanje pomoću softverskog programa SPSS

Podaci u datoj tabeli pokazuju da su vrednosti svih posmatranih varijabli od 2016. bile iznad proseka. To se pozitivno odrazilo na efikasnost osiguravajućih društava u Srbiji. Kako je Asimp. Sig. = .000 < .05, odbacuje se hipoteza da su razlike između varijabli (merenja) jednake nuli, odnosno prihvata se hipoteza da su razlike između njih statistički značajne.

U Tabeli 3. prikazana je korelaciona matrica inicijalnih podataka.

Tabela 3. Korelaciona matrica

Correlations		1	2	3	4	5
1 Broj zaposlenih	Pearson Correlation	1	-.319	-.245	-.336	-.255
	Sig. (2-tailed)		.441	.558	.416	.541
	N	8	8	8	8	8

2 Aktiva	Pearson Correlation	-.319	1	.993**	.976**	.988**
	Sig. (2-tailed)	.441		.000	.000	.000
	N	8	8	8	8	8
3 Kapital	Pearson Correlation	-.245	.993**	1	.982**	.993**
	Sig. (2-tailed)	.558	.000		.000	.000
	N	8	8	8	8	8
4 Poslovni (funkcionalni) prihodi	Pearson Correlation	-.336	.976**	.982**	1	.960**
	Sig. (2-tailed)	.416	.000	.000		.000
	N	8	8	8	8	8
5 Neto dobitak	Pearson Correlation	-.255	.988**	.993**	.960**	1
	Sig. (2-tailed)	.541	.000	.000	.000	
	N	8	8	8	8	8

**Correlation is significant at the 0.01 level (2-tailed).

Napomena: Autorovo kalkulisane pomoću softverskog programa SPSS

Korelaciona matrica pokazuje da postoji jaka korelaciona veza između analiziranih varijabli na nivou statističke značajnosti (Sig. (2-tailed) = .000 < .05), sem broja zaposlenih. Na poboljšanje efikasnosti osiguravajućih društava u značajnoj meri može se uticati efikasnijim upravljanjem aktivom, kapitalom, poslovnim (funkcionalnim) prihodima i profitom. U tom smislu neophodno je, isto tako, značajno unaprediti efikasnost upravljanja ljudskim resursima putem treninga, napredovanja u karijeri, fleksibilnog zapošljavanja i radnog vremena, te adekvatnog sistema nagrađivanja. U svemu tome značajnu ulogu ima i prodaja osiguravajućih usluga putem interneta.

Težinski koeficijenti (ponderi) kriterijuma su utvrđeni pomoću AHP metode (Saaty, 2008). Oni su prikazani u Tabeli 4. i na Slici 1.

Tabela 4. Težinski koeficijenti kriterijuma

AHP With Arithrmetic Mean Method					
Initial Comparisons Matrix					
	C1	C2	C3	C4	C5
C1	1	2	2	2	1
C2	0.5	1	1	1	2
C3	0.5	1	1	0.5	1
C4	0.5	1	2	1	1
C5	1	0.5	1	1	1
SUM	3.5	5.5	7	5.5	6

Normalized Matrix						
	C1	C2	C3	C4	C5	Weights of Criteria
C1	0.2857	0.3636	0.2857	0.3636	0.1667	0.2931
C2	0.1429	0.1818	0.1429	0.1818	0.3333	0.1965
C3	0.1429	0.1818	0.1429	0.0909	0.1667	0.1450
C4	0.1429	0.1818	0.2857	0.1818	0.1667	0.1918
C5	0.2857	0.0909	0.1429	0.1818	0.1667	0.1736
					SUM	1
Consistency Ratio	0.0483	COMPARE WITH 0.1; IT SHOULD BE LESS THAN 0.1.				

Napomena: Autorovo kalkulisane pomoću softverskog programa AHPSoftware-Excel

Slika 1. Rangiranje kriterijuma

Izvor: Autorova slika

Na prvom mestu po značaju jeste kriterijum broj zaposlenih. Zatim slede: aktiva, poslovni (funkcionalni) prihodi, neto dobitak i kapital. To kazuje da se efikasnijim upravljanjem ljudskim kapitalom, pored ostalog, može značajno uticati na ostvarenje ciljne efikasnosti osiguravajućih društava u Srbiji.

U Tabeli 5. prikazana je inicijalna matrica odlučivanja.

Tabela 5. Inicijalna matrica

Initial Matrix					
Weights of criteria	0.2931	0.1965	0.145	0.1918	0.1736
Kind of criteria	-1	1	1	1	1
	C1	C2	C3	C4	C5
A1	10918	138052	28617	55424	2009
A2	11295	167768	35177	58747	2900
A3	11252	191796	44795	70572	4625
A4	11043	215589	50816	79017	6009
A5	10894	232968	53981	82209	6634
A6	10649	279227	61703	86850	9072
A7	10917	299739	72147	92194	11680
A8	11164	314197	76871	95274	13003
MAX	11295	314197	76871	95274	13003
MIN	10649	138052	28617	55424	2009
0-Optimal Value	10649	314197	76871	95274	13003

Napomena: Autorovo izračunavanje

U Tabeli 6. prikazana je normalizovana matrica odlučivanja.

Tabela 6. Normalizovana matrica

Normalized Matrix						
Weights of criteria	0.2931	0.1965	0.145	0.1918	0.1736	1
Kind of criteria	-1	1	1	1	1	
	C1	C2	C3	C4	C5	
0-Optimal Value	0.1145	0.1459	0.1534	0.1331	0.1886	
A1	0.1117	0.0641	0.0571	0.0775	0.0291	
A2	0.1079	0.0779	0.0702	0.0821	0.0421	
A3	0.1083	0.0891	0.0894	0.0986	0.0671	
A4	0.1104	0.1001	0.1014	0.1104	0.0872	
A5	0.1119	0.1082	0.1078	0.1149	0.0962	
A6	0.1145	0.1297	0.1232	0.1214	0.1316	
A7	0.1117	0.1392	0.1440	0.1288	0.1694	
A8	0.1092	0.1459	0.1534	0.1331	0.1886	

Napomena: Autorovo izračunavanje

U Tabeli 7. prikazana je težinski normalizovana matrica odlučivanja.

Tabela 7. Težinski normalizovana matrica

Normalized Weighted Matrix					
	C1	C2	C3	C4	C5
0-Optimal Value	0.0336	0.0287	0.0222	0.0255	0.0327
A1	0.0327	0.0126	0.0083	0.0149	0.0051
A2	0.0316	0.0153	0.0102	0.0157	0.0073
A3	0.0318	0.0175	0.0130	0.0189	0.0116
A4	0.0324	0.0197	0.0147	0.0212	0.0151
A5	0.0328	0.0213	0.0156	0.0220	0.0167
A6	0.0336	0.0255	0.0179	0.0233	0.0228
A7	0.0327	0.0273	0.0209	0.0247	0.0294
A8	0.0320	0.0287	0.0222	0.0255	0.0327

Napomena: Autorovo izračunavanje

U Tabeli 8. prikazano je rangiranje alternativa.

Tabela 8. Rangiranje alternativa

		S	K	K	Ranking
	0-Optimal Value	0.1428	1.0000	1.0000	
2013	A1	0.0735	0.5150	0.5150	8
2014	A2	0.0802	0.5616	0.5616	7
2015	A3	0.0928	0.6500	0.6500	6
2016	A4	0.1030	0.7219	0.7219	5
2017	A5	0.1084	0.7595	0.7595	4
2018	A6	0.1230	0.8617	0.8617	3
2019	A7	0.1351	0.9463	0.9463	2
2020	A8	0.1412	0.9892	0.9892	1

Napomena: Autorovo izračunavanje pomoću ARASSoftwre-Excel

Dobijeni rezultati empirijskog istraživanja na bazi ARAS metode pokazuju da su osiguravajuća društva bila najefikasnija u 2020. godini. Zatim slede: 2019, 2018, 2017, 2016, 2015, 2014. i 2013. U posmatranom vremenskom rasponu (2013–2020) kontinuirano se, dakle, povećavala efikasnost osiguravajućih društava u Srbiji. Na to su pozitivno uticali brojni makro i mikro faktori (ekonomska klima, zaposlenost, životni standard, digitalizacija celokupnog poslovanja, sve razvijenije shvatanje značaja osiguranja svih vrsta). Negativan uticaj pandemije koronavirusa zanemarljiv

je i u velikoj meri, pored ostaloga, nadoknađen povećanom elektronskom prodajom osiguravajućih usluga, kao i osiguranjem infrastrukture (imovine). Tome svakako treba dodati i sve razvijenije shvatanje značaja osiguranja od potencijalnih rizika svih vrsta.

V. Zaključak

Na osnovu dobijenih rezultata empirijskog istraživanja efikasnosti osiguravajućih društava u Srbiji na bazi ARAS metode, može se zaključiti da su ona bile najefikasnija u 2020. godini. Zatim slede: 2019, 2018, 2017, 2016, 2015, 2014. i 2013. U posmatranom vremenskom rasponu (2013–2020), što je naročito karakteristično, kontinuirano se povećavala efikasnost osiguravajućih društava u Srbiji. Na to su pozitivno uticali brojni makro i mikro faktori, kao što su: ekonomska klima, zaposlenost, životni standard, digitalizacija celokupnog poslovanja, sve veće shvatanje značaja neživotnog i životnog osiguranja. Negativan uticaj pandemije kovida 19 zanemarljiv je i u velikoj meri, pored ostaloga, nadoknađen povećanom elektronskom prodajom osiguravajućih usluga, kao i osiguranjem infrastrukture (imovine). Pokazalo se da je u uslovima pandemije koronavirusa osiguranje od svih vrsta potencijalnih rizika svakako dobilo na značaju.

Zarad ostvarenja što veće efikasnosti osiguravajućih društava u Srbiji u budućnosti, neophodno je što efikasnije upravljati aktivom, kapitalom, poslovnim (funkcionalnim) prihodima, profitom i, naročito, ljudskim resursima.

Literatura

- Beiragh, R.G., Alizadeh, R., Kaleibari, S. S., Cavallaro, F., Zolfani, S. H., Bausys, R. and Mardani, A. (2020). An integrated Multi-Criteria Decision Making Model for Sustainability Performance Assessment for Insurance Companies. *Sustainability*, 12(3), 789.
- Chatterjee, P., & Chakraborty, S. (2013). Gear material selection using complex proportional assessment and additive ratio assessment-based approaches: a comparative study. *International Journal of Materials Science and Engineering*, 1(2), 104-111.
- Dahooie, J. H., Zavadskas, E. K., Vanaki, A. S., Firoozfar, H. R., Lari, M. & Turskis, Z. (2019). A new evaluation model for corporate financial performance using integrated CCSD and FCM-ARAS approach. *Economic Research – Ekonomska Istraživanja*, 32(1), 1088-1113.
- Ersoy, N. (2017). Performance measurement in retail industry by using a multi-criteria decision making methods. *Ege Academic Review*, 17(4), 539–551.
- Isseveroglu, G. and Sezer, O. (2015). Financial Performance of Pension Companies Operating in Turkey with TOPSIS Analysis Method. *International*

Journal of Academic Research in Accounting, Finance and Management Sciences, 5(1), 137–147.

- Jovčić, S., Simić, V., Průša, P., Dobrodolac, M. (2020). Picture Fuzzy ARAS Method for Freight Distribution Concept Selection, *Symmetry*, 12(7), 1062.
- Koc, N. and F.Uysal, (2017). Reverse logistics and application of ARAS method. *Journal of Management, Marketing and Logistics (JMML)*, 4(2), 178-185.
- Kočović, J., Šulejić, P., Rakonjac-Antić, T. (2010). *Osigurajne*. Beograd: Ekonomski fakultet.
- Lukic, R. (2010). *Revizija u bankama*. Beograd: Ekonomski fakultet.
- Lukić, R. (2016). *Računovodstvo osiguravajućih kompanija*. Beograd: Ekonomski fakultet.
- Lukić, R. (2018). *Bankarsko računovodstvo*. Beograd: Ekonomski fakultet.
- Lukić, R. and Hadrovic Zekic, B. (2019). Evaluation of efficiency of trade companies in Serbia using the DEA approach. Proceedings of the 19 th International Scientific Conference BUSINESS LOGISTICS IN MODERN MANAGEMENT October 10-11, Osijek, Croatia, Josip Juraj Strossmayer University of Osijek, Faculty of Economics in Osijek, 145-165.
- Lukic, R, Hadrovic Zekic, B. and Crnjac Milic, D. (2020a). Financial performance evaluation of trading companies in Serbia using the integrated Fuzzy AHP-TOPSIS Approach. 9th INTERNATIONAL SCIENTIFIC SYMPOSIUM REGION, ENTREPRENEURSHIP, DEVELOPMENT, Under the auspices of: REPUBLIC OF CROATIA MINISTRY OF SCIENCE AND EDUCATION, Osijek, Croatia, Josip Juraj Strossmayer, June, 690-703.
- Lukic, R. (2020b). Analysis of the efficiency of trade in oil derivatives in Serbia by applying the Fuzzy AHP-TOPSIS method. *Business Excellence and Management*, 10 (3), 80-98.
- Lukic, R., Vojteski Kljenak, D. and Anđelić, S. (2020c). Analyzing financial performances and efficiency of the retail food in Serbia by using the AHP-TOPSIS method. *Economics of Agriculture*, Year 67, No. 1, 2020, (pp. 55-68), Belgrade. DOI: <https://doi.org/10.5937/ekoPolj2001055L>
- Lukic, R., Vojteski Kljenak, D., Andelic, S. and Gavilovic, M. (2021a). Application WASPAS method in the evaluation of efficiency of agricultural enterprises in Serbia. *Economics of Agriculture*, Year 68, No. 2, (pp. 375-388), Belgrade. DOI: <https://doi.org/10.5937/ekoPolj2102375L>
- Lukic, R. (2021b). Analysis of the efficiency of insurance companies by lines of insurance in Serbia using the COCOSO method. *Journal of Insurance Theory and Practice* 2, 24-38. DOI: 10.5937/TokOsig2102009L
- Lukić, R. (2021c). Analiza efikasnosti finansijskih institucija na bazi OCRA metode. *Tehnika*, 76(1), 103-111. DOI: 10.5937/tehnika2101103L

- Mandić, K., Delibašić, B., Knežević, S. & Benković, S. (2017). Analysis of the efficiency of insurance companies in Serbia using the fuzzy AHP and TOPSIS methods. *Economic Research – Ekonomska Istraživanja*, 30(1), 550-565.
- Rakonjac-Antić, T. (2018). *Penzijsko i zdravstveno osiguranje*. Beograd: Ekonomski fakultet.
- Rostamzadeh, R. Esmaeili, A., Shahriyari Nia, A., Saparauskas, J., Keshavarz Ghorabae, M. (2017). A Fuzzy Aras Method for Supply Chain Management Performance Measurement in SMEs under Uncertainty. *Transformations in Business & Economics*, 16(2A (41A), 319-348.
- Saaty, T. L. (2008). Decision Making With The Analytic Hierarchy Process. *Int J Serv Sci*, 1(1), 83-98.
- Sliogeriene, J., Turskis, Z., & Streimikiene, D. (2013). Analysis and choice of energy generation technologies: The multiple criteria assessment on the case study of Lithuania. *Energy Procedia*, 32, 11-20.
- Thakkar, J. J. (2021). Additive Ratio Assessment Method (ARM/ARAS). In: *Multi-Criteria Decision Making. Studies in Systems, Decision and Control*, vol 336. Springer, Singapore.
- Tsolas, Ioannis, E. (2020). Financial Performance Assessment of Construction Firms by Means of RAM-Based Composite Indicators. *Mathematics*, 8(8), 1347.
- Tsvetkova, L., Bugaev, Y., Belousova, T., Zhukova, O. (2021). Factors Affecting the Performance of Insurance Companies in Russian Federation. *Montenegrin Journal of Economics*, 17(1), 209-218.
- Zavadskas, E. K., & Turskis, Z. (2010). A new additive ratio assessment (ARAS) method in multicriteria decision-making. *Technological and Economic Development of Economy*, 16(2), 159-172. <https://doi.org/10.3846/tede.2010.10>.

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Prof. Radojko M. Lukić, PhD¹

APPLICATION OF ARAS METHOD IN ASSESSING EFFICIENCY OF INSURANCE COMPANIES IN SERBIA

SCIENTIFIC PAPER

Abstract

The issue of assessment of the efficiency of insurance companies based on multi-criteria analysis has become increasingly pressing, complex and significant. It provides the grounds for the achievement of future improved efficiency of insurance companies by using adequate measures. With this in view, the paper analyses the efficiency of insurance companies in Serbia based on ARAS (Additive Ratio Assessment) method. The results obtained from the empirical research of the efficiency of insurance companies in Serbia by ARAS method show that the year 2020 was the most efficient. Lately, the efficiency of insurance companies in Serbia has continuously increased, positively triggered by a number of factors such as the economic climate, standard of living, employment, modern cost management concepts, revenues and profit, electronic sale of insurance services, digitization of overall business. The negative impact of the Corona virus pandemic in Serbia is negligible (compared to the other industries) and partially compensated for by the increased online sale of the insurance services and/or the growth in insurance of infrastructure (property) on the one hand and the raised awareness of the need to be covered by insurance against potential risks of all kinds, on the other hand.

Key words: *efficiency, insurance, ARAS method***JEL Classification:** C2, C6, G1, G2, G22

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I. Introduction

The evaluation of the efficiency of insurance companies based on multi-criteria analysis (Beiragh, 2020) is becoming increasingly significant. Starting from this, the subject of the research in the paper comprises an efficiency analysis of insurance companies in Serbia based on the ARAS method. The aim and purpose is to treat this issue with a greater complexity in terms of quality and, especially, the quantity in order to get to know what is the real efficiency of insurance companies in Serbia, as a starting point for improving the efficiency in future by taking adequate steps. This, among other things, reflects the scientific and professional contribution of this paper.

Recently, an increasingly rich literature has been dedicated to assessing the efficiency of all companies, including the insurance companies, based on multi-criteria analysis (Saaty, 2008; Chatterjee, 2013; Isseveroglu, 2015; Ersoy, 2017; Lukic, 2018, 2019, 2020a, b, c, 2021a, b, c; Beiragh, 2020; Tsolas, Ioannis, 2020; Tsvetkova, 2021). In this context, the role and importance of the ARAS method is growing (Thakkar, 2021). In the relevant literature, as far as we know, there is no completed paper dedicated to evaluating the efficiency of insurance companies in Serbia using the ARAS method (Kočović, 2010; Lukić, 2010, 2016; Mandić, 2017; Rakonjac Antić, 2018). This paper is intended to fill the gap to some extent, which reflects, *inter alia*, its scientific and professional contribution.

The standard research hypothesis of the issue processed in this paper relies upon the fact that a continuous analysis and control of the factors of influence is a prerequisite for improving the efficiency of insurance companies in the future by taking the adequate steps. Here, the application of ARAS method also plays a significant role.

The research methodology of the given hypothesis relies upon the application of AHP and ARAS methods. To some extent, we used a statistical analysis for the most complex quantitative analysis of the problem treated in this paper.

For the purposes of researching the problem dealt with in this paper by using the presented methodology, we collected the empirical data from the Serbian Business Registers Agency. These data were produced in accordance with the relevant international standards, so that no restrictions are imposed on the international-scope comparison.

II. ARAS Method

ARAS (*Additive Ratio Assessment*) method is one of the multi-criteria analysis technique. It was developed by Zavadskas and Turskis (Zavadskas and Turskis, 2010). Unlike other methods of multi-criteria decision-making, the ranking of alternatives is based on the value of the utility function (Chatterjee and Chakraborty, 2013; Sliogene et al. 2013; Rostamzadeh, 2017; Koc, 2017; Dahooie, 2019; Jovčić, 2020). The ARAS method procedure consists of several steps (Zavadskas et. Al., 2010):

Step 1: Formulate a decision matrix.

The decision matrix (DMM) is formulated as follows:

$$X = \begin{bmatrix} x_{01} & \cdots & x_{0j} & \cdots & x_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix}; i = \overline{0, m}; j = \overline{1, n} \quad (1)$$

where m – the number of alternatives, n – the number of criteria describing each alternative, x_{ij} – the performance value i -th alternatives in relation to j -th criterion, x_{0j} – optimum value of j -th criterion.

If the optimum value of the j -th criterion is unknown, than

$$\begin{aligned} x_{0j} &= \max_i x_{ij}, \text{ ako je } \max_i x_{ij} \text{ poželjno;} \\ x_{0j} &= \min_i x_{ij}^*, \text{ ako je } \min_i x_{ij}^* \text{ poželjno} \end{aligned} \quad (2)$$

Step 2: Normalization of the criterion value

In this stage, the initial criterion values are normalized – by defining value $\bar{x}_{ij}$ normalized decision matrices - $\bar{X}$.

$$\bar{X} = \begin{bmatrix} \bar{x}_{01} & \cdots & \bar{x}_{0j} & \cdots & \bar{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \bar{x}_{i1} & \cdots & \bar{x}_{ij} & \cdots & \bar{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \bar{x}_{m1} & \cdots & \bar{x}_{mj} & \cdots & \bar{x}_{mn} \end{bmatrix}; i = \overline{0, m}; j = \overline{1, n} \quad (3)$$

If maximum value is suggested, the normalization is as follows:

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^m x_{ij}} \quad (4)$$

If minimum value is suggested, the procedure comprises two stages:

$$x_{ij} = \frac{1}{x_{ij}^*}; \quad \bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^m x_{ij}} \quad (5)$$

Step 3: determining the weight normalized matrix - $\hat{X}$

The weight coefficients are most often determined by the method of professional grade. Only well-founded weight coefficients should be used, in any case, because they are always subjective in nature and affect the outcome. The sum of weight coefficients is limited (i.e. it equals 1):

$$\sum_{j=1}^n w_j = 1 \quad (6)$$

$$\hat{X} = \begin{bmatrix} \hat{x}_{01} & \cdots & \hat{x}_{0j} & \cdots & \hat{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \hat{x}_{i1} & \cdots & \hat{x}_{ij} & \cdots & \hat{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \hat{x}_{m1} & \cdots & \hat{x}_{mj} & \cdots & \hat{x}_{mn} \end{bmatrix}; i = \overline{0, m}; j = \overline{1, n} \quad (7)$$

The weight-normalized value of the criterion is defined as shown below:

$$\hat{x}_{ij} = \bar{x}_{ij} w_j; i = \overline{0, m} \quad (8)$$

Where w_j is the weight (relevance) of the j -th criterion and $\bar{x}_{ij}$ is normalized grade of the j -th criterion.

The function of optimal value is defined as shown below:

$$S_i = \sum_{j=1}^n \hat{x}_{ij}; i = \overline{0, m} \quad (9)$$

Where S_i is the function of the optimal value of the i -th alternative. If S_i is biggest, the criterion is the best.

Utility degree calculation (K_i) of the alternative a_i is done (by using the previous equation) as shown below:

$$K_i = \frac{S_i}{S_0}, \quad i = \overline{0, m} \quad (10)$$

Where S_i and S_0 are optimum criterion values.

Value K_i is within the range . Relative efficiency (position, ranking) of the alternative is defined as per value of the utility function. The best one has the highest value.

III. Method of Analytic Hierarchy Process (AHP)

Having in mind that the weight coefficient of the criteria in the application of the ARAS method is defined by using the AHP method, we shall make a short review of its theoretical and methodological features.

Method of analytic hierarchy process (AHP) (Analytic Hierarchy Process - AHP) is implemented through the below steps (Saaty, 2008):

Step 1: Formation of the comparison pair matrix

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad (11)$$

Step 2: Normalization of the comparison pairs matrix

$$a_{ij}^* = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}}, i, j = 1, \dots, n \quad (12)$$

Step 3: Defining relative significance, i.e. the weight vector

$$w_i = \frac{\sum_{i=1}^n a_{ij}^*}{n}, i, j = 1, \dots, n \quad (13)$$

Consistency index – CI represents a measure of deviation n from $\lambda_{\max}$ and may be represented by the following formula:

$$CI = \frac{\lambda_{\max} - n}{n} \quad (14)$$

If $CI < 0,1$ the estimated coefficient values of a_{ij} are consistent and the deviation $\lambda_{\max}$ from n is negligible. In other words, this means that the AHP method accepts the inconsistency less than 10%.

By the help of the consistency index, we can calculate the consistency ratio $CR = CI/RI$, whereby the RI is a random index.

IV. Efficiency Measurement of Insurance Companies in Serbia Based on AHP-ARAS Method: Results and Discussion

When measuring the efficiency of insurance companies in Serbia based on ARAS method, the applied criteria include C1 – number of employees, C2 – assets, C3 – equity, C4 – operating (functional) income, C5 – net profit. The alternatives represent the years observed A1 – 2013, A2 – 2014, A3 – 2015, A4 – 2016, A5 – 2017, A6 – 2018, A7 – 2019 and A8 – 2020. (The calculation was made by applying the ARAS Software-Excel software program and the obtained results are displayed in the tables below as well as in the graphs)

The Table 1 shows the initial data for efficiency measurement of insurance companies in Serbia for the period 2013–2020.

Table 1 Initial data for efficiency measurement of insurance companies in Serbia

	Number of employees	Assets	Equity	Operating (functional) income	Net profit
2013	10918	138052	28617	55424	2009
2014	11295	167768	35177	58747	2900
2015	11252	191796	44795	70572	4625
2016	11043	215589	50816	79017	6009
2017	10894	232968	53981	82209	6634
2018	10649	279227	61703	86850	9072
2019	10917	299739	72147	92194	11680
2020	11164	314197	76871	95274	13003

Note: Data are declared in million dinars. The number of employees is shown as an integral number.

Source: Serbian Business Registers Agency

The Table 2 shows the initial data statistics

Table 2 Statistics

Statistics		Number of employees	Assets	Equity	Operating (functional) income	Net profit
N	Valid	8	8	8	8	8
	Missing	0	0	0	0	0
Median		10980.5000	224278.5000	52398.5000	80613.0000	6321.5000
Std. Deviation		215.52129	63672.36835	16892.16762	14787.73070	3976.85730
Minimum		10649.00	138052.00	28617.00	55424.00	2009.00
Maximum		11295.00	314197.00	76871.00	95274.00	13003.00
NPar Tests						
Friedman test						
Ranks						
Mean Rank		1.75	5.00	3.00	4.00	1.25
Test Statistics ^a						
N		8				
Chi-Square		30.800				
df		4				
Asymp. Sig.		.000				
a. Friedman Test						

Note: Author's calculation by the use of a software program SPSS

The data in the given table show that the values of all observed variables since 2016 were above average. This had a positive effect on the efficiency of insurance companies in Serbia. Since the Asimp. Sig. = .000 < .05, the hypothesis that the differences between the variables (measurements) equal zero is rejected, i.e. the hypothesis that the differences between them are statistically significant is accepted.

The Table 3 shows the correlation matrix of the initial data.

Table 3 Correlation matrix

Correlations		1	2	3	4	5
1 Number of employees	Pearson Correlation	1	-.319	-.245	-.336	-.255
	Sig. (2-tailed)		.441	.558	.416	.541
	N	8	8	8	8	8

2 Assets	Pearson Correlation	-.319	1	.993**	.976**	.988**
	Sig. (2-tailed)	.441		.000	.000	.000
	N	8	8	8	8	8
3 Equity	Pearson Correlation	-.245	.993**	1	.982**	.993**
	Sig. (2-tailed)	.558	.000		.000	.000
	N	8	8	8	8	8
4 Operating (functional) income	Pearson Correlation	-.336	.976**	.982**	1	.960**
	Sig. (2-tailed)	.416	.000	.000		.000
	N	8	8	8	8	8
5 Net profit	Pearson Correlation	-.255	.988**	.993**	.960**	1
	Sig. (2-tailed)	.541	.000	.000	.000	
	N	8	8	8	8	8

**Correlation is significant at the 0.01 level (2-tailed).

Note: Author's calculation by the use of software program SPSS

The correlation matrix shows that there is a strong correlation between the analysed variables at the level of statistical significance (Sig. (2-tailed) = .000 < .05), except for the number of employees. A more efficient management of assets, equity, operating (functional) income and profit can significantly affect the improvement of efficiency of insurance companies. In that sense, it is also necessary to significantly improve the efficiency of human resource management through training, career advancement, flexible employment and working hours and an adequate remuneration system. Here, the sale of insurance services via the Internet also plays a significant role.

The weight coefficient (weights) of the criteria is determined by using the AHP method (Saaty, 2008). They are presented in the Table 4 and in the Figure 1.

Table 4 Weight coefficient of criteria

AHP With Arithmetical Mean Method					
Initial Comparisons Matrix					
	C1	C2	C3	C4	C5
C1	1	2	2	2	1
C2	0.5	1	1	1	2
C3	0.5	1	1	0.5	1
C4	0.5	1	2	1	1
C5	1	0.5	1	1	1
SUM	3.5	5.5	7	5.5	6

Normalized Matrix						
	C1	C2	C3	C4	C5	Weights of Criteria
C1	0.2857	0.3636	0.2857	0.3636	0.1667	0.2931
C2	0.1429	0.1818	0.1429	0.1818	0.3333	0.1965
C3	0.1429	0.1818	0.1429	0.0909	0.1667	0.1450
C4	0.1429	0.1818	0.2857	0.1818	0.1667	0.1918
C5	0.2857	0.0909	0.1429	0.1818	0.1667	0.1736
					SUM	1
Consistency Ratio	0.0483	COMPARE WITH 0.1; IT SHOULD BE LESS THAN 0.1.				

Note: Author's calculation by using the software program AHP Software-Excel

Figure 1 Criteria ranking

Source: Author's figure

The most significant criterion is the number of employees, followed by the assets, operating (functional) income, net profit and equity. This shows that a more efficient human capital management, among other things, can significantly affect the achievement of the targeted efficiency of insurance companies in Serbia.

Table 5 shows the initial decision-making matrix.

Table 5 Initial matrix

Initial Matrix					
Weights of criteria	0.2931	0.1965	0.145	0.1918	0.1736
Kind of criteria	-1	1	1	1	1
	C1	C2	C3	C4	C5
A1	10918	138052	28617	55424	2009
A2	11295	167768	35177	58747	2900
A3	11252	191796	44795	70572	4625
A4	11043	215589	50816	79017	6009
A5	10894	232968	53981	82209	6634
A6	10649	279227	61703	86850	9072
A7	10917	299739	72147	92194	11680
A8	11164	314197	76871	95274	13003
MAX	11295	314197	76871	95274	13003
MIN	10649	138052	28617	55424	2009
0-Optimal Value	10649	314197	76871	95274	13003

Note: Author's calculation

The Table 6 shows the normalized decision-making matrix.

Table 6 Normalized matrix

Normalized Matrix						
Weights of criteria	0.2931	0.1965	0.145	0.1918	0.1736	1
Kind of criteria	-1	1	1	1	1	
	C1	C2	C3	C4	C5	
0-Optimal Value	0.1145	0.1459	0.1534	0.1331	0.1886	
A1	0.1117	0.0641	0.0571	0.0775	0.0291	
A2	0.1079	0.0779	0.0702	0.0821	0.0421	
A3	0.1083	0.0891	0.0894	0.0986	0.0671	
A4	0.1104	0.1001	0.1014	0.1104	0.0872	
A5	0.1119	0.1082	0.1078	0.1149	0.0962	
A6	0.1145	0.1297	0.1232	0.1214	0.1316	
A7	0.1117	0.1392	0.1440	0.1288	0.1694	
A8	0.1092	0.1459	0.1534	0.1331	0.1886	

Note: Author's calculation

The Table 7 shows the weight normalized decision-making matrix.

Table 7 Weight normalized matrix

Normalized Weighted Matrix					
	C1	C2	C3	C4	C5
0-Optimal Value	0.0336	0.0287	0.0222	0.0255	0.0327
A1	0.0327	0.0126	0.0083	0.0149	0.0051
A2	0.0316	0.0153	0.0102	0.0157	0.0073
A3	0.0318	0.0175	0.0130	0.0189	0.0116
A4	0.0324	0.0197	0.0147	0.0212	0.0151
A5	0.0328	0.0213	0.0156	0.0220	0.0167
A6	0.0336	0.0255	0.0179	0.0233	0.0228
A7	0.0327	0.0273	0.0209	0.0247	0.0294
A8	0.0320	0.0287	0.0222	0.0255	0.0327

Note: Author's calculation

The Table 8 shows the alternatives ranking.

Table 8 Alternatives ranking

		S	K	K	Ranking
	0-Optimal Value	0.1428	1.0000	1.0000	
2013	A1	0.0735	0.5150	0.5150	8
2014	A2	0.0802	0.5616	0.5616	7
2015	A3	0.0928	0.6500	0.6500	6
2016	A4	0.1030	0.7219	0.7219	5
2017	A5	0.1084	0.7595	0.7595	4
2018	A6	0.1230	0.8617	0.8617	3
2019	A7	0.1351	0.9463	0.9463	2
2020	A8	0.1412	0.9892	0.9892	1

Note: Author's calculation by using the ARASoftware-Excel

The obtained results of empirical research based on the ARAS method show that insurance companies were most efficient in the year of 2020, followed by 2019, 2018, 2017, 2016, 2015, 2014 and 2013. In the observed time period (2013–2020), the efficiency of insurance companies in Serbia has continuously increased. This was positively affected by numerous macro and micro factors (economic climate, employment, standard of living, digitalization of overall business, increasingly developed understanding of the importance of insurance coverage of all types). The

negative impact of the coronavirus pandemic is negligible and largely compensated for, *inter alia*, by the increased electronic sale of insurance services, as well as by concluding the infrastructure (property) insurance. We should, by all means, add the increasingly raised awareness of the significance of concluding the insurance coverage against potential risks of all kinds.

V. Conclusion

Based on the results obtained from the empirical efficiency research of the insurance companies in Serbia following the ARAS method, it can be concluded that the greatest efficiency was recorded in the year 2020, followed by 2019, 2018, 2017, 2016, 2015, 2014 and 2013. It is especially characteristic that, in the observed time period (2013–2020), the efficiency of insurance companies in Serbia was continuously increasing. This was positively affected by a number of macro and micro factors such as the economic climate, employment, living standard, digitalization of the entire business, raising awareness of the importance of concluding non-life and life insurance. The negative impact of the Covid 19 pandemics was negligible and largely compensated for, *inter alia*, by the increased electronic sale of insurance services as well as the infrastructure (property) insurance. The insurance against all types of potential risks has certainly proved to gain importance in the context of the Coronavirus pandemics.

In order to achieve the highest efficiency of insurance companies in Serbia in the future, it is necessary to more efficiently manage their assets, equity, operating (functional) income, profit and, in particular, the human resources.

Literature

- Beiragh, R.G., Alizadeh, R., Kaleibari, S. S, Cavallaro, F, Zolfani, S. H, Bausys, R. and Mardani, A. (2020). An integrated Multi-Criteria Decision Making Model for Sustainability Performance Assessment for Insurance Companies. *Sustainability*, 12(3), 789.
- Chatterjee, P & Chakraborty, S. (2013). Gear Material Selection Using Complex Proportional Assessment and Additive Ratio Assessment-Based Approaches: a Comparative Study. *International Journal of Materials Science and Engineering*, 1(2), 104-111.
- Dahooie, J. H, Zavadskas, E. K, Vanaki, A. S, Firoozfar, H. R, Lari, M. & Turskis, Z. (2019). A New Evaluation Model for Corporate Financial Performance Using Integrated CCSD and FCM-ARAS Approach. *Economic Research-Ekonomska Istraživanja*, 32(1), 1088-1113.

- Ersoy, N. (2017). Performance Measurement in Retail Industry by Using a Multi-Criteria Decision Making Methods. *Ege Academic Review*, 17(4), 539–551.
- Isseveroglu, G. and Sezer, O. (2015). Financial Performance of Pension Companies Operating in Turkey with TOPSIS Analysis Method. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 5(1), 137–147.
- Jovčić, S, Simić, V, Průša, P, Dobrodolac, M. (2020). Picture Fuzzy ARAS Method for Freight Distribution Concept Selection. *Symmetry*, 12(7), 1062.
- Koc, N. and F.Uysal, (2017). Reverse Logistics and Application of ARAS Method. *Journal of Management, Marketing and Logistics (JMML)*, 4(2), 178-185.
- Kočović, J, Šulejić, P, Rakonjac-Antić, T. (2010). *Osiguranje*. Belgrade: Faculty of Economics.
- Lukić, R. (2010). *Revizija u bankama*. Belgrade: Faculty of Economics.
- Lukić, R. (2016). *Računovodstvo osiguravajućih kompanija*. Belgrade: Faculty of Economics.
- Lukić, R. (2018). *Bankarsko računovodstvo*. Belgrade: Faculty of Economics.
- Lukic, R. and Hadrovic Zekic, B. (2019). Evaluation of Efficiency of Trade Companies in Serbia using the DEA Approach. Proceedings of the 19th International Scientific Conference BUSINESS LOGISTICS IN MODERN MANAGEMENT October 10-11, Osijek, Croatia, Josip Juraj Strossmayer University of Osijek, Faculty of Economics in Osijek, 145-165.
- Lukic, R, Hadrovic Zekic, B. and Crnjac Milic, D. (2020a). Financial Performance Evaluation of Trading Companies in Serbia using the Integrated Fuzzy AHP - TOPSIS Approach. 9th INTERNATIONAL SCIENTIFIC SYMPOSIUM REGION, ENTREPRENEURSHIP, DEVELOPMENT, Under the auspices of: REPUBLIC OF CROATIA MINISTRY OF SCIENCE AND EDUCATION, Osijek, Croatia, Josip Juraj Strossmayer, June, 690-703.
- Lukic, R. (2020b). Analysis of the efficiency of trade in oil derivatives in Serbia by applying the Fuzzy ahp-topsis method. *Business Excellence and Management*, 10 (3), 80-98.
- Lukic, R, Vojteski Kljenak, D. and Anđelić, S. (2020c). ANALYZING FINANCIAL PERFORMANCES AND EFFICIENCY OF THE RETAIL FOOD IN SERBIA BY USING THE AHP – TOPSIS METHOD. *Economics of Agriculture*, Year 67, No. 1, 2020, (pp. 55-68), Belgrade. DOI: <https://doi.org/10.5937/ekoPolj2001055L>
- Lukic, R, Vojteski Kljenak, D, Anđelic, S. and Gavilovic, M. (2021a). Application WASPAS Method in the Evaluation of Efficiency of Agricultural Enterprises in Serbia. *Economics of Agriculture*, Year 68, No. 2, (pp. 375-388), Belgrade. DOI: <https://doi.org/10.5937/ekoPolj2102375L>
- Lukic, R. (2021b). ANALYSIS OF THE EFFICIENCY OF INSURANCE COMPANIES BY LINES OF INSURANCE IN SERBIA USING THE COCOSO METHOD. *Journal of Insurance Theory and Practice* 2, 24-38. DOI: 10.5937/TokOsig2102009L

- Lukić, R. (2021 c). Analiza efikasnosti finansijskih institucija na bazi OCRA metode. *Tehnika*, 76(1), 103-111. DOI: 10.5937/tehnika2101103L
- Mandić, K., Delibašić, B., Knežević, S. & Benković, S. (2017). Analysis of the Efficiency of Insurance Companies in Serbia using the Fuzzy AHP and TOPSIS Methods. *Economic Research-Ekonomska Istraživanja*, 30(1), 550-565.
- Rakonjac-Antić, T. (2018). *Penzijско i zdravstveno osiguranje*. Belgrade: Faculty of Economics.
- Rostamzadeh, R. Esmaeili, A, Shahriyari Nia, A, Saparauskas, J, Keshavarz Ghorabae, M. (2017). A Fuzzy Aras Method for Supply Chain Management Performance Measurement in SME under Uncertainty. *Transformations in Business & Economics*, 16(2A (41A), 319-348.
- Saaty, T. L. (2008). Decision Making With the Analytic Hierarchy Process. *Int J Serv Sci*, 1(1), 83-98.
- Sliogeriene, J, Turskis, Z, & Streimikiene, D. (2013). Analysis and Choice of Energy Generation Technologies: The Multiple Criteria Assessment on the Case Study of Lithuania. *Energy Procedia*, 32, 11-20.
- Thakkar, J. J. (2021). Additive Ratio Assessment Method (ARM/ARAS). In: Multi-Criteria Decision Making. Studies in Systems, Decision and Control, vol. 336. Springer, Singapore.
- Tsolas, Ioannis, E. (2020). Financial Performance Assessment of Construction Firms by Means of RAM-Based Composite Indicators. *Mathematics*, 8(8), 1347.
- Tsvetkova, L, Bugaev, Y, Belousova, T, Zhukova, O. (2021). Factors Affecting the Performance of Insurance Companies in Russian Federation. *Montenegro Journal of Economics*, 17(1), 209-218.
- Zavadskas, E. K, & Turskis, Z. (2010). A New Additive Ratio Assessment (ARAS) Method in Multicriteria Decision-Making. *Technological and Economic Development of Economy*, 16(2), 159-172. <https://doi.org/10.3846/tede.2010.10>.

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