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Comparative Evaluation and Ranking of the European Countries Based on the Interdependence between Human Development and Internal Security Indicators

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Abstract: New solutions and techniques for developing country policies are used under real conditions. The present study aims to propose a new approach for evaluating and ranking the European countries by using the interrelation between two groups of criteria, associated with the Human Development Index (HDI) and the World Internal Security and Police Index (WISPI). HDI and its components rank countries by value and detail the values of the components of longevity, education and income per capita. WISPI focuses on the effective rendering of security services and the outcome of rendered services. The priority of criteria is determined in the descending order of their correlation values with other group criteria. The criteria weights are set simultaneously for both groups by applying the weight balancing method WEBIRA. The methodology based on minimising sum of squared differences of the weighted sums within groups is used. Finally, the generalised criteria measuring the level of the country are calculated using the SAW method. Cluster analysis of the countries was carried out and compared with MCDM results. The study revealed that WEBIRA ranking of countries is basically consistent with the results of cluster analysis. The proposed methodology can be applied to develop the management policy of the countries, as well as to their evaluation and ranking by using various indices, criteria and procedures. The results of this research can also be used to reveal national policy choices, to point out government policy priorities.

Keywords: human development; internal security; MCDM; weight balancing; WEBIRA; cluster analysis

1. Introduction

The European countries are exposed to various hybrid dangers (e.g., political differences, military aggression, financial and economic crises, natural and technogenic catastrophes, social upheavals, criminal offences, etc.). This problem is closely associated with the internal security of the states. The institutions, ensuring the internal security of the states, also guarantee their economic stability. The European Union (EU) is becoming a centre of sustainability of the European values and stability. The systematic and consistent attitudes towards the topical issues of internal security are formed by the EU member states through their joint regulations. However, the particular EU states develop their security systems depending on numerous internal and external factors. Therefore, their internal security systems have some specific features. The states not belonging to the EU also demonstrate their distinctive properties, though in the world involved in the global processes similar tendencies of changes in the internal safety systems can be observed [1]. This field of research has been barely explored. The World Internal Security and Police Index (WISPI) [2] focuses on describing both the effective rendering of security services and the outcome of the rendered services. WISPI is considered the first international index for measuring the indicators of the internal security worldwide, as well as ranking the states according to their ability to provide security services and boost security performance.

The economic and human development of a particular country relate to the state of security in this country [3]. Higher development levels, in terms of GDP per capita, are capable of providing social and individual prosperity or human development. It is not clear whether other interrelations between prosperity indicators exist on different levels of economic development. Social and human development and security status indicators improve with economic development. Public well-being increases with income rise at all levels of economic development [4]. Focusing on people instead of economic outcomes provides a wider range of options for policy-makers [5]. Countries' development policies should strive to remove any obstacles that impede people's freedoms: political freedom provides individuals to enjoy the freedom of political expression; economic facilities allow the use of economic resources for the purpose of consumption, production or exchange; social opportunities are made possible access to education and health; transparency guarantees relate to openness and the prevention of any type of corruption; and protective security allows a social safety network that protects individuals from misery [6]. Human development paves the way for economic development and security. State policy not only secures educational programs but also promotes development through innovation and expansion of new programs [7]. Meanwhile relationship exists between pro-government militias and various types of human rights violations [5]. A relationship between a given government regime's security repertoire and the likelihood of control and violence against civilians exists [8]. Uncontrollable human rights violations have a harmful effect on the positive country's image [9]. Since the government is a source of legitimate authority, laws and regulations also provide important cues about which course is supported and protected by the government. A legal country system that protects certain interests with certain methods sends a signal to world societal participants that these interests and these methods should be determined as a dominant image of the country [10].

Human development is a process, which seeks to expand the possibilities to create an environment where people can live long, healthy and creative lives. Human Development Index (HDI) [11] is one of the most widely used composite indicators of socioeconomic development of a country. People who have achieved high or very high human development level represent 51 percent of the global population. Researchers are extremely interested in factors influencing HDI [12]. Overwhelming evidence of the direct positive effects of economic freedom on human development is provided by a large number of the cross-country studies [13]. However, the 'original sin' of HDI involves neglecting the environmental and social sustainability and personal security issues [14].

A wide variety of approaches and evaluation techniques are used in the field of security research; however, there are some gaps, particularly if researchers aim to study the internal security of the whole country. The aim of the present study is to propose a new approach to identify a method of ranking the countries for evaluating the internal security of the European countries, using indicators such as the Human Development Index [11] and the Internal Security and Police Index [2]. Thus, the combining of HDI indicators with the World Internal Security and Police Index can provide an integrated evaluation approach for filling this gap. However, the conventional security system's modelling tools and models, such as expert-based or other approaches, do not propose any integral internal security metric, covering all types of threats, to which the countries and citizens are exposed.

There is not much research in the literature dedicated to studying HDI and particularly WISPI by means of mathematical modelling. Most research is related to the separate dimensions of HDI—public health, economic development and quality of life. The most commonly used methods are various tools of mathematical statistics, i.e., correlation, regression analysis and some econometric models.

The study by Zaborskis et al. [15] introduces several methods for measuring family affluence inequality in adolescent life satisfaction (LS) and assesses its relationship with macrolevel indices

(Gross National Income, Human Development Index and the mean Overall Life Satisfaction score). Poisson regression estimations and correlation analysis were used in this research. Murray et al. [16] investigated how preterm delivery rates differ in a country with a very high human development index and explored rural vs. urban environmental and socioeconomic factors that may be responsible for this variation. A multiple linear regression was used for this purpose. The study by Liu et al. [17] employs a panel smooth transition vector error correction model (PST-VECM) to explore the education-health causality. The paper by Sayed et al. [18] discusses the rank reversal issue in multicriteria decision-making (MCDM) techniques. The proposed methodology of the Goal Programming Benefit-of-the-Doubt (GP-BOD) aims to overcome this problem and obtain consistent and stable rankings for the human development index (HDI) framework. The paper by Carvalhal Monteiro et al. [19] proposes a new Human Development Index (HDI) classification method using the combination of the ELECTRE TRI method with statistical tools to define classes and class profiles for the HDI.

We could not find any quantitative investigation of WISPI in the literature. The synergy of HDI and WISPI as a research object is unprecedented in the scientific literature. However, the task of ranking the countries according to HDI and WISPI interrelation is an interesting and relevant issue.

MCDM methods usually rank countries by set of homogeneous (having the same nature) indicators. If several criteria groups having different nature exist, for example, subjective and objective, external and internal evaluations of alternatives, other methodologies should be proposed. KEMIRA [20] is the MCDM method implemented by maximising compatibility of two or more subsets of criteria, thus it is naturally appropriate for solving our task. In this research, a modification of KEMIRA called WEBIRA [21] has been applied to the case of two groups of evaluation criteria. The advantage of WEBIRA is that its efficiency does not decrease with increasing number of alternatives as other MCDM methods [22]. It also remains stable with increasing number of criteria [21].

Prioritisation of criteria is a separate issue of the WEBIRA method that needs to be addressed before solving the optimisation task. In this sense, WEBIRA is not a fully objective method for determining criteria weights. The problem of criteria prioritisation can be solved by applying wide range of objective or subjective (expert-based) methods. Examples of expert-based methods are Analytic Hierarchy Process (AHP) [23], Kemeny median method [24], Stepwise Weight Assessment Ratio Analysis (SWARA) [25], a fuzzy inference system (FIS) approach [26], etc. However, when dealing with country rating task, we need to look for alternative methods for prioritising criteria, because we do not have information about criteria assessments by experts. Objective methods for criteria weighting are based on initial data values and their structure (entropy-based methods [27], mathematical programming models [28], IDOCRIW [29], etc.).

There are three main steps of WEBIRA: (1) criteria priority setting separately in every subset; (2) criteria weight determining by solving optimisation problem; and (3) ranking of alternatives by applying one of MCDM methods. One of the novelty elements of this article is to use correlation analysis to set criteria priority. Statistical methods are traditionally used in weighting attributes. Thus, CRICTIC (Criteria Importance Through Intercriteria Correlation), developed by Diakoulaki et al. [30], aims to determine objective weights of relative importance in MCDM problems by considering correlation coefficient values between criteria and standard deviations of each criterion for alternatives. High correlation is considered as some kind of double counting, so assigned weights are inversely proportional to the correlation coefficient value. Our methodological assumption is based on the maximisation of compatibility between two different groups of indicators. A suitable way to measure compatibility is to apply intergroup correlation coefficients. Unlike correlations within groups, where attributes with strong correlation are undesirable, high correlation of the attribute with the attributes of other groups indicates that the interdependence between the two group's indicators became higher; such indicator is more preferable in the decision-making process.

This idea arose from the ultimate goal of this research—to evaluate countries by combining several dimensions: economic prosperity, comprehensive education, healthy lifestyle, safe environment and human security. Thus, two groups of criteria—X and Y—were distinguished and the optimisation task has been solved according to weight balancing procedure. This procedure ensures that the criteria for the two groups in the final order of alternatives are maximally aligned with each other.

2. Materials and Methods

2.1. Criteria and Their Definitions

The Human Development Index is a summary measure of average achievement in key dimensions of human development: (1) a long and healthy life; (2) knowledge; and (3) a decent standard of living. The knowledge dimension consists of two subdimensions: (1) mean of years of schooling for adults aged 25 years and more and (2) expected years of schooling for children of school entering age. The HDI is the geometric mean of normalised indices for each of the three dimensions [11]. In the present work, four components of HDI are used: the ability to lead a long and healthy life, measured by life expectancy at birth (years) (y_1); the ability to acquire knowledge, measured by the mean number of years of schooling (y_2); the expected years of schooling (y_3); and the ability to achieve a decent standard of living, measured by the gross national income (GNI) per capita (PPP $) ($y_4$) [11]. HDI makes an assessment of diverse countries with very different price levels. To compare economic statistics across countries, the data must first be converted into a common currency. For this reason GNI per capita is measured in purchasing power parity (PPP) international dollars (PPP $). One PPP dollar (or international dollar) has the same purchasing power in the domestic economy of any country as US$1 has in the US economy.

World Internal Security and Police Index (WISPI) measures the capacity and efficiency of police and security service providers to address the internal security issues worldwide through the four domains, i.e., capacity, process, legitimacy and outcomes (Table 1) [2]. Domain content can be explained by answering these questions:

Capacity: Do security providers have the resources needed to address security violation?
Process: Are the resources directed towards violence prevention used effectively?
Legitimacy: Are security providers trusted by the people? Do they abuse their position?
Outcomes: Do people feel safe in their neighbourhoods? Are crime rates low?

Each WISPI domain acquires values from 0 to 1. The higher the numerical value of the country's respective domain, the higher the position of that country in the corresponding rating. WISPI measures the ability of police and internal security service to protect society as well as provides broader measure of human security.

Table 1. World Internal Security and Police Index, Domains and Indicators [2].

Domain	Indicator	Definition
Capacity	Police	Number of Police and Internal Security Officers per 100,000 people
	Armed Forces	Number of Armed Service Personnel per 100,000 people
	Private Security	Number of Private Security Contractors per 100,000 people
	Prison Capacity	Ratio of Prisoners to Official Prison Capacity
Process	Corruption	Control of Corruption
	Effectiveness	Criminal Justice effectiveness, impartial, respects rights
	Bribe Payments to Police	% of Respondents who paid a bribe to a police officer in the past year
	Underreporting	Ratio of police reported thefts to survey reported thefts
Legitimacy	Due Process	Due process of law and rights of the accused
	Confidence in Police	% of Respondents who have confidence in their local police
	Public Use, Private Gain	Government officials in the police and the military do not use public office for private gain
	Political Terror	Use of Force by Government Against Its Own Citizens
Outcomes	Homicide	Number of Intentional Homicides per 100,000 people
	Violent Crime	% Assaulted or mugged in the last year
	Terrorism	Composite measure of deaths, injuries and incidents of terrorism
	Public Safety Perceptions	Perceptions of safety walking alone at night

The initial data matrix, maximum and minimum values of indicators are presented in Table 2.

Table 2. The initial values of World Internal Security and Police Index (WISPI) indices [2] and Human Development Index (HDI) factors [11].

Country	Mean Years of Schooling (years)	Expected Years of Schooling (years)	Life Expectancy at Birth (years)	GNI per Capita (PPP $)	Outcomes	Capacity	Legitimacy	Process
Albania	10.00	14.80	78.50	11.89	0.72	0.647	0.562	0.297
Armenia	11.70	13.00	74.80	9.14	0.893	0.921	0.516	0.479
Austria	12.10	16.10	81.80	45.42	0.894	0.77	0.899	0.817
Azerbaijan	10.70	12.70	72.10	15.60	0.871	0.723	0.487	0.295
Belarus	12.30	15.50	73.10	16.32	0.686	0.975	0.486	0.472
Belgium	11.80	19.80	81.30	42.16	0.807	0.71	0.847	0.79
Bosnia and Herzegovina	9.70	14.20	77.10	11.72	0.824	0.916	0.642	0.465
Bulgaria	11.80	14.80	74.90	18.74	0.753	0.985	0.556	0.494
Cyprus	12.10	14.60	80.70	31.57	0.77	0.736	0.794	0.634
Croatia	11.30	15.00	77.80	22.16	0.854	0.939	0.695	0.605
Czech Republic	12.70	16.90	78.90	30.59	0.827	0.875	0.772	0.638
Denmark	12.60	19.10	80.90	47.92	0.885	0.648	0.904	0.948
Estonia	12.70	16.10	77.70	28.99	0.734	0.967	0.804	0.754
Finland	12.40	17.60	81.50	41.00	0.893	0.674	0.919	0.922
France	11.50	16.40	82.70	39.25	0.783	0.773	0.817	0.734
Georgia	12.80	15.00	73.40	9.19	0.766	0.823	0.752	0.593
Germany	14.10	17.00	81.20	46.14	0.852	0.778	0.867	0.876
Greece	10.80	17.30	81.40	24.65	0.704	0.783	0.691	0.583
Hungary	11.90	15.10	76.10	25.39	0.793	0.541	0.647	0.632
Iceland	12.40	19.30	82.90	45.81	0.906	0.635	0.893	0.81
Ireland	12.50	19.60	81.60	53.75	0.805	0.841	0.852	0.78
Italy	10.20	16.30	83.20	35.30	0.761	0.724	0.725	0.681
Latvia	12.80	15.80	74.70	25.00	0.695	0.934	0.691	0.558
Lithuania	13.00	16.10	74.80	28.31	0.68	0.903	0.733	0.605
Montenegro	11.30	14.90	77.30	16.78	0.833	0.914	0.681	0.481
Netherlands	12.20	18.00	82.00	47.90	0.866	0.707	0.858	0.898
Norway	12.60	17.90	82.30	68.01	0.801	0.658	0.916	0.908
Poland	12.30	16.40	77.80	26.15	0.858	0.848	0.738	0.676
Portugal	9.20	16.30	81.40	27.32	0.834	0.909	0.732	0.679
Romania	11.00	14.30	75.60	22.65	0.805	0.835	0.616	0.535
Russian Federation	12.00	15.50	71.20	24.23	0.449	0.984	0.33	0.415

Table 2. *Cont.*

Country	Mean Years of Schooling (years)	Expected Years of Schooling (years)	Life Expectancy at Birth (years)	GNI per Capita (PPP $)	Outcomes	Capacity	Legitimacy	Process
Serbia	11.10	14.60	75.30	13.02	0.851	0.886	0.587	0.462
Slovakia	12.50	15.00	77.00	29.47	0.825	0.945	0.773	0.564
Slovenia	12.20	17.20	81.10	30.59	0.903	0.91	0.758	0.703
Spain	9.80	17.90	83.30	34.26	0.849	0.854	0.837	0.627
Sweden	12.40	17.60	82.60	47.77	0.848	0.611	0.886	0.92
Switzerland	13.40	16.20	83.50	57.63	0.864	0.674	0.9	0.824
United Kingdom	12.90	17.40	81.70	39.12	0.771	0.654	0.84	0.828
Maximum	14.10	19.80	83.50	68.01	0.91	0.99	0.92	0.95
Minimum	9.20	12.70	71.20	9.14	0.45	0.54	0.33	0.30

2.2. General Description of WEBIRA Method

Let the initial data be the results of the performed measurements, expert evaluations, etc., presented in $m \times n$-dimension matrix $X = \left(x_{ij}\right)_{m \times n}$. The element x_{ij} of the decision-making matrix is the estimate of the alternative i $(i = 1, 2, \ldots, m)$ based on using the criteria j $(j = 1, 2, \ldots, n)$. A data normalisation procedure is required because there are different criteria measurement units. There is a variety of data normalisation formulas, in this case a min–max normalisation was used:

$$\begin{cases} \widetilde{x}_{ij} = \dfrac{x_{ij} - \min\limits_{1 \le i \le m} x_{ij}}{\max\limits_{1 \le i \le m} x_{ij} - \min\limits_{1 \le i \le m} x_{ij}}, \text{ for the direct normalisation,} \\ \widetilde{x}_{ij} = \dfrac{\max\limits_{1 \le i \le m} x_{ij} - x_{ij}}{\max\limits_{1 \le i \le m} x_{ij} - \min\limits_{1 \le i \le m} x_{ij}}, \text{ for inverse normalisation.} \end{cases}$$

The choice of min–max normalisation is based on the results of previous studies [22,31], which revealed that min–max normalisation ensures the best stability of the SAW method compared to other well-known normalisation procedures such as max, sum, vector, logarithmic, etc. Stability of the min–max method was the highest for cases of both more and less separable alternatives. All the variables after the min–max normalisation gain their values between 0 and 1.

If new countries with values not in the range analysed initially would be introduced, normalisation would be performed again and all values after normalisation would also range between 0 and 1. However, after introducing new countries (cases) and recalculation of correlation coefficients the priority of criteria, data structure and, subsequently, the overall rating of the countries, could be changed. For this reason, only European countries were involved in the investigation.

The normalised decision-making matrix has the following form, $\widetilde{X} = \left(\widetilde{x}_{ij}\right)_{m \times n}, 0 \le \widetilde{x}_{ij} \le 1$. Let $w_j,\ j = 1, 2, \ldots, n$ be criteria weights, satisfying the conditions as follows

$$\sum_{j=1}^{n} w_j = 1,\ 0 \le w_j \le 1. \tag{1}$$

The Simple Additive Weighting (SAW) method [32] is a well-known and widely used MCDM tool. SAW with the weights $w_j,\ j = 1, 2, \ldots, n$ can be applied to solve MCDM problem. The aggregated value based on using the SAW criteria was calculated for each alternative as follows

$$S_i = \sum_{j=1}^{n} w_j \widetilde{x}_{ij},\ i = 1, 2, \ldots, m. \tag{2}$$

The values $0 \le \widetilde{x}_{ij} \le 1$ in Equation (2) were normalised so that the higher $\widetilde{x}_{ij}$ value would correspond to the better evaluation of the i-th alternative S_i.

The weighted coefficients (1) are usually determined by using various methods that could be based on expert judgement (subjective methods) or the objective weight assessing methods [33]. WEBIRA is objective weight assessing method which is appropriate for solving our problem for two reasons. The first is the absence of highly qualified expert judgements. This prevents the use of subjective methods such as Analytic Hierarchy Process (AHP), Delphi, Stepwise Weight Assessment Ratio Analysis (SWARA), etc. The second reason is the structure of the data. The set of criteria (indicators) naturally and logically could be divided to two groups of criteria. The idea of WEBIRA method is weights determining procedure when the rankings of alternatives in the few groups of criteria maximally match each other. This goal is achieved by performing a so-called weight balancing procedure aimed at minimising a certain objective function.

Suppose that n criteria are being divided to r groups. The coefficient calculation scheme is introduced when there are r normalised data matrices X^k:

$$X^k = \|x_{ij}^k\|_{m\times n^k}, 0 \leq x_{ij}^k \leq 1,\ k = 1,2,\ldots,r,\ \sum_{k=1}^{r} n^k = n. \tag{3}$$

The aggregated values for each matrix $k = 1,2,\ldots,r$ obtained by using SAW criteria were as follows

$$S_i^k = \sum_{j=1}^{n^k} w_j^k \tilde{x}_{ij}^k,\ i = 1,2,\ldots,m,\ k = 1,2,\ldots,r. \tag{4}$$

The coefficients w_j^k in Formula (4) satisfy the inequalities

$$1 \geq w_1^k \geq w_2^k \geq \ldots \geq w_{n^k}^k \geq 0,\ k = 1,2,\ldots,r. \tag{5}$$

The optimisation problem is formulated where the minimum value of the function has to be found:

$$F\left(W^1, W^2, \ldots, W^r\right) = \sum_{k=1}^{r-1}\sum_{l=k+1}^{r}\sum_{i=1}^{m}\left|S_i^k - S_i^l\right|^\delta$$

by checking the value of the function above with each vector $W^k = \left(w_1^k, w_2^k, \ldots, w_{n^k}^k\right)$, $k = 1,2,\ldots,r$ satisfying the inequalities (5) and the relationships (1). The parameter's δ value is $\delta = 2$ throughout the paper. The inequalities (5) can be determined by using various methods of processing the expert assessments; in Krylovas et al. [24], it has been proposed to apply Kemeny median [34] for this purpose. This method for prioritising criteria and determining weights which satisfy Formulas (1) and (5) is named the KEmeny Median Indicator Ranks Accordance (KEMIRA) method. The order of preference of the weighted coefficients can be determined by using other methods. In this paper correlation analysis is applied to the solution of this problem. Therefore, a group of the methods given in Krylovas et al. [21] is referred to as WEBIRA (WEight Balancing Indicator Ranks Accordance).

Suppose that $A = \{1,2,\ldots,m\}$ is a set of the available alternatives, while the subsets of the set A are denoted as follows

$$A_\alpha^+ = \left\{i \in A : S_i^1 > \alpha, S_i^2 > \alpha, \ldots, S_i^r > \alpha\right\},$$
$$A_\alpha^- = \left\{i \in A : S_i^1 \leq \alpha, S_i^2 \leq \alpha, \ldots, S_i^r \leq \alpha\right\},$$
$$A_\alpha^\pm = A \backslash (A_\alpha^+ \cup A_\alpha^-),$$

A_α^+ denotes the sets of the undoubtedly superior alternatives, A_α^- are the sets of undoubtedly inferior alternatives and $A_\alpha^\pm$ denotes the sets of alternatives whose assessment is doubtful. Note that when $0 \leq S_i^k \leq 1$, $A_0^+ = A_1^- = A$, $A_1^+ = A_0^- = \varnothing$. The functions $F^+(\alpha), F^-(\alpha),\ F^\pm(\alpha)$ are determined as the number of elements of the respective sets $A_\alpha^+, A_\alpha^-, A_\alpha^\pm$. It is obvious that $F^+(\alpha) + F^-(\alpha) + F^\pm(\alpha) = m$. $F^+(\alpha), F^-(\alpha),\ F^\pm(\alpha)$ are stepwise functions, having the first type points of discontinuity. The values of the functions can help assess the quality of weight balancing. In the ideal case, $F^\pm(\alpha) \equiv 0$. In this research, the authors deal with $A_0^+ = A_1^- = A$.

3. Results

A problem of determining the ranks of the European countries based on two groups of criteria $(r = 2)$, including internal security and human development, was solved. In the first step, correlation analysis was applied to the data in Table 2 for establishing the priority of the criteria, such as internal security, $X = (x_1, x_2, x_3, x_4)$ and human development, $Y = (y_1, y_2, y_3, y_4)$, in each group. The larger the absolute value of the correlation coefficient of the respective criterion with the criteria of the other group, the higher its priority order. The values of the Pearson correlation coefficients are presented in Table 3.

Process criteria has the highest priority value in the Int_Sec_Group, due to higher correlation with Y group criteria (0.868), followed by Legitimacy (0.823), Capacity (−0.537) and, finally, Outcomes criterion (0.467). In the human development group, GNI per Capita (0.868) has the highest priority value, Life Expectancy at birth (0.823) is second, the Expected Years of Schooling (0.772) is third and the Mean Years of Schooling (0.506) is last. Therefore, the priority order of the considered criteria is as follows

$$x_4 \succ x_1 \succ x_3 \succ x_2,\ y_4 \succ y_1 \succ y_3 \succ y_2$$

and the respective weight priority (5) is

$$1 \geq w_4^X \geq w_1^X \geq w_3^X \geq w_2^X \geq 0,\ 1 \geq w_4^Y \geq w_1^Y \geq w_3^Y \geq w_2^Y \geq 0. \quad (6)$$

Table 3. Values of Pearson correlation coefficients of the criteria (first row) and *p*-values (second row).

Factors (Criteria)	Life Expectancy at Birth y_1	Mean Years of Schooling y_2	Expected Years of Schooling y_3	GNI per Capita y_4	Legitimacy x_1	Outcomes x_2	Capacity x_3
GNI per capita y_4	0.757 ** 0.000	0.451 ** 0.005	0.762 ** 0.000	1			
Legitimacy x_1	0.823 ** 0.000	0.390 * 0.016	0.711 ** 0.000	0.794 ** 0.000	1		
Outcomes x_2	0.467 ** 0.003	−0.003 0.987	0.159 0.339	0.268 0.103	0.539 ** 0.000	1	
Capacity x_3	−0.537 ** 0.001	−0.116 0.487	−0.384 * 0.017	−0.531 ** 0.001	−0.492 ** 0.002	−0.319 0.051	1
Process x_4	0.754 ** 0.000	0.506 ** 0.001	0.772 ** 0.000	0.868 ** 0.000	0.890 ** 0.000	0.404 * 0.012	−0.498 ** 0.001

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

The second step in solving the MCDM problem is normalising the decision-making matrix elements x_{ij} and y_{ij}. Min–max normalisation equations were used in both cases. This method demonstrated the highest accuracy and was most stable compared to other normalisation techniques, when applied with SAW [30]. In the case of direct normalisation, the equations were as follows

$$\widetilde{x}_{ij} = \frac{x_{ij} - \min\limits_{1\leq i\leq m} x_{ij}}{\max\limits_{1\leq i\leq m} x_{ij} - \min\limits_{1\leq i\leq m} x_{ij}},\ \widetilde{y}_{ij} = \frac{y_{ij} - \min\limits_{1\leq i\leq m} y_{ij}}{\max\limits_{1\leq i\leq m} y_{ij} - \min\limits_{1\leq i\leq m} y_{ij}},$$

while the inverse normalisation equation was applied only to the Capacity criterion, having an opposite direction with respect to the goal:

$$\widetilde{x}_{ij} = \frac{\max\limits_{1\leq i\leq m} x_{ij} - x_{ij}}{\max\limits_{1\leq i\leq m} x_{ij} - \min\limits_{1\leq i\leq m} x_{ij}}.$$

In Table 4 the normalised values of the criteria $\widetilde{x}_{ij}, \widetilde{y}_{ij}$ are given.

Then, the procedure of weight balancing was carried out. A possible set of weights, satisfying the conditions (1) and (6), is presented in Table 5. The elements of this set were reselected and the weighted sums $S_i^X = \sum_{j=1}^4 w_j^x \widetilde{x}_{ij}, S_i^Y = \sum_{j=1}^4 w_j^y \widetilde{y}_{ij}$ were calculated for each alternative. The minimum value of the target function was obtained for the optimal weight values $W^{X*} = \left(w_1^{x*}, w_2^{x*}, w_3^{x*}, w_4^{x*}\right)$ and $W^{Y*} = \left(w_1^{y*}, w_2^{y*}, w_3^{y*}, w_4^{y*}\right)$:

$$F\left(W^{X*}, W^{Y*}\right) = \min_{W^X, W^Y} \sum_{i=1}^m \left(S_i^X - S_i^Y\right)^2 = \min_{W^X, W^Y} \sum_{i=1}^m \left(\sum_{j=1}^4 w_j^x \widetilde{x}_{ij} - \sum_{j=1}^4 w_j^y \widetilde{y}_{ij}\right)^2. \quad (7)$$

$F\left(W^{X*}, W^{Y*}\right)$ is the minimum value of a disagreement measure between two alternative rankings (according to the criteria values X and Y). It could be interpreted as the function of assessing the weight balancing quality.

Table 4. Normalised decision-making matrix.

Country (*Alternative*)	Outcomes	Capacity	Legitimacy	Process	Mean Years of Schooling	Expected Years of Schooling	Life Expectancy at Birth	GNI per Capita
Factors	x_2	x_3	x_1	x_4	y_2	y_3	y_1	y_4
Albania	0.5929	0.7612	0.3938	0.0030	0.1632	0.2957	0.5934	0.0465
Armenia	0.9715	0.1441	0.3157	0.2817	0.5102	0.0422	0.2926	0
Austria	0.9737	0.4842	0.9660	0.7993	0.5918	0.4788	0.8617	0.6161
Azerbaijan	0.9234	0.5900	0.2665	0	0.3061	0	0.0731	0.1096
Belarus	0.5185	0.0225	0.2648	0.2710	0.6326	0.3943	0.1544	0.1219
Belgium	0.7833	0.6193	0.8777	0.7580	0.5306	1	0.8211	0.5607
Bosnia and Herzegovina	0.8205	0.1554	0.5297	0.2603	0.1020	0.2112	0.4796	0.0436
Bulgaria	0.6652	0	0.3837	0.3047	0.5306	0.2957	0.3008	0.1630
Cyprus	0.7024	0.5608	0.7877	0.5191	0.5918	0.2676	0.7723	0.3809
Croatia	0.8862	0.1036	0.6196	0.4747	0.4285	0.3239	0.5365	0.2211
Czech Republic	0.8271	0.2477	0.7504	0.5252	0.7142	0.5915	0.6260	0.3642
Denmark	0.9540	0.7590	0.9745	1	0.6938	0.9014	0.7886	0.6586
Estonia	0.6236	0.0405	0.8047	0.7029	0.7142	0.4788	0.5284	0.3371
Finland	0.9715	0.7004	1	0.9601	0.6530	0.6901	0.8373	0.5411
France	0.7308	0.4774	0.8268	0.6722	0.4693	0.5211	0.9349	0.5114
Georgia	0.6936	0.3648	0.7164	0.4563	0.7346	0.3239	0.1788	0.0007
Germany	0.8818	0.4662	0.9117	0.8897	1	0.6056	0.8130	0.6283
Greece	0.5579	0.4549	0.6129	0.4410	0.3265	0.6478	0.8292	0.2633
Hungary	0.7527	1	0.5382	0.5160	0.5510	0.3380	0.3983	0.2760
Iceland	1	0.7882	0.9558	0.7886	0.6530	0.9295	0.9512	0.6228
Ireland	0.7789	0.3243	0.8862	0.7427	0.6734	0.9718	0.8455	0.7577
Italy	0.6827	0.5878	0.6706	0.5911	0.2040	0.5070	0.9756	0.4442
Latvia	0.5382	0.1148	0.6129	0.4027	0.7346	0.4366	0.2845	0.2693
Lithuania	0.5054	0.1846	0.6842	0.4747	0.7755	0.4788	0.2926	0.3256
Montenegro	0.8402	0.1599	0.5959	0.2848	0.4285	0.3098	0.4959	0.1296
Netherlands	0.9124	0.6261	0.8964	0.9234	0.6122	0.7464	0.8780	0.6583
Norway	0.7702	0.7364	0.9949	0.9387	0.6938	0.7323	0.9024	1
Poland	0.8949	0.3085	0.6926	0.5834	0.6326	0.5211	0.5365	0.2888
Portugal	0.8424	0.1711	0.6825	0.5880	0	0.5070	0.8292	0.3086
Romania	0.7789	0.3378	0.4855	0.3675	0.3673	0.2253	0.3577	0.2293
Russian Federation	0	0.0022	0	0.1837	0.5714	0.3943	0	0.2563
Serbia	0.8796	0.2229	0.4363	0.2557	0.3877	0.2676	0.3333	0.0658
Slovakia	0.8227	0.0900	0.7521	0.4119	0.6734	0.3239	0.4715	0.3452
Slovenia	0.9934	0.1689	0.7266	0.6248	0.6122	0.6338	0.8048	0.3643
Spain	0.8752	0.2950	0.8607	0.5084	0.1224	0.7323	0.9837	0.4266
Sweden	0.8730	0.8423	0.9439	0.9571	0.6530	0.6901	0.9268	0.6560
Switzerland	0.9080	0.7004	0.9677	0.8101	0.8571	0.4929	1	0.8235
United Kingdom	0.7045	0.7454	0.8658	0.8162	0.7551	0.6619	0.8536	0.5091

Table 5. The set of possible weight values $1 \geq w_4^{x,y} \geq w_1^{x,y} \geq w_3^{x,y} \geq w_2^{x,y} \geq 0$ for the criteria X and Y.

No	$w_2^{x,y}$	$w_3^{x,y}$	$w_1^{x,y}$	$w_4^{x,y}$	No	$w_2^{x,y}$	$w_3^{x,y}$	$w_1^{x,y}$	$w_4^{x,y}$
1	0	0	0	1	**13**	0	0.1	0.4	0.5
2	0	0	0.1	0.9	**14**	0	0.2	0.3	0.5
3	0	0	0.2	0.8	**15**	0.1	0.1	0.3	0.5
4	0	0.1	0.1	0.8	**16**	0.1	0.2	0.2	0.5
5	0	0	0.3	0.7	**17**	0	0.2	0.4	0.4
6	0	0.1	0.2	0.7	**18**	0.1	0.1	0.4	0.4
7	0.1	0.1	0.1	0.7	**19**	0	0.3	0.3	0.4
8	0	0	0.4	0.6	**20**	0.1	0.2	0.3	0.4
9	0	0.1	0.3	0.6	**21**	0.2	0.2	0.2	0.4
10	0	0.2	0.2	0.6	**22**	0.1	0.3	0.3	0.3
11	0.1	0.1	0.2	0.6	**23**	0.2	0.2	0.3	0.3
12	0	0	0.5	0.5					

The number of possible weight combinations and, accordingly, the values of the target function (7) is $23 \times 23 = 529$. The function $F(W^X, W^Y)$ gained its minimum value 0.397 for the respective weight values:

$$w_4^{x*} = 0.6,\ w_1^{x*} = 0.2, w_3^{x*} = 0.2, w_2^{x*} = 0;\ w_4^{y*} = 0.3,\ w_1^{y*} = 0.3, w_3^{y*} = 0.2, w_2^{y*} = 0.2. \quad (8)$$

Next, the step length 0.05 (twice as small as in Table 5) was chosen and the optimisation procedure was repeated. However, the authors failed to get a better result. The minimum value of the target function (7) remained the same with the same weights (8).

At the last step of WEBIRA, the weighted sum values of the criteria X and Y were calculated for each alternative as follows

$$Q_i\left(W^{X*}, W^{Y*}\right) = S_i^{X*} + S_i^{Y*},\ i = 1, 2, \ldots, m$$

and the ranking of the alternatives based on these values was performed. The final results are presented in Table 6.

When assessing the criteria of ranking the countries, it is important to take into consideration the mutual distribution of HDI and WISPI components (the difference between the ranks of HDI and WISPI of the countries) (Figure 1). The difference between the ranks of HDI and WISPI reflects the development priorities of the countries (Table 6). Appraisal of changes in the difference between these indicators allows forecasting the trend of the country's development (e.g., development of economic potential and increasing the welfare of the population, development associated with strengthening the policy and recognising the security priorities, or harmonious development). The minimal difference between HDI and WISPI shows a balanced internal policy pursued by the countries, implying that the countries allocate their resources to the internal security and public welfare in a balanced way.

Table 6. European countries ranking results based on the alternative methods of WEBIRA, HDI, WISPI and cluster analysis results.

Country (*Alternative*)	Q_i=S_i^{X*}+S_i^{Y*} WEBIRA	S_i^{Y*}(HDI)	S_i^{X*}(WISPI)	WEBIRA Rank (HDI + WISPI)	HDI Rank	WISPI Rank	HDI Minus WISPI	k-Means
Norway	1.7655	0.8560	0.9095	1	1	4	−3	4
Denmark	1.6999	0.7532	0.9467	2	6	1	5	4
Sweden	1.675	0.7435	0.9315	3	7	2	5	4
Switzerland	1.6368	0.8171	0.8197	4	2	7	−5	4
Iceland	1.6107	0.7887	0.8220	5	4	6	−2	4
Finland	1.5984	0.6822	0.9162	6	11	3	8	4
Netherlands	1.5913	0.7327	0.8586	7	8	5	3	4
Germany	1.5629	0.7535	0.8094	8	5	9	−4	4
United Kingdom	1.5043	0.6923	0.8120	9	10	8	2	4
Ireland	1.4978	0.8101	0.6877	10	3	12	−9	4
Belgium	1.4749	0.7207	0.7542	11	9	11	−2	4
Austria	1.4272	0.6575	0.7697	12	12	10	2	4
France	1.2962	0.6320	0.6642	13	13	13	0	3
Italy	1.1746	0.5682	0.6064	14	16	15	1	3
Slovenia	1.154	0.6000	0.5540	15	14	18	−4	3
Spain	1.1303	0.5941	0.5362	16	15	20	−5	3
Cyprus	1.0991	0.5179	0.5812	17	19	17	2	3
Estonia	1.0891	0.4983	0.5908	18	20	16	4	3
Czech Republic	1.0731	0.5583	0.5148	19	17	22	−5	3
Poland	1.0287	0.4784	0.5503	20	21	19	2	3
Greece	1.0009	0.5227	0.4782	21	18	24	−6	3
Hungary	0.9974	0.3801	0.6173	22	26	14	12	1
Portugal	0.9664	0.4428	0.5236	23	23	21	2	3
Lithuania	0.895	0.4364	0.4586	24	24	25	−1	2
Slovakia	0.8601	0.4445	0.4156	25	22	27	−5	3
Croatia	0.8073	0.3778	0.4295	26	27	26	1	3
Latvia	0.7876	0.4004	0.3872	27	25	28	−3	2
Georgia	0.7557	0.2656	0.4901	28	34	23	11	1
Romania	0.6799	0.2947	0.3852	29	30	29	1	1
Montenegro	0.6575	0.3354	0.3221	30	28	30	−2	1
Bulgaria	0.564	0.3044	0.2596	31	29	34	−5	2
Serbia	0.5361	0.2508	0.2853	32	35	32	3	1
Albania	0.5167	0.2838	0.2329	33	32	35	−3	1
Bosnia and Herzegovina	0.5129	0.2197	0.2932	34	36	31	5	1
Belarus	0.5084	0.2883	0.2201	35	31	36	−5	2
Armenia	0.4594	0.1983	0.2611	36	37	33	4	1
Russian Federation	0.3808	0.2701	0.1107	37	33	38	−5	2
Azerbaijan	0.2874	0.1161	0.1713	38	38	37	1	1

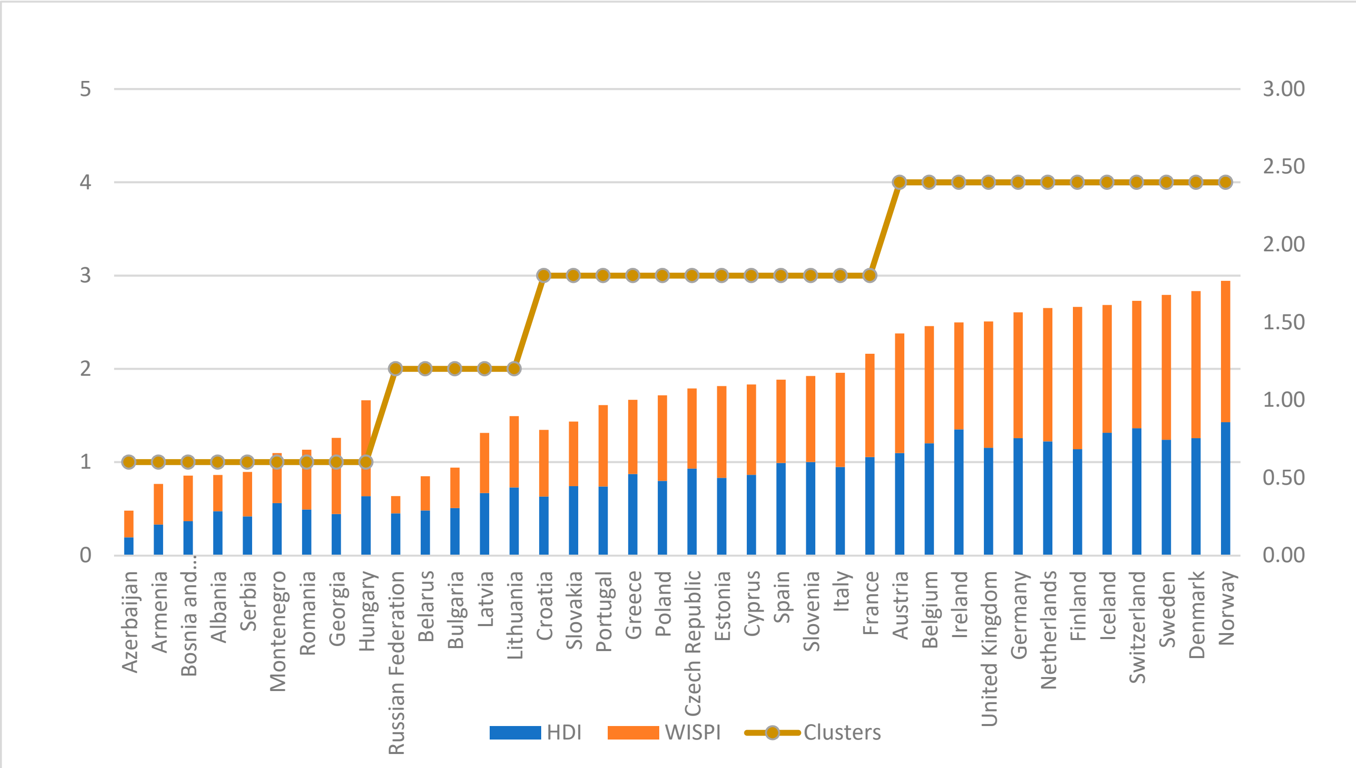

Figure 1. Countries' ranking according to WEBIRA and its components HDI and WISPI vs. cluster analysis results.

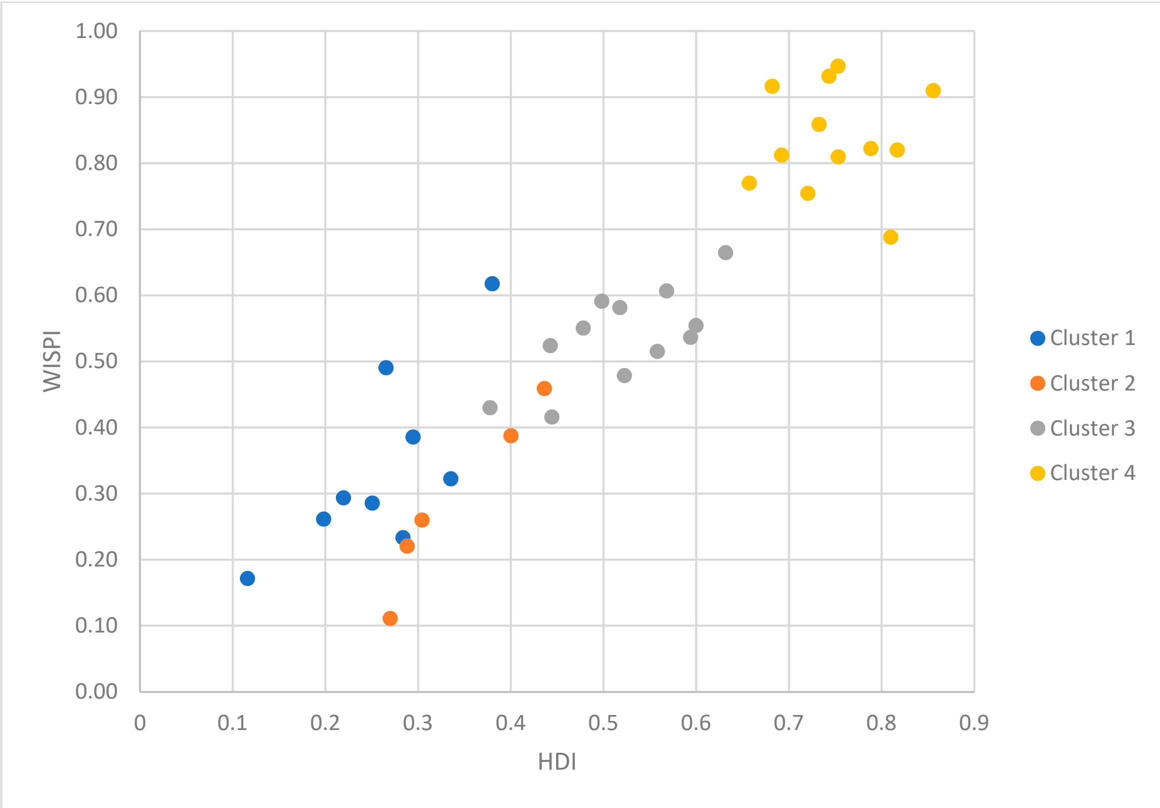

Figure 2. Cluster analysis results on HDI and WISPI axes.

In the following, the performed comparative analysis of WEBIRA method results with the results of cluster analysis is discussed. The clustering procedure was executed with standardised data. Based on the silhouette method, the European countries could be divided into four clusters. The partition into clusters was done by several hierarchical clustering methods and also techniques like k-means cluster analysis. The challenge when applying the hierarchical clustering methods is determining the proper distance measure. In our work, we have tested different distance measures, but there are alternative methods like A-BIRCH [35]. All of the used methods gave very similar results, so we chose the k-means method. Therefore, neither clustering approach can ultimately judge the actual quality of clustering; this needs human evaluation [36], which is highly subjective [37]. Because of these shortcomings, cluster analysis can only be used as rough initial test before applying more accurate methods. Table 6 shows the ranking of the European countries by using methods WEBIRA, HDI, WISPI and cluster analysis results. Table 6 and Figure 1 show that the WEBIRA ranking of countries is basically consistent with the results of cluster analysis. Spearman correlation coefficient of WEBIRA ranks and k-means cluster analysis results show very high correlation between them $\rho_S = 0.912$. All countries with the highest HDI and WISPI indicators have entered cluster 4. Cluster 3 consists of slightly lower HDI and WISPI countries with one exception—Hungary—which is the member of cluster 1. The countries with lowest HDI and WISPI are assigned to cluster 1. The most diverse is cluster 2, which consists of countries which at first glance do not have much in common, i.e., Lithuania, Latvia, Belarus, Bulgaria and Russian Federation. Figure 2 represents cluster analysis results on HDI and WISPI axes. It also shows that WISPI indicators in all cluster 2 countries except Lithuania are lower than in other countries adjacent to these in WEBIRA ranking.

4. Discussion

It is important to note that motivation to use correlations for the criteria prioritisation is based on the reasoning that the criteria of the two groups x_i and y_j describe the same phenomenon—the well-being of the population in the broad sense. Criteria prioritisation procedure consider correlations of x_i with y_j (not correlations in internal groups for x_i and y_j). Ideally, values of x_i must not be correlated with each other as well as values of y_j. However, the correlation between the criteria of different groups may be. If this assumption were completely wrong, WEBIRA would probably fail to balance the weight of the criteria and the final rating would be not logical. However, the final rating of alternatives is consistent with the results of cluster analysis. So, there is no reason to assert that priorities have been wrongly identified.

The question is: Can intergroup correlations be spurious? A spurious correlation can often be created by an antecedent which impacts both variables. In the current situation we do not have such causal relationships; our belief is that this negates the hypothesis of false correlations. Furthermore, security indicators correlation with national health indicators is ascertained in the literature [38].

The resulting weighted sum values S^X and S^Y are strongly correlated ($r = 0.861$) and the alternative for the Formula (7) may be the maximum of the correlation coefficient. There may be other alternatives to the Formula (7). Benchmarking of methods for setting priorities (6) is an interesting task looking forward to further research. To approve the use of correlations for setting the relative importance of the evaluation criteria other well-known objective methods, for example, the entropy method, would be applied. A sensitivity analysis of weights would be performed in order to demonstrate the stability of the results. This is also planned by the authors in their further research.

Security is not only a mighty driver of economic activity worldwide but also has a strong influence on public social welfare. Therefore, it is one of the most significant topics of discussion in the global society today [1]. On the other hand, the relevant problem is to assess the feasibility of identifying country threats in the economic, social and other spheres of society, based on the correlation and consistency of definitions of security and socioeconomic indicators according to their content and logical relationship [39]. Human development indicators are integrated part of economic, social and other spheres of public life and are related to the level of internal security of the countries. These are key elements in assessing the economic, social and internal security aspects of countries. Investigation shows that indicators of WISPI and HDI are closely related and their correlation is reasonable.

This should be considered in performing socioeconomic reforms in the EU. However, when the countries were categorised into more and less developed ones, based on the Human Development Index, they have different effects on their police systems [40]. Ranking the countries based on both indices has revealed the differences between the countries in this respect. It allows the authors to conclude that political strategies in the EU countries differ considerably. Political strategies in the EU member states can be focused on the most significant (weighty) indicators of HDI and WISPI, described in this study. It shows that there is no balance in the development strategies of these countries. According to our insight, this is a preliminary distribution that helps to understand the prevailing trends in the countries (HDI dominates in one group of countries, WISPI dominates in another group of countries and WISPI and HDI harmonise in a third group of countries). This allows us to distinguish countries by their distance from harmonious development according to HDI and WISPI. This question requires further and deeper research and validation.

There are various multiple criteria decision-making techniques available for the analysis of the alternatives based on a set of criteria. They often yield different ranking results of the alternatives. The question arises, which approach is most suitable? It is clear that it depends on the investigated problem and the goals to be achieved. In this research, the problem of ranking the countries by using not only Human Development, but also the criteria describing Internal Security and Police has been solved applying WEBIRA method. The MCDM method WEBIRA meets the objective pursued because it allows the researchers to carry out the weight balancing procedure by solving the optimisation problem and simultaneously determining the weights of the criteria of both groups. Then, the ranking procedure has been performed by applying the SAW method. Brute force (i.e., the total reselection) algorithm implementation was chosen for this particular task. However, the optimisation task could be solved by using other heuristic techniques.

5. Conclusions

In recent years, the events taking place in Europe have come into the focus of attention. Now, people, nations and economies, as well as the global development issues we are facing, have become more closely connected than ever. A completely new modelling algorithm has been proposed, which has not been implemented yet in ranking counties according to internal security criteria of the countries. This improves the understanding of how the methodology should be applied. Thus, the considered methodology is an advancement compared to the methods used in previous studies and provides a comprehensive approach to the analysis of the internal security of the states. When estimating the results of ranking the countries obtained by using various criteria and techniques (WEBIRA, HDI and WISPI), reliable correlations can be observed. It should be noted that the integral WEBIRA ranking method allows for objective determination of the considered states' distribution, as well as assigning weights to the criteria. Generalised criteria measuring the level of the country is being calculated by using the SAW method. Cluster analysis of the countries was carried out and compared with MCDM results. Cluster analysis approved the results of WEBIRA ranking. Thus, the clustering results of the countries correspond to their positions in the WEBIRA ranking. Moreover, their Spearman rank correlation coefficient value is very high (0.912).

This enables the objective evaluation of the security systems of the countries. It should also be mentioned that though HDI does not assess the internal security indicators of the countries, and while WISPI does not determine the level of their human development, they are similar to a great extent. The established strong correlation between HDI and WISPI rankings allows the authors to argue that the internal security of a state mainly depends on the trends of its human development and vice versa. The question arises, which factor, HDI or WISPI, prevails? The answer to this question is given by the correlations between these indicators and the integral combining index. The determination of the correlations between HDI and WISPI and WEBIRA (HDI+WISPI) rank allowed for establishing a stronger correlation between WEBIRA rank and HDI. This, in turn, allows the authors to conclude that the internal security of a state largely depends on the well-being of its citizens. Thus, to increase the internal security of a state, it is necessary not only to strengthen the police and security forces, but also to pay more attention to the well-being of its citizens.

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