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Full Length Article

Socio-economic development of countries based on the Composite Country Development Index (CCDI)

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ABSTRACT

World experience indicates the existence of significant imbalances in the development of countries. The problem of assessing the rational development of the regional and national economy is becoming urgent, since such assessments can prevent development imbalances across countries. The aim of this study is to elaborate a methodology to assess the countries' socio-economic development by integraring 12 modern indices of socio-economic development into the Composite Country Development Index (CCDI). The methodology of this research was based on a set of key indices that described socio-economic development level in four fields (social development, digital development, economic development, and environmental security) and then these indices were integrated into the CCDI. The study further applied factor analysis and R-Studio software to define the gaps of social and economic development in 59 selected countries using the trigonometric function of the angle sine. The correlation analysis confirmed the existence of a close interrelation among the studied countries. This paper noted that due to the emergence of new priorities, it is necessary to revise the assessment methodology of socio-economic development level and expand them to cover the decisive factors. This was confirmed by the results obtained, demonstrating various combinations of the development level in the four fields and their impact on the CCDI. The scientific contribution of this research is to form a methodology (e.g., the CCDI) for evaluating the socio-economic development level of countries in the world.

1. Introduction

In the context of global changes, including political, economic, social, and national upheavals, regions of the world react depressively to the consequences of the crisis, including those resulted from the coronavirus (Oldekop et al., 2020). The instability of the external environment of regional and national economies is one of the main factors that prevents achieving the strategic goals of a country's socio-economic development. Therefore, the monitoring and analysis of socio-economic development indices are crucial tasks. They contribute to implementing national and regional development strategies in the context of economic crisis, socio-political instability, social tension, and exponential dynamism (Yu et al., 2021). A set of indices of socio-economic development has been developed, which

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can form a system for monitoring socio-economic development at the global, regional, and national levels and, consequently, identifying existing imbalances in due time (Glinskiy et al., 2017).

Previous studies have proved the existence of significant disproportions in the development of countries and regions (Greenberg, 2017; De Francesco and Maggetti, 2018). These disproportions can be observed in economic, social, environmental, and other fields. Under modern conditions, the assessment of socio-economic development cannot be focused only on economic and social indices. This is due to the significant implementation of information and telecommunication technologies in social life (Parra et al., 2021). The level of economy digitalization and the development of smart technologies play an important role in socio-economic development (Wang et al., 2021). In order to achieve the sustainable development goals (SDGs) and adopt to climate change, it is important to consider the environmental component of socio-economic development. It also requires the investment and implementation of programs to minimize the ecological footprint (Udemba, 2021). He et al. (2021) evaluated the development of countries based on 4 components (social, digital, economic, and environmental components) by considering the significantly increased role of technology in providing the social interaction with the advent of the pandemic. This, in turn, is reflected in the economic and environmental components, as there has been a transformation in the priorities of money allocation (Cifuentes-Faura, 2021). In this regard, this study attempts to comprehensively analyze the socio-economic development of countries in the world for coping with various crises. Thus, it is necessary to create the optimal conditions for the functioning and development of the all countries in the word. It is particularly important to assess the stability of the balanced development of regional economy, which can prevent the emergence of disproportions and outline the ways to eliminate them. Consciously implementing organizational laws leads to higher development level of countries. As practice shows that disproportions in development are the result of non-compliance with the principle of proportionality. However, despite a broad range of studies and significant scientific and practical results on the unbalanced socio-economic development, there are still plenty of unresolved issues related to countries, which require further in-depth research.

This study is aimed at developing and testing a methodology to assess the socio-economic development level of countries in the world. The developed methodology includes current indices of social development, digital development, economic development, and environmental security fields, then these indices are integrated into a comprehensive index (which is called the Composite Country Development Index (CCDI)) for assessing the level of socio-economic development. The research objectives are as follows:

(1) Formulating criteria (directions) for the selection of socio-economic development indices of each country or region.
(2) Determining the degree of interrelations between countries using the correlation matrix.
(3) Investigating the socio-economic development level of the studied countries.
(4) Evaluating the socio-economic development of countries based on the proposed CCDI.
(5) Conducting a comparative analysis of the estimates obtained from countries and comparing them with the results of individual indices.

2. Literature review

It is becoming more and more important to determine new indices for describing socio-economic development level of a country. Nonetheless, the consequences of the pandemic are the main concern for the shift in the priorities of assessing the socio-economic development level of countries. Lenzen et al. (2020) focused on the direct and indirect side effects associated with social and economic losses due to the impending environmental imbalances. Stojkoski et al. (2022) examined the main determinants of the coronavirus effects; they determined the influence degree of each determinant and identified the most powerful ones. Science has proved the importance of social economy as a decisive factor, which can be used to evaluate negative consequences in the future. However, the theoretical works on the issue mainly focus on the causal reasoning, and few adaptative measures are formulated for alleviating or avoiding these negative impacts. Prawoto et al. (2020) found that the pandemic has caused a severe decrease in activities geared to socio-economic development, which has subsequently led to a drop in the population income. The conducted correlation and regression analyses revealed the connection between the pandemic and the resulting socio-economic development indices. This further proved the need to improve monetary policy to reduce costs and increase the level of production activity. Similarly, Gopalan and Misra (2020) investigated the outcomes of the pandemic outbreak for individual economy sectors and revealed the significant interdependence between them.

The modern scientific literature considers the socio-economic development level of countries from different perspectives. The first perspective relates to social development. It implies the formation and creation of an appropriate ideological system of the economy based on purposeful national influence. In this case, the socialization of economy takes place in the ideological system of national operation (Matthews, 2019). It is characterized by limited rationality, whereas values consistent with long-term goals are reflected in political documents at the level of socio-economic development. This forms a system of needs and interests of all its participants, since their satisfaction leads to a constant change in general regional economic indices (including the economic, social, and environmental indices) (Vasconcelos, 2021).

The second perspective is digital development. It assumes that changes in the structure of economic systems are embodied in the creation and improvement of institutions that stimulate the formation of technology-related values (Adeleye and Eboagu, 2019). These institutions cover a behavior system of economic entities that are responsible for technological development, an information technology (IT) business system, a system for promoting the accumulation of human resources in this area, and a system for managing service production. If such an institution exists neither in an unregulated market nor in the form of an initial institution, a welfare country with limited redistribution will emerge in socio-economic markets based on clearly stated integration concepts. In terms of the institutional structure for implementing the sustainable growth model, there are several institutions that ensure the redistribution of resources to

create the maximum profit and achieve economic benefits. Consequently, the reallocation of resources to create the maximum value and achieve economic results is provided by several institutions. Among them, the innovative and technological institutions play a crucial role (Balogun et al., 2020).

The third perspective is economic development. It entails the redistribution of the total income of the world economy to form and meet the social and spiritual requirements of the local community. The requirements are necessary conditions for a post-productive economy and are the results of industrial development (Reyes and Useche, 2019).

The fourth perspective is environmental security. Its central aim is to regulate the relationship between domestic and foreign countries with respective limited natural resources (Beylot et al., 2019). Environmental security is distinguished as a separate field because it requires special attention to the management conditions and enables production and other economic activities to have an impact on the environment (Wang et al., 2019). Although the identified perspectives are developed sufficiently to assess the socio-economic development level of countries, they have a rather narrow focus. This study intends to fill this gap by forming a comprehensive tool that integrates all the fields (social development, digital development, economic development, and environmental security) noted above, which difinces the ultimate research goal.

3. Materials and methods

3.1. Research design

The methodology of this study was grounded on the formation of the CCDI, which includes a set of socio-economic development indices of a country, covering four fields: social development, digital development, economic development, and environmental security. As an economic category, this index set reflects a multifaceted process aimed at promoting the economic efficiency, social justice, and sustainable development of a country. At the same time, this study suggested that the diversity of socio-economic development level complicates the formation of an effective management system. Due to the limited social, production, and environmental resources, this methodology requires to exert maximum effect and maintain a positive impact on the country.

Specifically, this study includes 7 interconnected stages, which are presented in Fig. 1.

Stage 1: determining a set of indices in terms of countries' socio-economic development. Currently, there are plenty of indices that characterize certain aspects of the countries' socio-economic development. Considering these indices separately or simultaneously, it is very difficult to form a clear assessment of socio-economic development level of countries, because for a country, some indices have leading position while for others, it may play less important role. To obtain a comprehensive assessment of the socio-economic development level of countries, we selected those indices based on four fields, including social development, digital development, economic development, and environmental security. The study totally involved 35 indices that can characterize different sides of the countries' socio-economic development, including Bertelsmann Transformation Index (Bertelsmann Stiftung, 2021), Carbon Dioxide Emissions (metric tons per capita) (World Bank Group, 2021a), Civil Liberties Index (Global Change Data Lab, 2021a), Corruption Perceptions Index (Transparency International, 2021), Digital Competitive Index (DCI; IMD World Competitiveness Center, 2021a),

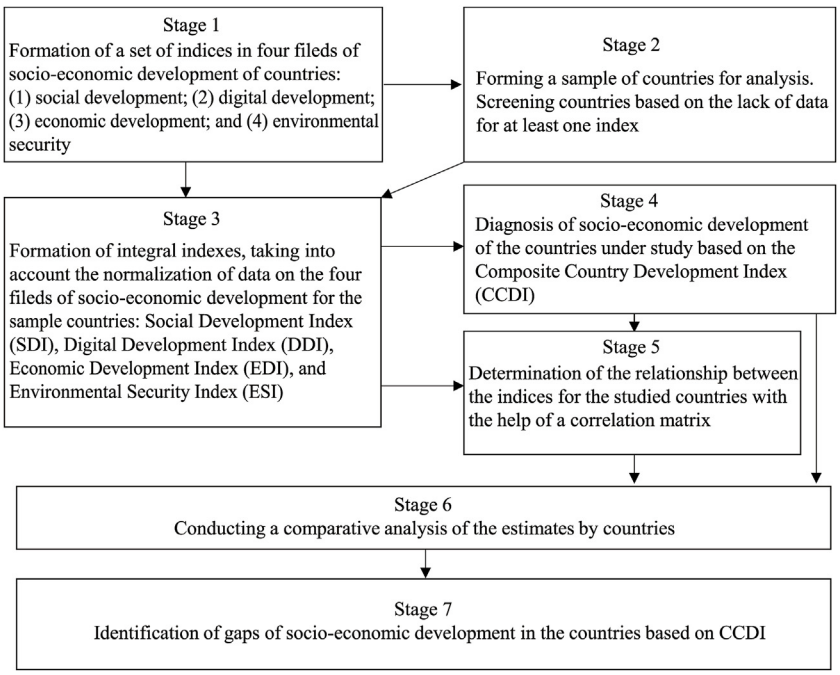

Fig. 1. Process and logic of the research.

Digital Platform Economy Index (Global Entrepreneurship and Development Institute, 2021), Doing Business Index (DBI; World Bank Group, 2021b), Energy Intensity Level of Primary Energy (MJ/$2017 PPP GDP) (World Bank Group, 2021c), Energy Trilemma Index (ETI; World Energy Council, 2021), Environmental Performance Index (EPI; Yale Center for Environmental Law & Policy, 2021), Fragile States Index (Fund for Peace, 2021), GDP Per Capita Growth (annual; %) (World Bank Group, 2021d), Gini Index (World Bank Group, 2021e), Global Competitive Index (GCI; IMD World Competitiveness Center, 2021b), Global Entrepreneurship Index (Knoema, 2021a), Global Foreign Direct Investment Country Attractiveness Index (GFICAI; Riadh, 2021), Global Gender Gap Index (World Bank Group, 2021f), Global Hunger Index (Global Hunger Index, 2021), Global Innovation Index (GII; Cornell INSEAD WIPO, 2021), Global Peace Index (Institute for Economics and Peace, 2021a), Global Terrorism Index (Institute for Economics and Peace, 2021b), Happiness Index (Sustainable Development Solutions Network, 2021), Health-Care Efficiency Index (Knoema, 2021b), High-Technology Exports (% of manufactured exports) (World Bank Group, 2021g), Human Development Index (HDI; United Nations Development Programme, 2021), Index of Economic Freedom (IEF; Index of Economic Freedom, 2021), International Property Rights Index (Property Rights Alliance, 2021), Knowledge Economy Index (Knoema, 2021c), Networked Readiness Index (NRI; Dutta and Lanvin, 2020), Political Rights Index (Global Change Data Lab, 2021b), Press Freedom Index (Reporters without Borders, 2021), Legatum Prosperity Index (LPI; Legatum Institute Foundation, 2021), Research and Development Expenditure (% of GDP) (World Bank Group, 2021h), Social Progress Index (Social Progress Imperative, 2021), and Sustainable Development Goals Index (SDGI; Sustainable Development Report, 2021). This study selected 12 key indices (LPI, HDI, IEF, GII, DCI, NRI, GCI, DBI, GFICAI SDGI, EPI, and ETI) that could be the basis for demonstrating the four fields. The screening process considered the methodology for calculating the indices to minimize the duplication of their contents and maximize the availability of data. In total, this study was based on the following indices that can characterized different fields of socio-economic development of countries:

(1) Social Development Index (SDI): LPI, HDI, and IEF;
(2) Digital Development Index (DDI): GII, DCI, and NRI;
(3) Economic Development Index (EDI): GCI, DBI, and GFICAI;
(4) Environmental Security Index (ESI): SDGI, EPI, and ETI.

Stage 2: forming a sample of countries for analysis. The availability of statistical data on all necessary indices was crucial in sample selection. Thus, according to the four fields, countries with available index data (12 indices) that are included in the proposed index system of socio-economic development were selected, while countries with unavailable index data were eliminated. Thus, a complete data set of 59 countries from the world was obtained, supplying the set of data with 12 indices.

Stage 3: the formation of integrated indices, considering the normalization of data on the four fields of socio-economic development level for the sample countries. SDI is the mean value of normalized of GII, DCI, and NRI; DDI is the mean value of normalized of SDGI, EPI, and ETI; EDI is defined as the mean of the normalized of LPI, HDI, and IEF; and ESI is the mean value of normalized of GCI, DBI, and GFICAI.

Stage 4: analysis of the socio-economic development level of the selected countries based on the CCDI. The CCDI of the i^{th} country was defined as follows:

$$\mathrm{CCDI}_i = \sqrt{\mathrm{SDI}_i^2 + \mathrm{DDI}_i^2 + \mathrm{EDI}_i^2 + \mathrm{ESI}_i^2}, \tag{1}$$

where i corresponds to the number of the studied country.

Stage 5: determination of the relationship between the indices for the studied countries with a correlation matrix. The correlation analysis identified the relationship between the studied indices and determined their highest and lowest levels. Based on the results of the analysis, we generated a correlation matrix in the R-Studio software (Posit PBC, Boston, United States).

Stage 6: comparative analysis of the assessments by country and region. This stage involved comparing the results obtained from countries and determining their common characteristics and differences. Therefore, it was possible to determine the key features of each country.

Stage 7: identification of gaps in socio-economic development level of the studied countries based on the CCDI. The original methodology was created, which involved various indices of socio-economic development of countries and allowed to identify gaps between its components. Fig. 2 shows the correlation of the four fields of the country's socio-economic development. In a state of equilibrium in their functioning, all indices were stable. In this case, stagnation occurred instead of economic development. Such a situation was impossible in practice, since the functioning of the main areas of a country was influenced by external factors (both positive and negative factors), which determined the development priorities. Moreover, the functioning of four fields showed equilibrium situation. The action of external factors can change the position of the curve, which characterized the function of the specific area in the country (Fig. 2b). The impact of external factors can change the position of the curve characterizing the functioning of a particular region in the country (Fig. 2b). Fig. 2b shows an example of the hypotenuse (b), which is formed according to the coordinates (values) of the indices in the axis directions. The right-angle sides of the forming triangle (e.g., a_1 and a_2) and the angle (λ) shown in Fig. 2b are opposite to the sine of the trigonometric function of the required sine of the angle. At the same time, the influence factors may vary in both the height direction and the width direction, and the influence may occur only in one or more regions simultaneously.

The form of the graph observed on the axes can be explained by the cyclical development of each identified area of state functioning. The reason for the occurrence of such cyclicality is external and internal factors of economic development. External factors include

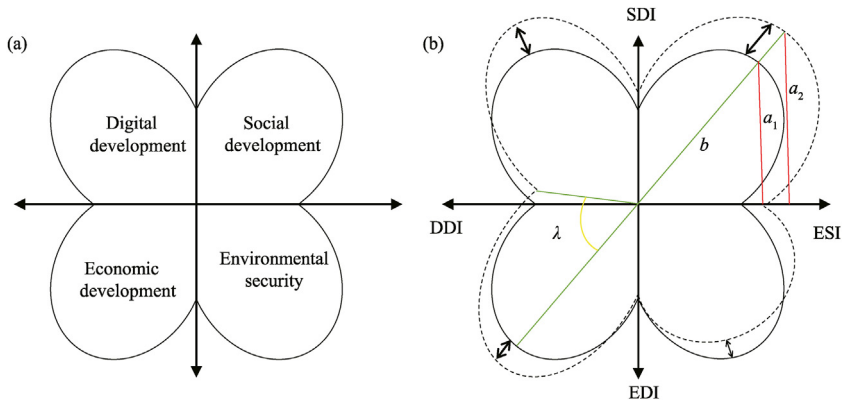

Fig. 2. Equilibrium situation in the functioning of the four fields of country's socio-economic development (a) and variants of their correlation (b) based on the proposed indices (SDI DDI, EDI, and ESI). a_1 and a_2, the right-angle sides of the forming triangle (red line); b, hypotenuse (green line); λ, the angle (yellow arc); two-way arrows indicate the direction of curve expansion and reduction; black line indicates equilibrium situation; dotted line indicates that the curve changes due to the influence of factors.

political upheavals, the discovery of large deposits of valuable natural resources, and technological revolutions that change the structure of social production and economic policy. Internal factors include equipment service lifetime, increased manufacturing costs, and the lack of supervision. The shape of this curve depends on the intensity of changes in the studied factors and the degree of their influence on the resulting index. The narrower the shape of the curve, the more cyclical the process. In other words, the more intensively these factors affect the area, the more attention should be paid by country government bodies to stabilize the situation in it.

The directions of country regulation and the choice of key development indices vary depending on the influence degree of the factors and the nature of the curve change. Thus, to determine the directions of strategic development, it is necessary to assess the degree of change in the curve according to the specific factor's impact. This impact can be described using the trigonometric sine function. The height of the curve change is described by the sine value and shows the development direction of a given area. The larger the sine value, the more intensively developed this area. In this case, the measures of country regulation should be aimed at maintaining and strengthening its development. The width of the curve change is also described by the value of the sine and shows the number of indices that should describe the development of the specific area. The influence of external factors determines the most priority fields for development in the country in a given period. Correspondingly, the selected area (the highest priority) on the axes expands and darkens more intensively in the visualization, and the rest part narrows with possible gaps. In accordance with Fig. 2, the formulas describing the influence of the external environment on the functioning of the country regulation areas with the aim of sustainable development are as follows:

$$\sin(a_{1,2,3,\dots}) = \frac{a_{1,2,3,\dots}}{b} \to \max, \tag{2}$$

$$\sin \lambda_{1,2,\dots} = a, |a| \le 1, \lambda \in \left[-\frac{\pi}{2}; \frac{\pi}{2}\right], \tag{3}$$

where a is the right-angle side of the forming triangle based on the axial indices (indices in the four studied fields); b is the hypotenuse, which is formed according to the coordinates (values) of the indices on the axis directions; and λ is the formed opposite (symmetrical) angle. The results of the proposed methodology were visualized by the R-Studio software.

3.2. Data sources

The CCDI proposed in this study integrates four aspects composed of 12 indices characterizing the countries' socio-economic development level. It enabled full-fledged evaluation and carrying out a comparative analysis of the countries. The study used data from 59 countries in 2020. Screening out countries with one or more absent indices, which facilitated forming a sample of countries and corresponding data. The data obtained were key performance indices in four fields, which were based on the availability of all indices for each country. In order to determine the CCDI, the data were normalized to a single scale. The initial data for the calculations were given in Table 1 (GCI (IMD World Competitiveness Center, 2021b); DBI (World Bank Group, 2021b); GFICAI (Riadh, 2021); LPI (Legatum Institute Foundation, 2021); HDI (United Nations Development Programme, 2021); IEF (Index of Economic Freedom, 2021); SDGI (Sustainable Development Report, 2021); EPI (Yale Center for Environmental Law and Policy, 2021); ETI (World Energy Council, 2021); GII (Cornell INSEAD WIPO, 2021); DCI (IMD World Competitiveness Center, 2021a); and NRI (Dutta and Lanvin, 2020)).

Table 1
Initial data of 12 indices for the studied 59 countries in 2020.

Country	GCI	DBI	GFICAI	LPI	HDI	IEF	SDGI	EPI	ETI	GII	DCI	NRI
Argentina	1.60	59.00	45.10	60.49	0.85	53.10	73.17	52.20	73.60	28.33	1.69	50.36
Australia	5.60	81.20	62.70	78.60	0.94	82.60	74.87	74.90	75.40	48.35	6.67	75.09
Austria	6.30	78.70	64.10	80.43	0.92	73.30	80.70	79.60	82.10	50.13	5.88	72.92
Belgium	4.00	75.00	64.60	76.13	0.93	68.90	79.96	73.30	76.70	49.13	4.00	70.67
Brazil	1.80	59.10	45.10	59.31	0.77	53.70	72.67	51.20	74.90	47.28	1.96	50.58
Bulgaria	2.10	72.00	50.70	64.40	0.82	70.20	74.77	57.00	75.20	48.62	2.22	55.03
Canada	12.50	79.60	63.50	79.82	0.93	78.20	78.19	71.00	81.50	52.26	8.33	74.92
Chile	2.60	72.60	50.60	68.39	0.85	76.80	77.42	55.30	71.70	33.86	2.44	54.06
China	5.00	77.90	63.70	61.49	0.76	59.50	73.89	37.30	67.00	53.28	6.25	58.44
Colombia	1.80	70.10	44.00	58.19	0.77	69.20	70.91	52.90	72.30	30.84	1.64	46.81
Cyprus	3.30	73.40	53.90	70.32	0.89	70.10	75.21	64.80	66.70	45.67	2.50	60.67
Czechia	3.10	76.30	58.80	73.12	0.90	74.80	80.58	71.00	78.40	48.34	2.86	66.33
Denmark	50.00	85.30	67.10	84.37	0.94	78.30	84.56	82.50	84.00	57.53	33.33	82.19
Estonia	3.60	80.60	58.20	76.89	0.89	77.70	80.06	65.30	75.30	48.28	4.76	70.32
Finland	7.69	80.20	65.70	83.05	0.94	75.70	83.77	78.90	82.10	57.02	10.00	80.16
France	3.13	76.80	67.20	76.55	0.90	66.00	81.13	80.00	81.70	53.66	4.17	73.18
Germany	5.88	79.70	69.90	81.07	0.95	73.50	80.77	77.20	80.90	56.55	5.56	77.48
Greece	2.04	68.40	50.50	67.32	0.89	59.90	74.33	69.10	70.60	36.79	2.17	55.20
Hungary	2.13	73.40	54.90	66.13	0.85	66.40	77.34	63.70	78.50	41.53	2.13	60.05
Iceland	4.76	79.00	43.30	80.21	0.95	77.10	77.52	72.30	76.40	49.23	4.35	70.55
India	2.33	71.00	43.30	53.64	0.65	56.50	61.92	27.60	56.20	35.59	2.08	41.57
Indonesia	2.50	69.60	40.60	61.10	0.72	67.20	65.30	37.80	66.80	26.49	1.79	46.71
Ireland	8.33	79.60	61.40	80.18	0.96	80.90	79.38	72.80	77.20	53.05	5.00	72.13
Israel	3.85	76.70	59.50	71.98	0.92	74.00	74.60	65.80	71.50	53.55	5.26	69.81
Italy	2.27	72.90	58.60	71.83	0.89	63.80	77.01	71.00	78.90	45.74	2.38	63.69
Japan	2.94	78.00	66.00	77.27	0.92	73.30	79.17	75.10	75.70	52.70	3.70	73.54
Jordan	1.72	69.00	38.80	56.59	0.73	66.00	68.05	53.40	56.90	27.79	1.89	47.50
Kazakhstan	2.38	79.60	45.50	60.57	0.83	69.60	71.06	44.70	70.30	28.56	2.78	51.38
Latvia	2.44	80.30	51.10	71.01	0.87	71.90	77.73	61.60	76.40	41.11	2.63	60.47
Lithuania	3.23	81.60	54.60	70.24	0.88	76.70	74.95	62.90	77.60	39.18	3.45	64.70
Luxembourg	6.67	69.60	58.60	81.02	0.92	75.80	74.31	82.30	77.60	50.84	3.57	75.27
Malaysia	3.70	81.50	53.60	67.49	0.81	74.70	71.76	47.90	72.90	42.42	3.85	61.43
Mexico	1.89	72.40	46.60	59.53	0.78	66.00	70.44	52.60	69.60	33.60	1.85	49.67
Mongolia	1.64	67.80	26.30	56.73	0.74	55.90	63.98	32.20	55.50	33.41	1.61	41.44
Netherlands	25.00	76.10	69.30	82.04	0.94	77.00	80.37	75.30	76.60	58.76	14.29	81.37
New Zealand	4.55	86.80	60.50	81.08	0.93	84.10	79.20	71.30	79.50	47.01	4.55	73.27
Norway	14.29	82.60	63.20	83.81	0.96	73.40	80.76	77.70	80.50	49.29	11.11	79.39
Peru	1.92	68.70	41.60	60.67	0.78	67.90	71.75	44.00	70.30	28.79	1.82	43.67
The Philippines	2.22	62.80	42.50	56.90	0.72	64.50	65.50	38.40	60.30	35.19	1.75	45.95
Poland	2.56	76.40	54.50	69.14	0.88	69.10	78.10	60.90	70.40	39.95	3.13	61.80
Portugal	2.70	76.50	57.00	74.07	0.86	67.00	77.65	67.00	76.80	43.51	2.70	64.40
Qatar	7.14	68.70	49.90	66.46	0.85	72.30	64.65	37.10	69.10	30.81	3.33	60.26
Romania	1.96	73.30	48.70	64.92	0.83	69.70	74.78	64.70	75.40	35.95	2.04	54.16
Russia	2.00	78.20	51.90	58.04	0.82	61.00	71.92	50.50	73.80	35.63	2.33	54.23
Saudi Arabia	4.17	71.60	48.80	59.01	0.85	62.40	65.85	44.00	67.00	30.94	2.94	57.97
Singapore	100.00	86.20	68.20	79.51	0.94	89.40	67.00	58.10	70.50	56.61	50.00	81.39
Slovakia	1.75	75.60	52.70	69.63	0.86	66.80	77.51	68.30	76.70	39.70	2.00	60.78
Slovenia	2.86	76.50	54.20	74.56	0.92	67.80	79.80	72.00	78.20	42.91	3.23	66.58
South Africa	1.69	67.00	46.30	56.43	0.71	58.80	63.41	43.10	62.10	32.67	1.67	45.26
Spain	2.78	77.90	61.70	75.84	0.90	66.90	78.11	74.30	77.90	45.60	3.03	67.31
Sweden	16.67	82.00	70.40	83.15	0.95	74.90	84.72	78.70	84.20	62.47	25.00	82.75
Switzerland	33.33	76.60	72.70	83.35	0.96	82.00	79.35	81.50	84.30	66.08	16.67	80.41
Thailand	3.45	80.10	49.50	60.41	0.78	69.40	74.54	45.40	65.20	36.68	2.56	53.45
Turkey	2.17	76.80	46.40	54.94	0.82	64.40	70.30	42.60	66.60	34.90	2.27	51.24
Ukraine	1.82	70.20	44.80	55.73	0.78	54.90	74.24	49.50	68.90	36.32	1.72	49.43
United Arab Emirates	11.11	80.90	59.10	67.11	0.89	76.20	70.30	55.60	69.70	41.79	7.14	64.42
United Kingdom	5.26	83.50	70.10	80.07	0.93	79.30	79.79	81.30	81.70	59.78	7.69	76.27
United States	10.00	84.00	75.90	77.46	0.93	76.60	76.43	69.30	79.80	60.56	100.00	78.91
Venezuela	1.59	30.20	23.90	42.09	0.71	25.20	61.68	50.30	69.90	30.84	1.59	34.57

Note: GCI, Global Competitive Index; DBI, Doing Business Index; GFICAI, Global Foreign Direct Investment Country Attractiveness Index; LPI, Legatum Prosperity Index; HDI, Human Development Index; IEF, Index of Economic Freedom; SDGI, Sustainable Development Goals Index; EPI, Environmental Performance Index; ETI, Energy Trilemma Index; GII, Global Innovation Index; DCI, Digital Competitive Index; NRI, Networked Readiness Index.

4. Results

4.1. Relationship between socio-economic development indices

In this study, we builted a correlation matrix to reasonably use the proposed index system. The system confirmed interrelations of the studied indices. The correlation between ESI and SDI was the highest. Therefore, there was a close connection between social development and environmental security for the studied countries. There was also a strong correlation between social and economic development fields according to indices of SDI, ESI, EDI, and DDI, with the correlation coefficients higher than 0.75.

The least correlated in the proposed index system was the digital development area. Nevertheless, no more than 10 countries showed such results, while the rest other indices were correlated well with each other. Due to the presence of interrelations between all the proposed indices, it was possible to form the CCDI for assessing the socio-economic development level.

4.2. Comparative analysis of socio-economic development indices

By evaluating the four fields of socio-economic development, we can identify the most developed ones and carry out a comparative analysis of countries. The results obtained are shown in Figs. 3 and 4. Since the SDI prevails for all Asia-Pacific countries, these countries were characterized by the high level of social development. Among the four indices considered, the value of DDI was the lowest. However, this did not imply a lag in the area of digital development. For example, Singapore holded a leading position in digital development among the studied Asia-Pacific countries, although its resulting index demonstrated the predominance of social and economic development. Therefore, the obtained data described only current development directions, and it was difficult to determine the overall dynamics. Besides, the CCDI demonstrated the leadership of Singapore, New Zealand, Australia, and Japan. Outsiders in terms of socio-economic development level were Mongolia, India, and the Philippines.

The assessment results of socio-economic development according to the four fields for the studied European countries are shown in Figs. 5 and 6. Countries such as the Czechia, Hungary, Romania, Slovakia, and Slovenia were revealed to prioritize environmental security. The social development was predominant for Estonia, Latvia, Lithuania, and Poland. It is asle worthy noting that Czechia, Latvia, Romania, and Slovenia showed little differences in ESI and SDI. Ukraine was characterized by a significant predominance of the digital development (e.g., DDI) over the other fields and the lowest level of economic development. These data comfirmed that the United Kingdom clearly surpassed other countries in terms of digital development. Obviously, its leadership was highly remarkable. The differences between SDI and ESI and between EDI and DDI implied that most of the studied European countries were characterized by bipolar development tendencies.

The assessment conducted using the CCDI determined the top leading European countries in terms of socio-economic development level (Fig. 6). The difference between the CCDI values of European countries and the calculated values of other countries was not significant. However, Ukraine was the only country with significantly lower value of the CCDI. Therefore, the comprehensive growth of European countries could be currently provided by focusing environmental security of socio-economic development level. Despite the actualization of digital development in the global economy, focusing on this area did not provide advantages for the European countries. According to the CCDI, Denmark, Sweden, and Switzerland were distinguished as the leaders among the studied countries, while Cyprus and Greece belonged to the group of outsiders. For the United Kingdom, a similar result was possibly the consequence of the stunted economic development resulting from Brexit.

The results of the assessment of the socio-economic development level of the Middle Eastern and African countries are given in Figs. 7 and 8. The asymmetric type of development prevailed for the countries in the Middle East and Africa, since most of them had

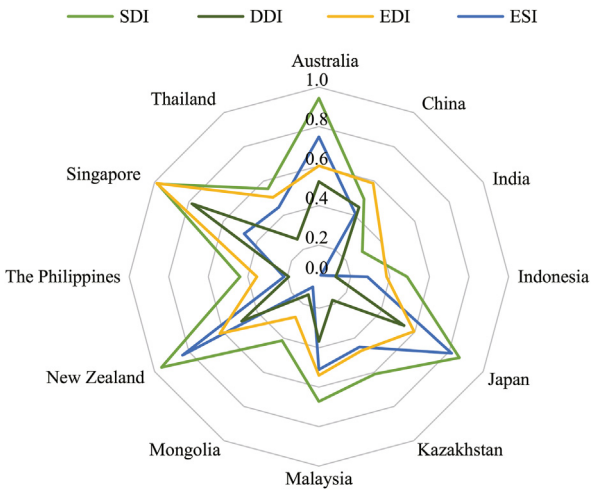

Fig. 3. Four indices (SDI, DDI, EDI, and ESI) of socio-economic development level of the studied Asia-Pacific countries.

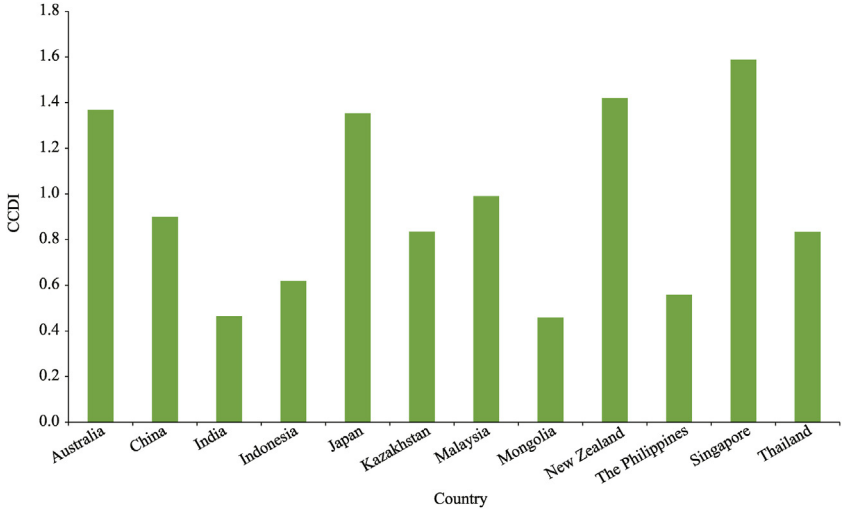

Fig. 4. CCDI of socio-economic development level of the studied Asia-Pacific countries.

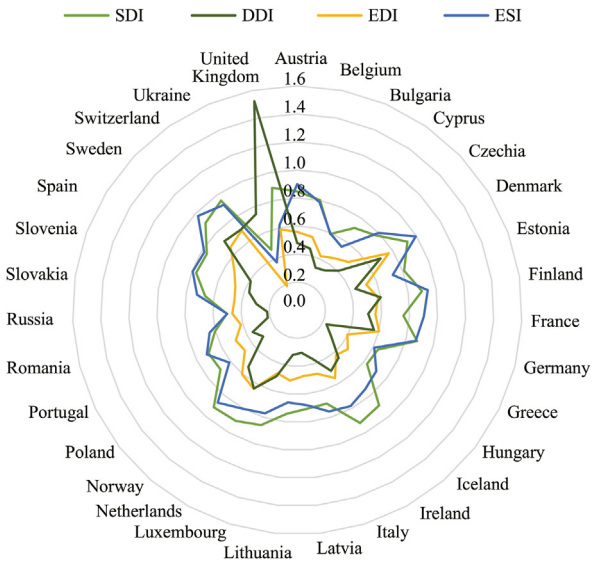

Fig. 5. Four indices (SDI, DDI, EDI, and ESI) of socio-economic development level of the studied European countries.

significant gaps among indices. At the same time, the predominance of different areas was also recorded. Thus, the United Arab Emirates and Turkey focused on digital development; Israel, Qatar, and Saudi Arabia were dominated by social development; and South Africa was characterized by bipolar gaps between SDI and EDI and between ESI and DDI. According to the CCDI, Israel was leading in the context of socio-economic development level, whereas outsiders were Turkey, South Africa, and Jordan.

The results of assessing socio-economic development level of the Americas are shown in Figs. 9 and 10. Most of the studied American countries had a dual development area marked by the predominance of social development and environmental security. The United States was a leader, having a significant advantage in digital development. Unlike other countries in the Americas, the United States can also be described as the most superior in the economic development. Besides, the results obtained from the CCDI revealed the dominating position of Canada. Venezuela was the country with the lowest level of socio-economic development in general.

The results of assessing socio-economic development level of all the studied countries were displayed in Figs. 11 and 12. It suggested that the Europe was the most developed among the countries studied. Moreover, European countries were characterized by the prioritization of social development and environmental security. Europian countries had a strongly pronounced bipolar type of development, due to the difference between the SDI and ESI as well as between EDI and DDI. According to the CCDI, the Asia-Pacific countries had no significant differences between four indices owing to comprehensive uniform development. Besides, the countries of the Middle East and Africa were defined to be outsiders in terms of socio-economic development level.

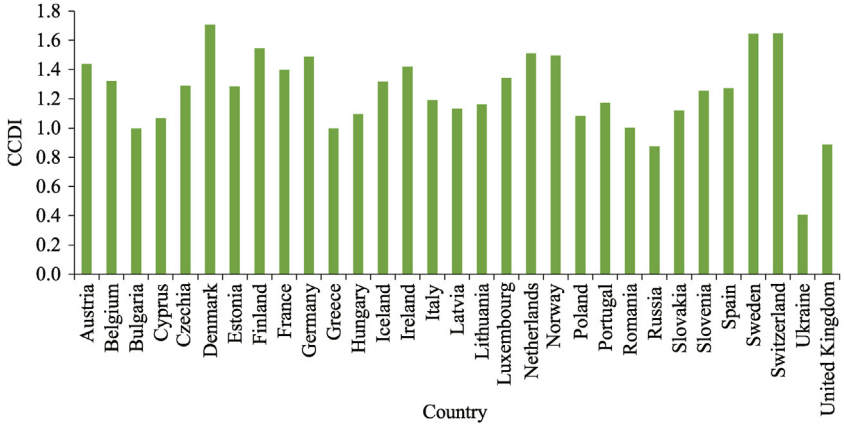

Fig. 6. CCDI of socio-economic development level of the studied European countries.

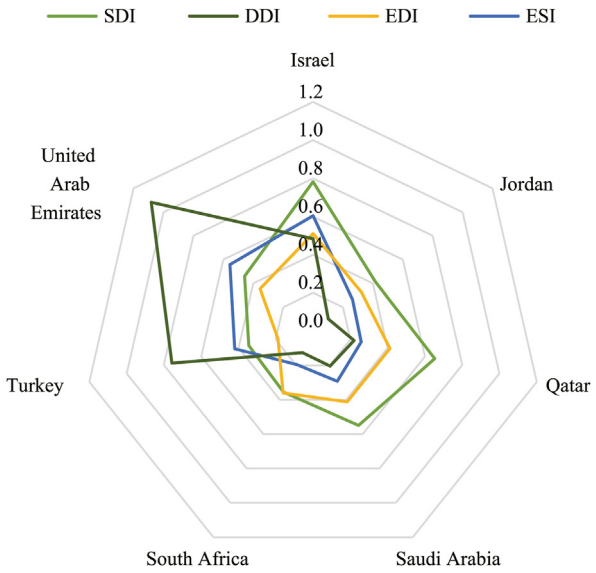

Fig. 7. Four indices (SDI, DDI, EDI, and ESI) of socio-economic development level of the studied Middle Eastern and African countries.

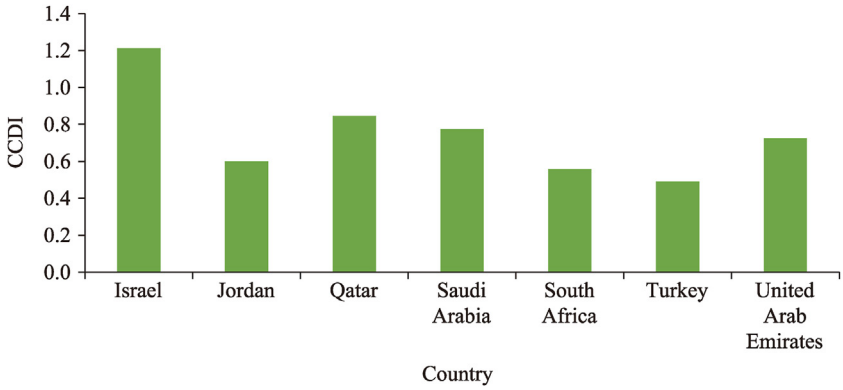

Fig. 8. CCDI of socio-economic development level of the studied Middle Eastern and African countries.

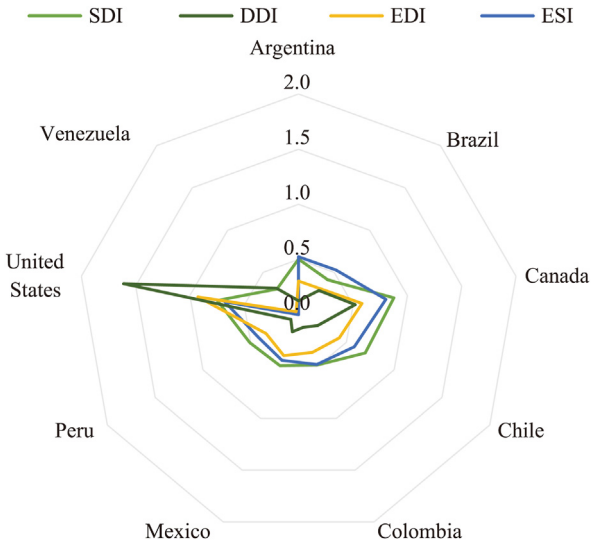

Fig. 9. Four indices (SDI, DDI, EDI, and ESI) of socio-economic development level of the studied American countries.

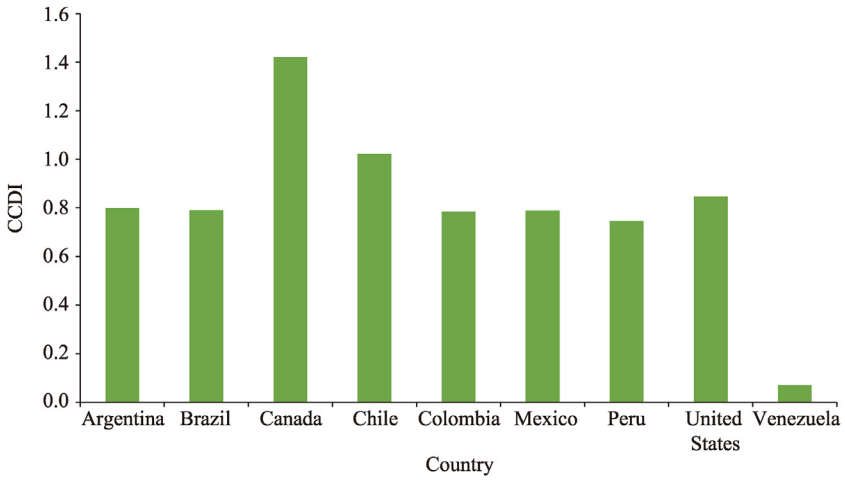

Fig. 10. CCDI of socio-economic development level of the studied American countries.

4.3. Effectiveness of countries' socio-economic development

Thus, the obtained results confirmed the desire of the studied countries for social development and environmental security considering the need for economic efficiency of processes. Fig. 13 displayed the variations of the four socio-economic development indices (SDI, DDI, EDI, and ESI).

As for Fig. 13, the narrower the shape of the curve, the more intensively the factors. Therefore, more attention should be paid by government authorities to stabilize the situation. The direction of country regulation and the choice of key development indices were depended on the influence of the nature of the curve change. This fact facilitated the identification of gaps in the socio-economic development of the studied countries. Visual modeling of the socio-economic development level using the trigonometric function (sine of the angle) also confirmed the predominance of social development and environmental security. At the same time, there were significant gaps in the filed of digital development and a small gap in the field of economic development. This was a consequence of the fact that the research samples included countries with varying economic progresses. In general, most of the studied countries had a high level of social development, indicating the global desire to meet the social demands of the population.

5. Discussion

The present work believed that social development, digital development, economic development, and environmental security are very important for assessing a country's socio-economic development level. Nevertheless, some researchers, including Draskovic et al.

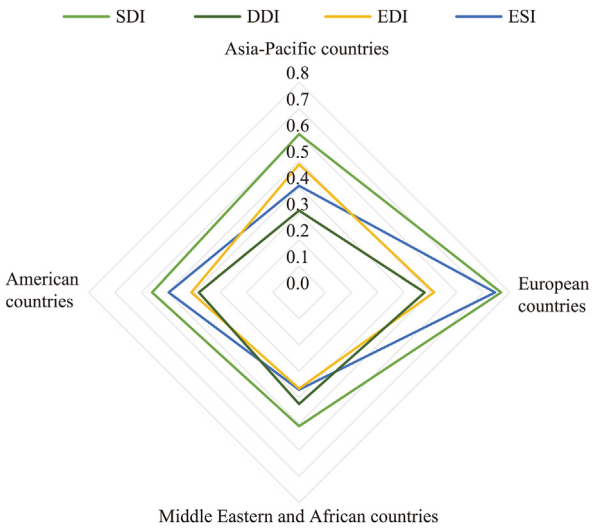

Fig. 11. Four indices (SDI, DDI, EDI, and ESI) of socio-economic development level of Asia-Pacific countries, American countries, Middle Eastern and African countries, and European countries.

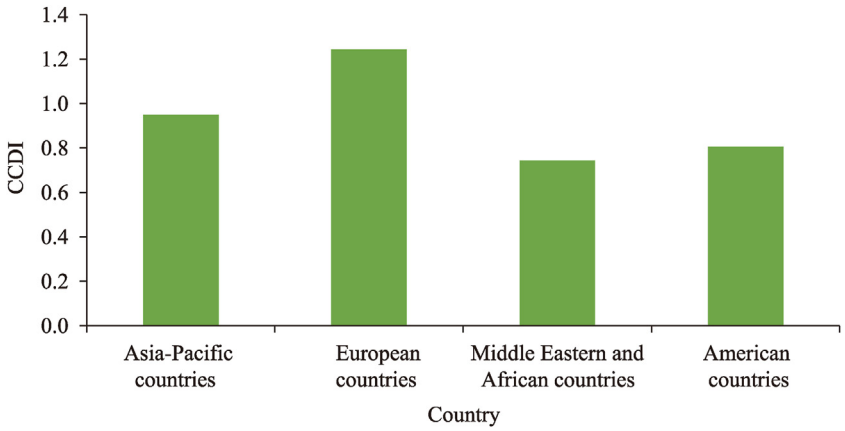

Fig. 12. CCDI of socio-economic development level of Asia-Pacific countries, American countries, Middle Eastern and African countries, and European countries.

(2017), referred to the sphere of social innovation as dominant field. They focused on the importance of increasing socio-cultural capital in the context of the modern economy, and stated that countries in economy transition should learn from the system reform mode and achievements of developed countries. Bilan et al. (2020) identified the causal relationship between income and labor costs and their impact on GDP. As a consequence, they noted that the social and economic development is determined by human development, the protection of property rights, taxation, budgeting, and GDP levels. Didenko et al. (2018), as well as Chehabeddine and Tvaronavičienė (2020), focused on the innovative components of socio-economic development level. They studied the innovative and technological potential, its connection with the social sector, and its impact on the demographic sphere of a specific territory. Their research findings contributed to the establishment of a new model of the regional socio-economic development level. Thus, there are numerous approaches to identify the indices of a country's socio-economic development. Within the framework of this study, the focus was only on four fields that are most vulnerable to changes in the external environment. The current paper proves the importance of the selected four fields, their dependence on external factors, and their impacts on the socio-economic development indices (Ozili, 2020).

The study provided the ground for the creation of an algorithm to assess a country's socio-economic development. Hence, the improvement was able to be described using a trigonometric function: the sine of an angle (Gupta and Deep, 2019). This study showed that based on the direction of a shift in the curve of the specific area, it is possible to outline the country's socio-economic development indices and quantify the degree of their changes (Hathroubi, 2019).

The advantage of this research is the original approach, which goes beyond a quantitative evaluation using the CCDI. It introduces an assessment that can determine the disproportions, asymmetry, and duality of countries' socio-economic development level in the context of the quantitative analysis in the four fields (Tian and Wang, 2019; Lachowicz and Leszczyński, 2020).

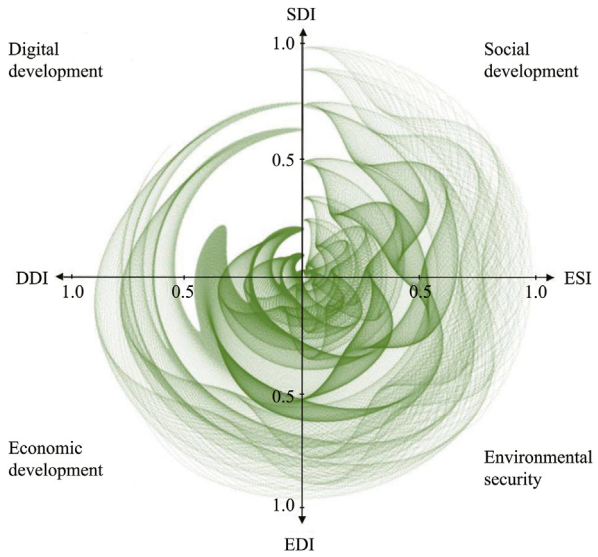

Fig. 13. The countries' socio-economic development based on the four indices (SDI, DDI, EDI, and ESI).

Previously to this research, Păuna (2020) has proved that the trigonometric function grants an opportunity of creating and optimizing reliable automated trading programs for each financial market, thereby obtaining good capital investment results. Therefore, the presented trigonometric function method (as a purely mathematical model) can be applied to any algorithmic and high-frequency trading software. The function parameters can be optimized for each capital market and any time period used.

The main limitation of this study is the number of countries studied, which were determined by the availability of statistical data on the necessary indices. Currently, 59 countries were the maximum possible number of investigations with the proposed indices. However, in future research, these uncertainties can be overcome by modifying the type and quantity of indices used.

6. Conclusions and implications

The conducted correlation analysis and the constructed matrix of interdependencies in this study made it is possible to discover the relationships among social development, digital development, economic development, and environmental security. Therefore, the socio-economic development level of the studied countries was examined in terms of key indices of the four fields and the CCDI. The analysis of the main socio-economic development indices of the Asia-Pacific countries demonstrated the predominance of social development. At the same time, each country of Asia-Pacific region had an individual set of development priorities. The European countries were characterized by the predominance of economic and social development. The analysis on the socio-economic development level of European countries revealed that due to the differences among four indices (SDI, DDI, EDI, and ESI), the socio-economic development level of most countries is bipolar. The countries in the Middle East and Africa showed an asymmetric type of development, since most of them had significant differenced among the indices (SDI, DDI, EDI, and ESI). The American countries were distinguished by a dual development direction marked with the predominance of social development and environmental security.

The analysis using the CCDI allowed to compare the countries' socio-economic development and recognize the leaders and outsiders of socio-economic development. Since the social development was priority for most of the countries studied, it is important to meet the social needs of its residents. According to the proposed methodology, the European countries had the highest level of socio-economic development. The overall leadership in the CCDI was registered for the European countries, whereas the countries of the Middle East and Africa were defined to be the least developed. Thus, this study proved that currently, the quality growth of countries is mainly focused on socio-economic development regarding environmental security. Although the current level of digital development was relatively high, it was difficult to guarantee advantages by focusing on this field, because the CCDI of all countries that give priority to this field was very low.

The scientific contribution of this study is related to the creation of a developed methodology to assess the countries' socio-economic development level. The study integrated four indices based on social development, digital development, economic development, and environmental security into the CCDI. This paper notes that due to the emergence of new priorities, it is necessary to revise the assessment methodology of socio-economic development and expand them to cover all the decisive factors. The results obtained confirm this demand and prove the different indices of four fields across the studied areas and their impacts on the CCDI. Since all the fields under study are somewhat interconnected, there is a need for the diversified development of countries.

The study points to the need to introduce policy initiatives for the quality development of countries, giving priority to social and economic development and emphasizing environmental security. It should be noted that digital development does not guarantee advantages at present. The study proved that countries considering digital development as the priority had a low CCDI value compared to other countries. Political measures should be aimed at reducing the gaps between the components of socio-economic development to

improve its efficiency in countries.

The findings of this work can provise a basis for researchers and practitioners to form development policies and programs, and the related indices in this paper can be used to confirm the current strategy of socio-economic development. The future research may be related to the modeling and forecasting the socio-economic development level of countries and analysing the risks and deviations that may arise from pandemic and other crisis phenomena and their consequences.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Adeleye, N., Eboagu, C., 2019. Evaluation of ICT development and economic growth in Africa. Netnomics Econ. Res. Electron. Netw. 20 (1), 31–53.

Balogun, A.L., Marks, D., Sharma, R., et al., 2020. Assessing the potentials of digitalization as a tool for climate change adaptation and sustainable development in urban centres. Sustain. Cities Soc. 53, 101888. https://doi.org/10.1016/j.scs.2019.101888.

Beylot, A., Secchi, M., Cerutti, A., et al., 2019. Assessing the environmental impacts of EU consumption at macro-scale. J. Clean. Prod. 216, 382–393.

Bilan, Y., Mishchuk, H., Samoliuk, N., et al., 2020. Impact of income distribution on social and economic well-being of the state. Sustainability 12 (1), 429. https://doi.org/10.3390/su12010429.

Chehabeddine, M., Tvaronavičienė, M., 2020. Securing regional development. Insig. Region. Develop. 2 (1), 430–442.

Cifuentes-Faura, J., 2021. Analysis of containment measures and economic policies arising from COVID-19 in the European Union. Int. Rev. Appl. Econ. 35 (2), 242–255.

Cornell INSEAD WIPO, 2021. Global innovation index 2020 [2023-01-11]. https://www.globalinnovationindex.org/Home.

De Francesco, F., Maggetti, M., 2018. Assessing disproportionality: indexes of policy responses to the 2007–2008 banking crisis. Polit. Sci. 51 (1), 17–38.

Didenko, N.I., Skripnuk, D.F., Kikkas, K.N., et al., 2018. Innovative and technological potential of the region and its impact on the social sector development. In: 2018 International Conference on Information Networking (ICOIN). IEEE. Chiang Mai, Thailand, pp. 611–615.

Draskovic, M., Milica, D., Mladen, I., et al., 2017. Preference of institutional changes in social and economic development. J. Internat. Stud. 10 (2), 318–328.

Dutta, S., Lanvin, B., 2020. The Network readiness index 2020: accelerating digital transformation in a post-COVID global economy [2023-01-11]. Portulans Institute. https://networkreadinessindex,org/wp-content/uploads/2020/10/NRI-2020-Final-Report-October2020.pdf.

Fund for Peace, 2021. Fragile states index [2023-01-11]. https://fragilestatesindex.org/.

Glinskiy, V., Serga, L., Novikov, A., et al., 2017. Investigation of correlation between the regions sustainability and territorial differentiation. Procedia Manuf. 8, 323–329.

Global Change Data Lab, 2021a. Civil Liberties, 2021 [2023-01-11]. https://ourworldindata.org/grapher/civil-liberties-fh?country=ARG~AUS~BWA~CHN.

Global Change Data Lab, 2021b. Political rights index [2023-01-11]. https://ourworldindata.org/grapher/political-rights-fh?country=ARG~AUS~BWA~CHN.

Global Entrepreneurship and Development Institute, 2021. The digital Platform economy index 2020 [2023-01-11]. http://thegedi.org/wp-content/uploads/2020/12/DPE-2020-Report-Final.pdf.

Global Hunger Index, 2021 [2023-01-11] Global Hunger Index Scores. https://www.globalhungerindex.org/ranking.html.

Gopalan, H.S., Misra, A., 2020. COVID-19 pandemic and challenges for socio-economic issues, healthcare and national programs in India. Diab. Metab. Syndr. Clin. Res. Rev. 14 (5), 757–759.

Greenberg, P., 2017. Disproportionality and resource-based environmental inequality: an analysis of neighborhood proximity to coal impoundments in Appalachia. Rural Soc. 82 (1), 149–178.

Gupta, S., Deep, K., 2019. A hybrid self-adaptive sine cosine algorithm with opposition based learning. Expert Syst. Appl. 119, 210–230.

Hathroubi, S., 2019. Inclusive finance, growth and socio-economic development in Saudi Arabia: a threshold cointegration approach. J. Econ. Develop. 44 (2), 77–111.

He, W., Zhang, Z.J., Li, W., 2021. Information technology solutions, challenges, and suggestions for tackling the COVID-19 pandemic. Int. J. Inf. Manag. 57, 102287. https://doi.org/10.1016/j.ijinfomgt.2020.102287.

IMD World Competitiveness Center, 2021a. The IMD world digital competitiveness ranking 2020 results [2023-01-11]. https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2020/.

IMD World Competitiveness Center, 2021b. World competitiveness rankings 2020 results [2023-01-11]. https://www.imd.org/wcc/world-competitiveness-center-rankings/world-competitiveness-ranking-2020/.

Index of Economic Freedom, 2021. Country rankings [2023-01-11]. https://www.heritage.org/index/explore?view=by-region-country-year#top.

Institute for Economics and Peace, 2021a. Global Peace index 2021: measuring Peace in a complex world [2023-01-11]. https://www.visionofhumanity.org/wp-content/uploads/2021/06/GPI-2021-web-1.pdf.

Institute for Economics and Peace, 2021b. Global terrorism index [2023-01-11]. https://www.visionofhumanity.org/maps/global-terrorism-index/#/.

Knoema, 2021a. . Global entrepreneurship index [2023-01-11]. https://knoema.com/atlas/topics/World-Rankings/World-Rankings/Global-entrepreneurship-index.

Knoema, 2021b. Health-care efficiency index [2023-01-11]. https://knoema.com/atlas/topics/World-Rankings/World-Rankings/Health-care-efficiency-index.

Knoema, 2021c. Knowledge economy index [2023-01-11]. https://knoema.com/atlas/topics/World-Rankings/World-Rankings/Knowledge-economy-index.

Lachowicz, M., Leszczyński, H., 2020. Modeling asymmetric interactions in economy. Mathematics 8 (4), 523. https://doi.org/10.3390/math8040523.

Legatum Institute Foundation, 2021. The Legatum prosperity index 2020 [2023-01-11]. https://www.prosperity.com/about/resources.

Lenzen, M., Li, M., Malik, A., et al., 2020. Global socio-economic losses and environmental gains from the Coronavirus pandemic. PLoS One 15 (7), e0235654. https://doi.org/10.1371/journal.pone.0235654.

Matthews, R., 2019. Conclusion: new directions for Canadian sociological analysis and regional development policy. In: Matthews, R. (Ed.), The Creation of Regional Dependency. University of Toronto Press, Toronto, pp. 217–220.

Oldekop, J.A., Horner, R., Hulme, D., et al., 2020. COVID-19 and the case for global development. World Dev. 134, 105044. https://doi.org/10.1016/j.worlddev.2020.105044.

Ozili, P., 2020. COVID-19 in Africa: socio-economic impact, policy response and opportunities. Int. J. Sociol. Soc. Pol. 42 (3/4), 177–200.

Parra, C.M., Gupta, M., Mikalef, P., 2021. Information and communication technologies (ICT)-enabled severe moral communities and how the (Covid19) pandemic might bring new ones. Int. J. Inf. Manag. 57, 102271. https://doi.org/10.1016/j.ijinfomgt.2020.102271.

Păuna, C., 2020. Reliable signals and limit conditions using trigonometric interpolation for algorithmic capital investments. In: Proceedings of 7th Business Systems Laboratory International Symposia Conference. University of Alicante, Alicante, 1–16.

Prawoto, N., Priyo Purnomo, E., Az Zahra, A., 2020. The impacts of Covid-19 pandemic on socio-economic mobility in Indonesia. Internat. J. Econom. Busin. Administ. 8 (3), 57–71.

Property Rights Alliance, 2021. International property rights index [2023-01-11]. https://www.internationalpropertyrightsindex.org/#world-map.

Reyes, G.E., Useche, A.J., 2019. Competitiveness, economic growth and human development in Latin American and Caribbean countries 2006–2015: a performance and correlation analysis. Competit. Rev. Internat. Busin. J. 29 (2), 139–159.

Riadh, B.J., 2021. Global foreign direct investment country attractiveness index [2023-01-11]. http://www.fdiattractiveness.com/ranking-2020/.

Social Progress Imperative, 2021. Social progress index [2023-01-11]. https://www.socialprogress.org/index/global/results.

Stiftung, Bertelsmann, 2021. Bertelsmann transformation index [2023-01-11]. https://bti-project.org/en/?&cb=00000.
Stojkoski, V., Utkovski, Z., Jolakoski, P., et al., 2022. The socio-economic determinants of the coronavirus disease (COVID-19) pandemic. Sci. Rep. 12, 7099. https://doi.org/10.1038/s41598-022-10894-6.
Sustainable Development Report, 2021. Rankings. [2023-01-11]. https://sdgindex.org/reports/sustainable-development-report-2020/.
Sustainable Development Solutions Network, 2021. The World Happiness Report 2020 [2023-01-11]. https://worldhappiness.report/ed/2020/.
Tian, Y., Wang, L., 2019. Mutualism of intra-and inter-prefecture level cities and its effects on regional socio-economic development: a case study of Hubei Province, Central China. Sustain. Cities Soc. 44, 16–26.
Transparency International, 2021. Corruption Perceptions index [2023-01-11]. https://www.transparency.org/en/cpi/2021?gclid=Cj0KCQiAzeSdBhC4ARIsACj36uE51sWcBIwDGuqhXsev1pKDJwyuHjgYy7cW7Q4jIorTqV5GV89ma0aAu7fEALw_wcB.
Udemba, E.N., 2021. Nexus of ecological footprint and foreign direct investment pattern in carbon neutrality: new insight for United Arab Emirates (UAE). Environ. Sci. Pollut. Res. 28 (26), 34367–34385.
United Nations Development Programme, 2021. Human Development Index [2023-01-11]. http://hdr.undp.org/en/indicators/137506.
Vasconcelos, V.V., 2021. Social justice and sustainable regional development: reflections on discourse and practice in public policies and public budget. Insig. Region. Develop. 3 (1), 10–28.
Wang, M., Zhao, X., Gong, Q., et al., 2019. Measurement of regional green economy sustainable development ability based on entropy weight-topsis-coupling coordination degree–A case study in Shandong Province, China. Sustainability 11 (1), 280. https://doi.org/10.3390/su11010280.
Wang, D., Zhou, T., Wang, M., 2021. Information and communication technology (ICT), digital divide and urbanization: evidence from Chinese cities. Technol. Soc. 64, 101516. https://doi.org/10.1016/j.techsoc.2020.101516.
Reporters without Borders, 2021. Press freedom index [2023-01-11]. https://rsf.org/en/index.
World Bank Group, 2021a. Carbon Dioxide Emissions [2023-01-11]. https://data.worldbank.org/indicator/EN.ATM.CO2E.PC.
World Bank Group, 2021b. Ease of Doing Business Scores [2023-01-11]. https://www.doingbusiness.org/en/data/doing-business-score.
World Bank Group, 2021c. Energy Intensity Level of Primary Energy [2023-01-11]. https://data.worldbank.org/indicator/EG.EGY.PRIM.PP.KD.
World Bank Group, 2021d. GDP Per Capita Growth [2023-01-11]. GDP.PCAP.KD.ZG. https://data.worldbank.org/indicator/NY.
World Bank Group, 2021e. GINI Index [2023-01-11]. https://data.worldbank.org/indicator/SI.POV.GINI.
World Bank Group, 2021f. Global Gender Gap Index [2023-01-11]. https://genderdata.worldbank.org/.
World Bank Group, 2021g. High-technology Exports [2023-01-11]. https://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS.
World Bank Group, 2021h. Research and Development Expenditure [2023-01-11]. https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS.
World Energy Council, 2021. Energy Trilemma Index [2023-01-11]. https://trilemma.worldenergy.org.
Yale Center for Environmental Law & Policy, 2021. Environmental Performance Index [2023-01-11]. https://epi.yale.edu/epi-results/2020/component/epi.
Yu, Z., Razzaq, A., Rehman, A., et al., 2021. Disruption in global supply chain and socio-economic shocks: a lesson from COVID-19 for sustainable production and consumption. Operat. Managem. Res. 15 (1), 233–248.