Opportunities and Challenges in Sustainability
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Opportunities and Challenges for Sustainable Development in Emerging Markets: A Comparative Assessment of Logistics Performance

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Abstract: In emerging markets, logistics systems play a critical role in shaping economic integration, the attractiveness of investment, and the potential of development. Differences in logistics performance across countries often reflect in-depth structural conditions related to institutional quality, business environment, and infrastructural capacity, which in turn create distinct development-related opportunities and challenges. This study aims to comparatively assess the logistics performance of emerging markets, in order to identify such structural conditions and their implications for development pathways. To achieve this objective, an integrated "CRiteria Importance Through Intercriteria Correlation Opportunity Losses-Based Polar Coordinate Distance" (CRITIC–OPLO-POCOD) Multi-Criteria Decision-Making (MCDM) framework was applied to evaluate the logistics performance of 49 emerging markets with four indicators derived from the Agility Emerging Markets Logistics Index (AEMLI). The empirical results indicated that business fundamentals were the most influential determinant of logistics performance. The importance of regulatory stability, governance effectiveness, and investment climate has been highlighted. Contrasting structural opportunities and constraints were reflected by the fact that China emerged as the highest-performing country whereas Venezuela consistently ranked lowest. Robustness analysis confirmed a high degree of consistency between the proposed approach and several established decision-making methods, thus supporting the reliability of the findings. Overall, the study provided evidence-based insights into how logistics performance affected the opportunities and challenges in the development of the emerging markets, in order to offer practical implications for policy prioritization and strategic planning.

Keywords: Emerging markets; Logistics performance; Sustainable development; Opportunities and challenges; Multi-Criteria Decision-Making

1. Introduction

In emerging economies, sustainable development is often constrained not only by environmental pressures but also by structural and institutional conditions that shape economic activities. Logistics systems play a critical role in resource allocation, infrastructural efficiency, and regional integration, rendering them an important yet underexplored factor influencing sustainability-related opportunities and challenges. This study aims to comparatively assess logistics performance across emerging markets, in order to identify structural conditions that support or hinder sustainable developmental pathways.

Globalization and the increasing competitiveness of regions that were previously underrepresented in international markets have significantly reshaped global trade dynamics. This transformation has heightened the

strategic importance of logistics, which assumes a critical role in enabling the efficient movement of goods across borders. Effective logistics systems ensure the safety and timeliness of shipments while contributing to cost reduction, particularly as international trade volumes continue to expand (Martí et al., 2017). The ability of a country to participate effectively in global trade largely depends on the availability and accessibility of efficient logistics networks for traders. In this regard, government services, public investments, and regulatory policies play a decisive role in shaping the effectiveness of national logistics systems (Ekici et al., 2016).

The efficiency of logistics services is a key determinant of trade performance and international integration. Inadequate logistics infrastructure and services may hinder the integration of a country into global trade networks, whereas improvements in trade-related logistics within a liberalized economic environment can increase trade volumes and generate economies of scale and scope in both production and distribution (Gani, 2017). Beyond trade facilitation, logistics has evolved into a powerful engine of economic growth by linking different sectors of the economy and connecting national markets to the global marketplace. The logistics sector contributes substantially to creation of employment, income growth, and inflows of foreign direct investment, while also enhancing the competitiveness of firms and industries that increasingly rely on efficient logistics services (Tang & Abosedra, 2019). However, improving logistics performance remains challenging without clear and comprehensive metrics that allow policymakers and practitioners to evaluate and understand logistics capabilities and performance levels across countries (Nayak et al., 2024).

In this context, the Agility Emerging Markets Logistics Index (AEMLI) serves as a prominent benchmarking tool for assessing and ranking the logistics competitiveness and potential of emerging markets. Published annually, the AEMLI evaluates over 50 emerging economies with a combination of structural indicators and short- to medium-term performance measures. It provides a thorough assessment of countries' domestic and international logistics environments, business fundamentals, and digital readiness. These factors are critical in shaping the attractiveness of emerging markets for logistics providers, freight forwarders, distributors, and global investors. The index draws data from reputable international sources, including Transport Intelligence, the World Bank, the International Monetary Fund, and the World Economic Forum, as well as expert surveys, to assess how effectively emerging economies facilitate logistics operations and integrate into global trade networks (Agility, 2025).

Although the AEMLI is often compared with the World Bank's Logistics Performance Index (LPI), the two indices differ substantially in scope, objectives, and methodological approach. The LPI is a perception-based global index that evaluates logistics efficiency through surveys of freight forwarders and it focuses on operational dimensions such as customs performance, infrastructural quality, international shipments, and timeliness (Arvis et al., 2023). In contrast, the AEMLI adopts a market-oriented and data-driven perspective tailored specifically to emerging economies; it integrates quantitative indicators with industry surveys to evaluate domestic opportunities, international logistics performance, business fundamentals, and digital readiness (Agility, 2025). While the LPI primarily emphasizes operational efficiency, the AEMLI offers a broader and more strategic assessment of market attractiveness and growth potential in emerging markets.

The motivation of this study lies in the identification and comparative evaluation of logistics performance levels across emerging markets, with a particular focus on understanding the structural opportunities and challenges relevant to sustainable development. Accordingly, the primary objective of this research is to assess the logistics performance of emerging market countries for year 2025 by utilizing data obtained from the AEMLI reports. To achieve this objective, a novel integrated "CRiteria Importance Through Intercriteria Correlation Opportunity Losses-Based Polar Coordinate Distance" (CRITIC–OPLO-POCOD) Multi-Criteria Decision-Making (MCDM) framework was proposed. Within this framework, the CRITIC method (Diakoulaki et al., 1995) was employed to objectively determine the weights of logistics performance criteria by considering both the standard deviation of each criterion and the correlation structure among the criteria, thereby enabling a holistic evaluation of the decision model. Subsequently, the OPLO-POCOD (Opportunity Losses-Based Polar Coordinate Distance) method (Sheikh & Senfi, 2024) was applied to rank emerging market countries based on their logistics performance, as it relied on ordered pair comparisons and distance calculations from maximum and minimum reference values, which allow robust and discriminative ranking results.

The proposed CRITIC–OPLO-POCOD methodology was applied to a sample of 49 emerging markets with four main logistics performance criteria derived from the AEMLI framework, i.e., Domestic Opportunities, International Opportunities, Business Fundamentals, and Digital Readiness. The main contribution of this study to the literature is twofold. First, it provides a methodological contribution by introducing a robust hybrid MCDM approach for evaluation of logistics performance in emerging markets. Second, it offers an objective and up-to-date assessment of the logistics performance of emerging markets for 2025, thereby providing valuable insights for policymakers, investors, and logistics practitioners in the context of sustainable development in emerging economies.

The remainder of this paper is organized as follows. Section 2 presents a comprehensive review of the related literature. Section 3 describes the proposed research methodology (CRITIC-OPLO-POCOD Method) in detail. Section 4 outlines the empirical application for emerging markets of the model. Section 5 shows the robustness test via comparative analysis. Section 6 discusses the results of the logistics performance analysis for emerging

markets. Section 7 presents the managerial and policy implications, and Section 8 concludes the study with key findings and directions for future research.

2. Literature Review

The evaluation of logistics performance across countries has attracted increasing scholarly attention, particularly through the application of MCDM methods. These studies differ in terms of geographical scope, selected criteria, and methodological frameworks, yet collectively contribute to a deeper understanding of the determinants of logistics and supply chain performance. From a sustainability perspective, these studies also provided important insights into the structural conditions that shaped development opportunities and constraints across countries, particularly in emerging economies.

Kara & Yalçın (2022) assessed the performance of the digital logistics market in developing countries using the Method Based on the Removal Effects of Criteria (MEREC) and Ranking of Alternatives Through Functional Mapping of Criterion Sub-Intervals into a Single Interval (RAFSI) methods. Their findings highlighted technology as the most critical criterion influencing digital logistics performance, with China, Malaysia, and Qatar emerging as the top-performing countries. Similarly, Özbek & Özekenci (2023) focused on digital logistics market performance in developing nations by applying the logarithmic percentage change-driven objective weighting (LOPCOW)-based Multi-Attribute Utility Theory (MAUT), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Measurement of Alternative and Ranking According to the Compromise Solution (MARCOS), and Combined Compromise Solution (CoCoSo) methods. Their results consistently ranked the United Arab Emirates (UAE) as the leading country in digital logistics readiness.

Several studies have concentrated on logistics performance within regional or economic blocks. Miškić et al. (2023) proposed an integrated evaluation framework combining the MEREC and MARCOS methods to assess the LPI of European Union countries, identifying Germany as the highest-performing nation. Consistent with this finding, Gelmez et al. (2024) employed SD-based Complex Proportional Assessment (COPRAS) and Simple Additive Weighting (SAW) methods to analyze the logistics performance of G20 countries, again confirming Germany's leading position. Likewise, Kargı (2022) evaluated the logistics performance of Organization for Economic Cooperation and Development (OECD) countries using Entropy and Weighted Aggregated Sum Product Assessment (WASPAS) methods. He concluded that infrastructure was the most influential criterion and that Germany ranked first overall.

Several studies emphasized the importance of business-related factors in logistics performance. Kara et al. (2022) analyzed the logistics market performance of developing countries using Entropy and Multi-Attributive Border Approximation Area Comparison (MABAC) methods and identified business fundamentals as the most significant criterion, with the UAE achieving the highest performance. Supporting this perspective, Özekenci (2023) applied Stepwise Weighted Assessment Ratio Analysis (SWARA)–Criteria Importance Ratio Analysis (CRITIC)-based CoCoSo methods to developing countries and reaffirmed business fundamentals as the most vital criterion, while ranking China as the top-performing country. These findings suggest that business-related conditions constitute a critical structural dimension influencing logistics performance, which in turn shapes the capacity of a country to support sustainable economic development.

Other researchers have adopted alternative methodological integrations to explore logistics performance. Hadzikadunic et al. (2023) evaluated the logistics performance of European Union countries using CRITIC-Full Consistency Method (FUCOM) and MARCOS methods and identified Finland as the leading performer. Çıray et al. (2024) assessed global logistics performance through the Entropy-based Organization, Rangement Et Synth&e De DonnCes Relarionnelles (ORESTE) method and discovered that infrastructure was the most critical criterion and Singapore the top-ranked country. Akbulut et al. (2024) analyzed G20 countries using a standard deviation (SD), Private Set Intersection (PSI), and MEREC-based Magnitude of the Area for the Ranking of Alternatives (MARA) model, thus emphasizing customs efficiency as the most essential factor and positioning Germany at the forefront.

More recently, Özekenci (2025) has examined the market performance of green logistics among the top 20 emerging economies listed in the AEMLI report. The study identified international logistics opportunities as the most important criterion using Symmetry Point of Criterion (SPC)-based Ranking of Alternatives with Weights of Criterion (RAWEC), Ranking the Solutions Based on the Mean Value of Criteria (RSMVC), Stable Preference Ordering towards Ideal Solution (SPOTIS), and Alternative Ranking Order Method Accounting for Two-Step Normalization (AROMAN) methods. China, the United Arab Emirates, Malaysia, Saudi Arabia, and Brazil consistently ranked among the top performers across different methods. Finally, Bulut & Abacıoğlu (2025) revisited the AEMLI framework by adjusting criteria weights and analyzing their effects on country rankings through MEREC, MABAC, and Multi-Attribute Ideal-Real Comparative Analysis (MAIRCA) methods. Their study concluded that the revised weights demonstrated stronger alignment with existing empirical evidence in the literature in Table 1.

Overall, the reviewed studies revealed that logistics performance was influenced by multiple interrelated

dimensions, such as infrastructure, business fundamentals, digital readiness, customs efficiency, and international opportunities, which collectively reflected broader structural conditions across countries. From the perspective of sustainable development, these structural differences might translate into distinct opportunities and challenges for emerging economies. This diversity also underscored the necessity of robust and comparative methodological frameworks, such as the CRITIC–OPLO-POCOD approach proposed in this study, to ensure reliable and consistent performance evaluation outcomes.

Table 1. Literature reviews of logistics performance evaluation with MCDM at the country level

Research	Scope	Methods	Key Criterion	Top-Ranked Country/Countries
Kara & Yalçın (2022)	Developing countries (Digital logistics)	MEREC, RAFSI	Technology	China, Malaysia, Qatar
Kara et al. (2022)	Developing countries	Entropy, MABAC	Business fundamentals	The UAE
Miškić et al. (2023)	EU countries	MEREC, MARCOS	Overall logistics performance	Germany
Hadzikadunic et al. (2023)	EU countries	CRITIC-FUCOM, MARCOS	Overall logistics performance	Finland
Özbek & Özekenci (2023)	Developing countries (Digital logistics)	LOPCOW-MAUT, TOPSIS, MARCOS, CoCoSo	Digital readiness	The UAE
Kargı (2022)	OECD countries	Entropy, WASPAS	Infrastructure	Germany
Gelmez et al. (2024)	G20 countries	SD-COPRAS, SAW	Overall logistics performance	Germany
Çıray et al. (2024)	Global economies	Entropy-ORESTE	Infrastructure	Singapore
Akbulut et al. (2024)	G20 countries	SD, PSI, MEREC–MARA	Customs	Germany
Özekenci (2023)	Developing countries	SWARA–CRITIC–CoCoSo	Business fundamentals	China
Özekenci (2025)	Top 20 emerging economies (AEMLI)	SPC-RAWEC, RSMVC, SPOTIS, AROMAN	International opportunities	China, the UAE, Malaysia, Saudi Arabia, Brazil
Bulut & Abacıoğlu (2025)	Emerging markets (AEMLI-based)	MEREC, MABAC, MAIRCA	Adjusted AEMLI criteria	Consistent with the literature

3. Methodology: The CRITIC-OPLO-POCOD Method

This study employed an integrated CRITIC–OPLO-POCOD framework as a decision-support tool to comparatively assess the logistics performance of emerging markets and to identify structural differences relevant to sustainable development. Within this framework, the CRITIC method was used to derive the criteria weight vector based on the correlation among criteria and their SDs, thereby objectively reflecting the amount of information contained in each criterion. The OPLO-POCOD method was then applied to rank countries by utilizing ordered pair values and distance-based evaluations, so as to enable a robust and reliable performance ordering of alternatives.

The application of the CRITIC–OPLO-POCOD method requires an objective dataset. This dataset should include country-level scores of emerging markets with respect to logistics performance criteria. Accordingly, the decision model consists of logistics performance criteria for emerging markets $(\wp = \{\wp_1, \wp_2, \dots, \wp_t, \dots, \wp_t\}\ (t = 1,2, \dots, T))$ and emerging market countries $\left(\mathring{A} = \{\mathring{A}_1, \mathring{A}_2, \dots, \mathring{A}_p, \dots, \mathring{A}_P\}\ (p = 1,2, \dots, P)\right)$ as alternatives.

The proposed CRITIC–OPLO-POCOD method is composed of two stages. In Stage 1, the identified logistics performance criteria for emerging markets are weighted using the CRITIC method. In Stage 2, the performance ranking of emerging market countries is determined by using the OPLO-POCOD method by incorporating the criteria weights obtained in the first stage. The notations related to the proposed method are presented in Table A1 in the Appendix. Based on these notations, the methodological implementation proceeds as follows:

Stage i – Weighting of Emerging Market Logistics Performance Criteria Using the CRITIC Method.

Step i-1: In the CRITIC method, which adopts an objective criteria-weighting approach, subjective evaluations are replaced by the direct use of criterion-based scores of the alternatives for determining the weights of criteria. Within this framework, an initial decision matrix $\left(\mathcal{G} = [\mathcal{G}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ must be constructed using primary or secondary sources such as report. In the initial matrix, the element $\mathcal{G}_{\mathrm{pt}}$ represents the score of the p^{th} alternative with respect to the t^{th} criterion. The general form of the initial decision matrix is presented in Eq. (1):

$$\mathcal{G} = \begin{bmatrix} \mathcal{G}_{11} & \cdots & \mathcal{G}_{1ht} & \cdots & \mathcal{G}_{1T} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \mathcal{G}_{p1} & \cdots & \mathcal{G}_{pt} & \ldots & \mathcal{G}_{pT} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \mathcal{G}_{P1} & \cdots & \mathcal{G}_{Pt} & \ldots & \mathcal{G}_{PT} \end{bmatrix}; (p = 1,2, \ldots, P; t = 1,2, \ldots, T) \quad (1)$$

Step i-2: In the CRITIC method, the scores obtained from reports may be expressed in different scales and forms; therefore, normalization is required prior to analysis. Accordingly, a normalized decision matrix $\left(\mathcal{K} = [\mathcal{K}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ is constructed by applying cost-based normalization (distance from the maximum) for cost criteria and benefit-based normalization (distance from the minimum) for benefit criteria (Eq. (2)):

$$\mathcal{K}_{pt} = \begin{cases} \dfrac{\mathcal{G}_{pt} - \min\limits_{p} \mathcal{G}_{pt}}{\max\limits_{p} \mathcal{G}_{pt} - \min\limits_{p} \mathcal{G}_{pt}} \text{ for } t \in \wp^{+} \\ \dfrac{\max\limits_{p} \mathcal{G}_{pt} - \mathcal{G}_{pt}}{\max\limits_{p} \mathcal{G}_{pt} - \min\limits_{p} \mathcal{G}_{pt}} \text{for } t \in \wp^{-} \end{cases}; (p = 1,2, \ldots, P; t = 1,2, \ldots, T) \quad (2)$$

Step i-3: In the correlation-based CRITIC method, the normalized decision matrix is used to construct the inter-criteria correlation matrix $(\mathcal{H} = [\mathcal{H}_{\mathrm{tt}'}]_{\mathrm{TT}})$. This matrix represents the degree of relationship among the criteria (Eq (3)).

$$\mathcal{H}_{tt'} = \frac{\sum_{p=1}^{P}\left((\mathcal{K}_{pt} - \overline{\mathcal{K}_t})(\mathcal{K}_{pt} - \overline{\mathcal{K}_{t'}})\right)}{\sqrt{\sum_{p=1}^{P}\left((\mathcal{K}_{pt} - \overline{\mathcal{K}_t})^2 (\mathcal{K}_{pt} - \overline{\mathcal{K}_{t'}})^2\right)}}; (p = 1,2, \ldots, P; t, t' = 1,2, \ldots, T) \quad (3)$$

Step i-4: In the CRITIC method, a criterion information vector $(\mathcal{F} = [\mathcal{F}_{\mathrm{t}}]_{\mathrm{T}})$ is employed. This vector is calculated based on the SD (σ_{t}) of each criterion and the inter-criteria correlation matrix (Eq. (4)). The criterion information vector is then used to determine the final criteria weights:

$$\mathcal{F}_t = \sigma_t \sum_{t'=1}^{T} (1 - \mathcal{H}_{tt'}); (t, t' = 1,2, \ldots, T) \quad (4)$$

Step i-5: As a final step, linear normalization Eq. (5) is applied to rescue the criteria weights into the $[0,1]$ interval and to ensure that their sum equals one. As a result of the linear normalization process, the logistics performance criteria weight vector $(\varpi = [\varpi_{\mathrm{t}}]_{\mathrm{T}})$ for emerging markets is obtained:

$$\varpi_t = \frac{\mathcal{F}_t}{\sum_{t=1}^{T} \mathcal{F}_t}; (t = 1,2, \ldots, T) \quad (5)$$

Herein, ϖ_t indicates the weight of the h^{th} emerging markets logistics performance criterion. This vector is identified as $\varpi = (\varpi_1, \varpi_2, \ldots, \varpi_T)$, corresponding to: $\sum_{t=1}^{T} \varpi_t = 1$ and $\varpi_t \geq 0 \; \forall \; t$.

Stage ii – Ranking of Emerging Markets by Employing the OPLO-POCOD Method.

Step ii-1: The initial decision matrix constructed in Step i-1 for the CRITIC method Eq. (1) is equivalently adopted as the input decision matrix $\left(\mathcal{G} = [\mathcal{G}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ for the OPLO-POCOD method, where each element represents the criterion-specific performance score of an alternative emerging market.

Step ii-2: Since the OPLO-POCOD method operates based on the distances of alternatives from the maximum (benefit-based) and minimum (cost-based) criterion values, a distance matrix $\left(\mathcal{U} = [\mathcal{U}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ to the maximum and minimum values is computed (Eq. (6)) for each criterion across all alternatives:

$$\mathcal{U}_{pt} = \begin{cases} \left|\mathcal{G}_{pt} - \max\limits_{p}(\mathcal{G}_{pt})\right| \text{ for } t \in \wp^{+} \\ \left|\mathcal{G}_{pt} - \min\limits_{p}(\mathcal{G}_{pt})\right| \text{ for } t \in \wp^{-} \end{cases}; (p = 1,2, \ldots, P; t = 1,2, \ldots, T) \quad (6)$$

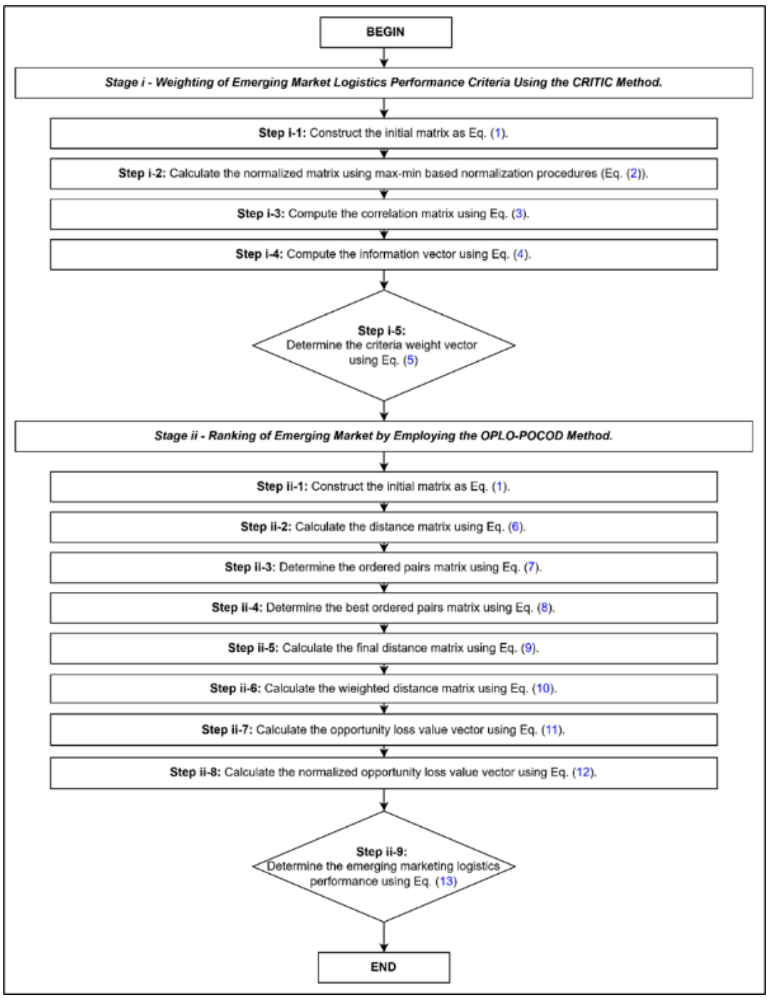

Figure 1. Workflow of the CRITIC–OPLO-POCOD method

Step ii-3: As the OPLO-POCOD method is based on pairwise order-oriented computations, ordered pairs $\left(\mathcal{Q} = [\mathcal{Q}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ are constructed Eq (7) to represent the distances of alternatives from the maximum and minimum scores:

$$\mathcal{Q}_{pt} = (\mathcal{G}_{pt}, \mathcal{U}_{pt}); (p = 1,2,\dots,P; t = 1,2,\dots,T) \tag{7}$$

Step ii-4: Using the maximum and minimum values of the ordered pairs, the best ordered pair $(\mathcal{B} = [\mathcal{B}_{\mathrm{t}}]_{\mathrm{T}})$ is determined separately for benefit-based and cost-based criteria Eq. (8):

$$\mathcal{B}_t = \begin{cases} \left(\max\limits_{p}(\mathcal{Q}_{pt}), \min\limits_{p}(\mathcal{Q}_{pt})\right) & \text{for } t \in \wp^{+} \\ \left(\min\limits_{p}(\mathcal{Q}_{pt}), \min\limits_{p}(\mathcal{Q}_{pt})\right) & \text{for } t \in \wp^{-} \end{cases}; (p = 1,2,\dots,P; t = 1,2,\dots,T) \tag{8}$$

Step ii-5: The final distance matrix $\left(\mathcal{D} = [\mathcal{D}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ is obtained by computing the distances of each ordered pair from the corresponding best ordered pair (Eq. (9)):

$$\mathcal{D}_{pt} = \begin{cases} \sqrt{\left(\mathcal{Q}_{pt} - \mathcal{B}_t\right)^2 + \left(\mathcal{Q}_{pt} - \mathcal{B}_t\right)^2} & \text{for } t \in \wp^{+} \\ \sqrt{\left(\mathcal{Q}_{pt} - \mathcal{B}_t\right)^2 + \left(\mathcal{Q}_{pt} - \mathcal{B}_t\right)^2} & \text{for } t \in \wp^{-} \end{cases}; (p = 1,2,\dots,P; t = 1,2,\dots,T) \tag{9}$$

Step ii-6: The final distances are multiplied by the corresponding criteria weights to obtain the weighted distance

matrix $\left(\mathcal{X} = [\mathcal{X}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ (Eq. (10)):

$$\mathcal{X}_{pt} = \mathcal{D}_{pt}\varpi_t; (p = 1,2, \dots, P; t = 1,2, \dots, T) \tag{10}$$

Step ii-7: Opportunity loss values $\left(\mathcal{Y} = [\mathcal{Y}_{\mathrm{p}}]_{\mathrm{p}}\right)$ are computed for each alternative (Eq. (11)):

$$\mathcal{Y}_p = \sum_{t=1}^{T} \mathcal{X}_{pt}\,; (p = 1,2, \dots, P; t = 1,2, \dots, T) \tag{11}$$

Step ii-8: The opportunity loss values associated with each alternative are linearly normalized $\left(\mathcal{Z} = [\mathcal{Z}_{\mathrm{p}}]_{\mathrm{p}}\right)$ (Eq. (12)):

$$\mathcal{Z}_p = \frac{\mathcal{Y}_p}{\sum_{p=1}^{P} \mathcal{Y}_p}; (p = 1,2, \dots, P) \tag{12}$$

Step ii-9: By subtracting the normalized opportunity loss values from one, the performance score $\left(\mathcal{R} = [\mathcal{R}_{\mathrm{p}}]_{\mathrm{p}}\right)$ and the corresponding ranking of each alternative are obtained (Eq. (13)):

$$\mathcal{R}_p = 1 - \mathcal{Z}_p; (p = 1,2, \dots, P) \tag{13}$$

Here, $\mathcal{R}_p$ identifies the emerging market logistics performance of the p^{th} emerging market. The emerging market logistics performance ranking vector is identified as $\mathcal{R} = (\mathcal{R}_1, \mathcal{R}_2, \dots, \mathcal{R}_P)$. The workflow of the CRITIC–OPLO-POCOD approach is illustrated in Figure 1.

4. Case Study: Implementation of the CRITIC–OPLO-POCOD Method for the Emerging Economies

To determine the logistics performance levels of emerging markets, the CRITIC–OPLO-POCOD method was applied in a case study. Within this scope, 49 countries classified as emerging markets were identified. The logistics performance indicators for these countries were obtained from the AEMLI. The AEMLI reports were published on a regular basis and provided country-level information across various logistics performance indicators. From a sustainability perspective, this application aims to capture structural conditions that shape development opportunities and constraints across emerging economies.

These reports included country-specific logistics performance scores for emerging markets, as well as data corresponding to four main criteria: Domestic Opportunities, International Opportunities, Business Fundamentals, and Digital Readiness. These criteria collectively reflected key institutional, infrastructural, and technological conditions that influence the capacity of countries to support sustainable economic activities and long-term development.

The four criteria serving as logistics performance indicators in the AEMLI reports were defined as follows:

• Domestic Opportunities $(\wp_1)$: This criterion reflects the prevailing market conditions and the state of logistics infrastructure that influence the success of domestic logistics and supply chain operations. In particular, the availability and effectiveness of logistics service providers in import and export processes serve as key indicators of domestic opportunities. Overall, the level of logistics infrastructure development and economic opportunities determine the degree of domestic opportunities. Countries with higher scores under this criterion tend to experience faster and more efficient logistics operations within their domestic markets.

• International Opportunities $(\wp_2)$: This criterion reflects the external market conditions of a country and its integration into global trade networks, which influence the success of international logistics and cross-border supply chain operations. In particular, the efficiency of customs procedures, the quality of international transportation connectivity, and the availability and effectiveness of global logistics service providers serve as key indicators of international opportunities. Overall, a country's openness to international trade, regulatory environment, and participation in global value chains determine the level of international opportunities. Countries with higher scores under this criterion tend to experience more efficient, reliable, and competitive international logistics and trade operations.

Table 2. Scores of emerging market logistics performance according to the AEMLI criteria

Code	Country	Domestic Opportunities ($\wp_1$)	International Opportunities ($\wp_2$)	Business Fundamentals ($\wp_3$)	Digital Readiness ($\wp_4$)
$Å_1$	China	8.58	9.65	6.37	8.47
$Å_2$	India	7.59	7.49	6.03	5.76
$Å_3$	UAE	5.53	5.90	8.53	6.55
$Å_4$	Saudi Arabia	5.61	6.07	7.45	5.82
$Å_5$	Malaysia	5.26	5.78	7.72	6.41
$Å_6$	Indonesia	6.16	6.12	5.85	5.41
$Å_7$	Mexico	5.49	6.45	5.61	5.25
$Å_8$	Qatar	5.36	4.92	6.97	6.25
$Å_9$	Thailand	5.05	5.86	5.94	5.82
$Å_{10}$	Vietnam	5.09	5.81	6.01	5.37
$Å_{11}$	Chile	4.88	5.07	6.88	5.68
$Å_{12}$	Türkiye	5.31	5.41	5.10	5.66
$Å_{13}$	Brazil	5.51	5.78	4.18	5.19
$Å_{14}$	Oman	5.06	4.72	6.72	5.54
$Å_{15}$	Bahrain	4.99	4.49	6.91	5.72
$Å_{16}$	Jordan	4.78	4.62	7.15	5.23
$Å_{17}$	Kuwait	5.07	4.52	6.03	5.29
$Å_{18}$	Uruguay	4.81	4.47	6.69	5.22
$Å_{19}$	South Africa	4.83	4.99	5.15	5.05
$Å_{20}$	Colombia	4.85	4.97	5.50	4.76
$Å_{21}$	Kenya	4.55	4.75	5.34	5.44
$Å_{22}$	Philippines	4.97	4.95	4.53	5.05
$Å_{23}$	Egypt	4.91	4.92	5.10	4.63
$Å_{24}$	Kazakhstan	4.55	4.40	5.97	5.32
$Å_{25}$	Morocco	4.59	4.76	5.86	4.61
$Å_{26}$	Sri Lanka	4.86	4.69	4.19	5.22
$Å_{27}$	Peru	4.75	4.79	5.05	4.57
$Å_{28}$	Argentina	4.90	4.81	3.58	4.83
$Å_{29}$	Cambodia	4.41	4.56	5.07	4.82
$Å_{30}$	Ghana	4.66	4.70	4.67	4.50
$Å_{31}$	Iran	4.92	4.59	3.72	4.93
$Å_{32}$	Pakistan	4.86	4.68	4.04	4.44
$Å_{33}$	Ecuador	4.57	4.58	4.46	4.58
$Å_{34}$	Paraguay	4.54	4.40	4.26	5.02
$Å_{35}$	Tunisia	4.49	4.59	5.18	4.01
$Å_{36}$	Tanzania	4.67	4.24	4.70	4.59
$Å_{37}$	Algeria	4.74	4.61	4.39	4.00
$Å_{38}$	Bangladesh	4.85	4.38	4.60	4.55
$Å_{39}$	Ukraine	4.29	4.43	4.60	4.59
$Å_{40}$	Uganda	4.54	4.40	3.94	4.48
$Å_{41}$	Lebanon	4.78	4.26	3.72	4.39
$Å_{42}$	Nigeria	4.82	4.53	3.46	3.98
$Å_{43}$	Bolivia	4.64	4.35	3.25	4.42
$Å_{44}$	Ethiopia	4.43	4.65	2.77	4.44
$Å_{45}$	Libya	4.66	4.33	3.53	3.94
$Å_{46}$	Angola	4.56	4.39	2.39	3.72
$Å_{47}$	Mozambique	4.39	4.29	2.44	4.04
$Å_{48}$	Myanmar	4.21	4.26	3.62	3.35
$Å_{49}$	Venezuela	4.97	4.02	0.34	3.67

• Business Fundamentals ($\wp_3$): This criterion reflects the overall business environment and institutional framework that influence the effectiveness and sustainability of logistics and supply chain operations as well as the broader environment of economic development. Factors such as regulatory quality, ease of doing business, investment climate, political and economic stability, and the efficiency of legal and financial systems serve as key indicators of business fundamentals. Overall, a supportive business environment, transparent regulations, and strong institutional structures determine the level of business fundamentals. Countries with higher scores under this criterion tend to attract greater logistics investment, foster more resilient supply chains, and enable more stable

and efficient logistics operations.

• Digital Readiness ($\wp_4$): This criterion reflects the level of digitalization in a country and technological infrastructure that supports logistics and supply chain operations. In particular, the availability and quality of digital infrastructure, the adoption of advanced information and communication technologies, and the extent to which digital solutions are integrated into logistics processes serve as key indicators of digital readiness. Overall, the maturity of digital ecosystems, the accessibility of data, and the use of digital platforms in trade, transportation, and customs operations determine the level of digital readiness. Countries with higher scores under this criterion tend to benefit from enhanced visibility, coordination, and efficiency in logistics and supply chain activities, thereby improving the overall logistics performance.

The 2025 scores of 49 emerging markets with respect to the four criteria described above are presented in Table 2. This table also serves as the initial decision matrix for the application of the CRITIC–OPLO-POCOD method.

The step-by-step implementation of the CRITIC–OPLO-POCOD method for analyzing the logistics performance of emerging market countries is presented as follows:

Case Study-Stage i – Weighting of Emerging Market Logistics Performance Criteria Using the CRITIC Method.

Step i-1: The data on the emerging markets obtained from the Agility (2025) report are presented in Table 2.

The matrix constructed from these data was considered the initial decision matrix $\left(\mathcal{G} = [\mathcal{G}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$. According to the AEMLI reports, China exhibited the highest performance in terms of the Domestic Opportunities criterion, whereas Myanmar recorded the lowest score. With respect to International Opportunities, China ranked highest, while Venezuela showed the weakest performance. In terms of Business Fundamentals, the United Arab Emirates (UAE) achieved the highest score, whereas Venezuela ranked lowest. Finally, regarding Digital Readiness, China demonstrated the strongest performance, while Myanmar recorded the lowest score.

Step i-2: The initial decision matrix was normalized using cost-based normalization (distance from the maximum) for cost criteria and benefit-based normalization (distance from the minimum) for benefit criteria Eq (2). The resulting normalized matrix $\left(\mathcal{K} = [\mathcal{K}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ is presented in Table A2 in the Appendix.

Step i-3: The criteria correlation matrix $(\mathcal{H} = [\mathcal{H}_{\mathrm{tt}'}]_{\mathrm{TT}})$ was constructed Eq. (3) and presented in Table A3.

Step i-4: The criterion information vector $(\mathcal{F} = [\mathcal{F}_{\mathrm{t}}]_{\mathrm{T}})$ was calculated Eq. (4) and also presented in Table A3.

Step i-5: The logistics performance criteria weight vector $(\varpi = [\varpi_{\mathrm{t}}]_{\mathrm{T}})$ for emerging markets was determined through linear normalization Eq. (5) and is presented in Table 3. The resulting ranking of the criteria based on importance is as follows: Business Fundamentals, Domestic Opportunities, International Opportunities, and Digital Readiness. Accordingly, business fundamentals emerge as the most influential criterion in determining logistics performance.

Table 3. Criteria weight vector of emerging markets logistics performance ($\varpi = [\varpi_t]_T$)

	Domestic Opportunities ($\wp_1$)	**International Opportunities** ($\wp_2$)	**Business Fundamentals** ($\wp_3$)	**Digital Readiness** ($\wp_4$)
ϖ_t	0.2333	0.2037	0.3825	0.1806
Rank	2nd	3rd	1st	4th

Case Study - Stage ii – Ranking of Emerging Markets by Employing the OPLO-POCOD Method.

Step ii-1: Within the OPLO-POCOD method, the initial decision matrix $\left(\mathcal{G} = [\mathcal{G}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ was defined as the matrix presented in Table 2.

Step ii-2: The distances matrix $\left(\mathcal{U} = [\mathcal{U}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ was calculated Eq. (6) and shown in Table A4.

Step ii-3: The ordered pairs $\left(\mathcal{Q} = [\mathcal{Q}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ was determined Eq. (7) and shown in Table A5.

Step ii-4: The best ordered pair $(\mathcal{B} = [\mathcal{B}_{\mathrm{t}}]_{\mathrm{T}})$ was determined Eq. (8) and also shown in Table A5.

Step ii-5: The final distance matrix $\left(\mathcal{D} = [\mathcal{D}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ was computed Eq. (9) and shown in Table A6.

Step ii-6: The weighted distance matrix $\left(\mathcal{X} = [\mathcal{X}_{\mathrm{pt}}]_{\mathrm{PT}}\right)$ was computed Eq. (10) and shown in Table A7.

Step ii-7: The opportunity loss values $\left(\mathcal{Y} = [\mathcal{Y}_{\mathrm{p}}]_{\mathrm{p}}\right)$ was computed Eq. (11) and shown in Table A7.

Step ii-8: The normalized opportunity loss values $\left(\mathcal{Z} = [\mathcal{Z}_{\mathrm{p}}]_{\mathrm{p}}\right)$ was computed Eq. (12) and shown in Table A7.

Step ii-9: The emerging market logistics performance score $\left(\mathcal{R} = [\mathcal{R}_{\mathrm{p}}]_{\mathrm{p}}\right)$ was computed Eq. (13) and shown in Table 4.

Table 4. Emerging market logistics performance score $\left(\mathcal{R} = [\mathcal{R}_p]_P\right)$

Code	*Country*	$\mathcal{R}_p$	*Rank*	Code	*Country*	$\mathcal{R}_p$	*Rank*
$Å_1$	China	0.9955	1st	$Å_{26}$	Sri Lanka	0.9776	30th
$Å_2$	India	0.9885	3rd	$Å_{27}$	Peru	0.9787	25th
$Å_3$	UAE	0.9901	2nd	$Å_{28}$	Argentina	0.9761	39th
$Å_4$	Saudi Arabia	0.9874	5th	$Å_{29}$	Cambodia	0.9783	27th
$Å_5$	Malaysia	0.9878	4th	$Å_{30}$	Ghana	0.9777	29th
$Å_6$	Indonesia	0.9845	7th	$Å_{31}$	Iran	0.9763	38th
$Å_7$	Mexico	0.9833	13th	$Å_{32}$	Pakistan	0.9765	37th
$Å_8$	Qatar	0.9853	6th	$Å_{33}$	Ecuador	0.9771	33rd
$Å_9$	Thailand	0.9834	12th	$Å_{34}$	Paraguay	0.9768	35th
$Å_{10}$	Vietnam	0.9831	14th	$Å_{35}$	Tunisia	0.9779	28th
$Å_{11}$	Chile	0.9841	8th	$Å_{36}$	Tanzania	0.9773	32nd
$Å_{12}$	Türkiye	0.9813	17th	$Å_{37}$	Algeria	0.9766	36th
$Å_{13}$	Brazil	0.9796	23rd	$Å_{38}$	Bangladesh	0.9774	31st
$Å_{14}$	Oman	0.9835	11th	$Å_{39}$	Ukraine	0.9768	34th
$Å_{15}$	Bahrain	0.9837	9th	$Å_{40}$	Uganda	0.9756	40th
$Å_{16}$	Jordan	0.9836	10th	$Å_{41}$	Lebanon	0.9752	41st
$Å_{17}$	Kuwait	0.9816	16th	$Å_{42}$	Nigeria	0.9746	42nd
$Å_{18}$	Uruguay	0.9825	15th	$Å_{43}$	Bolivia	0.9742	44th
$Å_{19}$	South Africa	0.9797	22nd	$Å_{44}$	Ethiopia	0.9733	45th
$Å_{20}$	Colombia	0.9802	20th	$Å_{45}$	Libya	0.9743	43rd
$Å_{21}$	Kenya	0.9799	21st	$Å_{46}$	Angola	0.9717	48th
$Å_{22}$	Philippines	0.9786	26th	$Å_{47}$	Mozambique	0.9718	47th
$Å_{23}$	Egypt	0.9792	24th	$Å_{48}$	Myanmar	0.9733	46th
$Å_{24}$	Kazakhstan	0.9807	18th	$Å_{49}$	Venezuela	0.9675	49th
$Å_{25}$	Morocco	0.9802	19th				

5. Robustness Analysis

To examine the robustness of the results obtained from the CRITIC–OPLO-POCOD method in determining the logistics performance levels of emerging markets, a comparative analysis was conducted using several well-established MCDM methods proposed in the literature. The primary objectives of this framework were to compare the results of case study with those derived from alternative methods and to assess the consistency of the findings across different methodological approaches. Since alternative ranking methods employed distinct normalization techniques and decision-making logics to identify the best-performing alternatives, such a comparison provided a comprehensive robustness assessment. From a sustainability perspective, such robustness is essential to ensure that the identification of development-related opportunities and challenges across emerging economies is not driven by methodological artifacts.

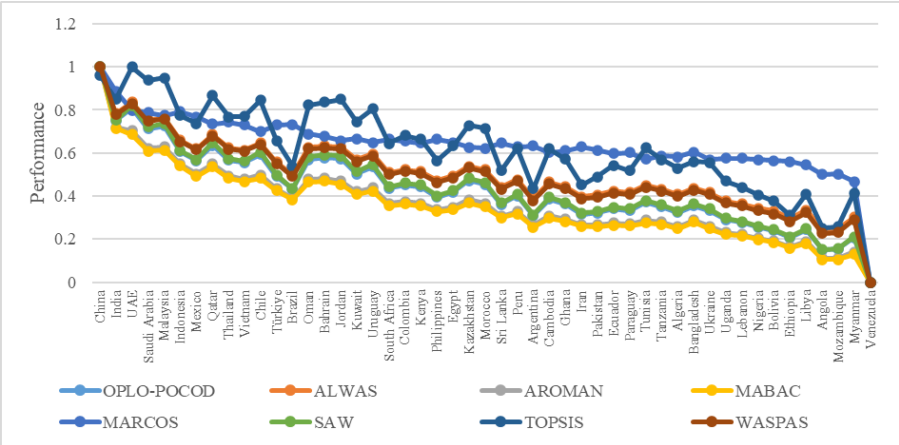

Figure 2. OPLO-POCOD versus other decision-making methods.

Table 5. Ranking of emerging market logistics performance according to robustness test

Code	Country	OPLO-POCOD	ALWAS	AROMAN	MABAC	MARCOS	SAW	TOPSIS	WASPAS
$Å_1$	China	1	1	1	1	1	1	2	1
$Å_2$	India	3	3	2	2	2	3	6	3
$Å_3$	UAE	2	2	3	3	3	2	1	2
$Å_4$	Saudi Arabia	5	5	5	5	5	5	4	5
$Å_5$	Malaysia	4	4	4	4	6	4	3	4
$Å_6$	Indonesia	7	7	6	6	4	7	12	7
$Å_7$	Mexico	13	13	8	8	7	13	16	13
$Å_8$	Qatar	6	6	7	7	9	6	5	6
$Å_9$	Thailand	12	12	10	10	8	12	14	12
$Å_{10}$	Vietnam	14	14	12	12	11	14	13	14
$Å_{11}$	Chile	8	8	9	9	13	8	8	8
$Å_{12}$	Türkiye	17	17	16	15	12	17	21	17
$Å_{13}$	Brazil	23	23	18	18	10	23	33	23
$Å_{14}$	Oman	11	11	13	13	14	11	10	11
$Å_{15}$	Bahrain	9	9	11	11	15	9	9	9
$Å_{16}$	Jordan	10	10	14	14	19	10	7	10
$Å_{17}$	Kuwait	16	16	17	17	16	16	15	16
$Å_{18}$	Uruguay	15	15	15	16	22	15	11	15
$Å_{19}$	South Africa	22	22	21	21	18	22	22	22
$Å_{20}$	Colombia	20	20	20	20	20	20	19	19
$Å_{21}$	Kenya	21	21	22	22	24	21	20	21
$Å_{22}$	Philippines	26	26	25	25	17	26	29	26
$Å_{23}$	Egypt	24	24	24	24	21	24	23	24
$Å_{24}$	Kazakhstan	18	18	19	19	28	18	17	18
$Å_{25}$	Morocco	19	19	23	23	29	19	18	20
$Å_{26}$	Sri Lanka	30	30	28	27	23	30	36	30
$Å_{27}$	Peru	25	25	26	26	27	25	25	25
$Å_{28}$	Argentina	39	39	37	37	25	39	41	39
$Å_{29}$	Cambodia	27	27	27	28	33	27	26	27
$Å_{30}$	Ghana	29	29	29	29	31	29	27	29
$Å_{31}$	Iran	38	38	35	35	26	38	39	38
$Å_{32}$	Pakistan	37	37	36	36	30	37	37	37
$Å_{33}$	Ecuador	33	33	33	33	35	33	32	33
$Å_{34}$	Paraguay	35	35	34	34	34	34	35	35
$Å_{35}$	Tunisia	28	28	31	31	40	28	24	28
$Å_{36}$	Tanzania	32	32	32	32	36	32	28	32
$Å_{37}$	Algeria	36	36	39	39	37	36	34	36
$Å_{38}$	Bangladesh	31	31	30	30	32	31	30	31
$Å_{39}$	Ukraine	34	34	38	38	41	35	31	34
$Å_{40}$	Uganda	40	40	40	40	39	40	38	40
$Å_{41}$	Lebanon	41	41	41	41	38	41	40	41
$Å_{42}$	Nigeria	42	42	42	42	42	42	44	42
$Å_{43}$	Bolivia	44	44	43	43	43	44	45	44
$Å_{44}$	Ethiopia	45	46	45	45	44	46	46	46
$Å_{45}$	Libya	43	43	44	44	45	43	43	43
$Å_{46}$	Angola	48	48	48	48	47	48	48	48
$Å_{47}$	Mozambique	47	47	47	47	46	47	47	47
$Å_{48}$	Myanmar	46	45	46	46	48	45	42	45
$Å_{49}$	Venezuela	49	49	49	49	49	49	49	49

In this context, the Aczel-Alsina Weighted Assessment (ALWAS) (Pamucar et al., 2023), AROMAN (Bošković et al., 2023), MABAC (Pamučar & Ćirović, 2015), MARCOS (Stević et al, 2020), SAW, TOPSIS (Lai et al., 1994), and WASPAS (Chakraborty & Zavadskas, 2014) methods widely applied in performance evaluation and alternative ranking studies were selected for comparison. Using the criteria weight vector obtained from the CRITIC method, these MCDM techniques were implemented, and the resulting logistics performance scores of emerging markets were computed. Comparative logistics performance results across methods are illustrated in Figure 2, where the performance values derived from OPLO-POCOD were compared with those obtained from

the other methods.

To ensure comparability, the results were standardized using max–min distance normalization, and correlation relationships among the methods were analyzed. The correlation coefficient between OPLO-POCOD and ALWAS was found to be 0.9957, while the correlations with AROMAN, MABAC, MARCOS, SAW, TOPSIS, and WASPAS were 0.9929, 0.9905, 0.8711, 0.9999, 0.9522, and 0.9967, respectively. These high correlation values provided strong empirical evidence supporting the robustness and reliability of the results obtained through the OPLO-POCOD method.

Furthermore, the logistics performance rankings of the 49 emerging countries obtained from all methods are presented in Table 5. Except for the TOPSIS method, China ranked first across all alternative methods, whereas Venezuela was consistently identified as the country with the lowest logistics performance in all rankings. Although variations in country rankings were observed across methods, these differences were method-specific and reflected the distinct computational structures of the applied techniques.

Notable ranking changes were observed in several methods. Under the ALWAS method, changes in ranking occurred in only two countries, namely Ethiopia and Myanmar. In the AROMAN method, Mexico exhibited the largest upward shift, while Ukraine experienced the most significant decline. The MABAC method identified Brazil and Mexico as the countries with the greatest improvement in ranking, whereas Morocco, Jordan, and Ukraine displayed the largest downward movements. In the MARCOS method, Argentina recorded the highest upward change, while Tunisia experienced the most pronounced decline. According to the SAW method, Paraguay and Myanmar demonstrated the largest increase in ranking positions, whereas Ukraine and Ethiopia showed the greatest decrease. Finally, in the WASPAS method, Colombia and Myanmar exhibited the most significant upward movement, while Morocco and Ethiopia experience the largest decline.

Despite these variations of ranking, the overall performance trends remained largely consistent with those obtained from the OPLO-POCOD method. Consequently, the comparative analysis confirmed that the CRITIC–OPLO-POCOD approach effectively and reliably identified the logistics performance levels of emerging markets, thereby demonstrating the methodological robustness and validity of the proposed framework for supporting reliable cross-country comparisons relevant to sustainable development analysis.

6. Results

This section presents the empirical results of the logistics performance assessment for emerging markets based on the 2025 AEMLI dataset, with a focus on identifying structural conditions that shape development-related opportunities and challenges. The empirical findings provided both methodological and practical insights into the determinants of logistics performance in emerging economies and allowed a thorough comparison with the existing literature. From a sustainability perspective, the dominance of business fundamentals indicated that institutional quality and regulatory stability constituted fundamental enabling conditions for long-term development in emerging economies.

The CRITIC-based weighting results revealed that business fundamentals were the most influential criterion in determining the logistics performance of emerging markets, followed by domestic opportunities, international opportunities, and digital readiness. This finding is highly consistent with prior studies which emphasized the critical roles of institutional quality, regulatory environment, investment climate, and macroeconomic stability in the performance of logistics and supply chain. In particular, Kara et al. (2022) and Özekenci (2023) similarly identified business fundamentals as the dominant criterion in the evaluations of logistics performance of the developing countries, thus highlighting the importance of a supportive business ecosystem.

The relatively lower weight assigned to digital readiness, while still significant, suggests that although digital infrastructure enhances logistics efficiency, its impact may be contingent upon the existence of strong institutional and economic foundations. This result aligns with the findings of Kara & Yalçın (2022) and Özbek & Özekenci (2023), who reported that digital readiness became more decisive when evaluated within a technology-focused logistics context rather than in a comprehensive market-level assessment.

The OPLO-POCOD-based ranking results indicated that China consistently emerged as the top-performing country in logistics performance among the emerging markets, while Venezuela ranked lowest. These findings are in strong agreement with the majority of existing studies. Previous research by Kara & Yalçın (2022), Özekenci (2023), and Özekenci (2025) also positioned China as a leading logistics performer and attributed its success to its extensive logistics infrastructure, strong industrial base, and integration into global value chains. This result suggests that countries with strong logistics infrastructure and institutional capacity are better positioned to leverage logistics systems as an opportunity of development.

Similarly, the persistently low ranking of Venezuela across all applied MCDM methods reflected structural economic challenges, institutional inefficiencies, and weak logistics infrastructure, which have also been documented in earlier assessments of logistics performance. The robustness of these extreme rankings across different methods further strengthened the credibility of the proposed framework. Conversely, persistently low logistics performance reflected structural challenges that might constrain sustainable development pathways in

such economies.

To validate the robustness of the CRITIC–OPLO-POCOD results, a comparative analysis was conducted using several widely adopted MCDM methods, including ALWAS, AROMAN, MABAC, MARCOS, SAW, TOPSIS, and WASPAS. The high correlation coefficients observed between OPLO-POCOD and these alternative methods (particularly SAW (0.9999), WASPAS (0.9967), and ALWAS (0.9957)) demonstrated a strong consistency in performance evaluations.

These findings are consistent with the methodological robustness reported in prior comparative studies, such as Gelmez et al. (2024) and Akbulut et al. (2024), in which high inter-method correlations were evidence of the reliability of the result. Although the MARCOS method exhibited a comparatively lower correlation coefficient (0.8711), this deviation could be attributed to methodological differences in reference point construction and normalization procedures rather than inconsistencies in the underlying data.

Despite observable ranking shifts for certain countries (such as Mexico, Brazil, Myanmar, and Ethiopia), the overall performance trends remained stable across the methods. These variations reflect the sensitivity of MCDM techniques to normalization and aggregation procedures, a phenomenon widely acknowledged in the literature. Nevertheless, the consistency of top and bottom performers across the methods reinforces the robustness of the OPLO-POCOD ranking mechanism.

The findings of this study corroborated the dominant themes identified in the logistics performance literature. Similar to studies focusing on OECD, EU, and G20 countries (Gelmez et al., 2024; Kargı, 2022; Miškić et al., 2023), this research confirmed that strong institutional frameworks and business-friendly environments were central to superior logistics performance. However, by concentrating explicitly on emerging markets and employing AEMLI-based criteria, this study extended the existing knowledge beyond traditional global or regional indices such as the LPI.

Overall, the results indicated that differences in logistics performance across the emerging markets primarily reflected variations in institutional strength, business environment, and infrastructure conditions. These structural differences were translated into distinct development-related opportunities and challenges, thus shaping the capacity of countries to support sustainable economic activities. The consistent performance patterns observed across the methods further reinforced the reliability of these insights for cross-country developmental analysis.

7. Implications

The findings of this study offered important insights into the opportunities and challenges associated with sustainable development in the emerging markets, particularly through the lens of logistics performance and structural conditions. By revealing how institutional quality, business environment, and infrastructure shaped the outcomes of logistics, the study also provided methodological and practical implications for cross-country performance evaluation.

7.1. Methodological Implications

From a methodological perspective, this study illustratesd the effectiveness of integrating the CRITIC and OPLO-POCOD methods for country-level logistics performance assessment. The CRITIC method objectively determined criteria weights by simultaneously accounting for the variability of each criterion and the interdependence among the criteria through correlation analysis. This approach mitigated the subjectivity commonly associated with expert-based weighting techniques and enabled a holistic evaluation of logistics performance dimensions. The OPLO-POCOD method further strengthened the evaluation framework by employing ordered pair–based distance calculations, which enhanced the power of discrimination among the alternatives and reduced the likelihood of rank reversal. The high correlation levels observed between OPLO-POCOD and the widely used MCDM methods provided empirical evidence of its robustness and reliability. Consequently, the proposed hybrid framework offers a flexible and replicable methodological tool that can be applied to other multi-criteria performance evaluation contexts, such as transportation systems, resilience of the supply chain, sustainability assessment, and digital transformation analysis. Importantly, the methodological contribution primarily lies in its ability to support reliable identification of development-related opportunities and challenges rather than in methodological novelty itself.

7.2. Practical and Managerial Implications

The empirical results yielded valuable insights into policymakers, logistics service providers, and investors operating in the emerging markets. Additionally, the results highlighted that improvements in domestic logistics capabilities and international connectivity could significantly enhance the attractiveness of a country as a regional logistics hub. The identification of business fundamentals as the most influential criterion underscored the importance of a stable regulatory environment, transparent governance structures, and investment-friendly policies

in enhancing national logistics performance. Governments seeking to improve their logistics competitiveness should prioritize reforms that strengthen institutional quality, reduce bureaucratic barriers, and foster private sector participation in logistics infrastructure and services. For logistics firms and multinational enterprises, the rankings provide a data-driven benchmark for market selection and strategic planning. Countries with higher logistics performance scores represent more favorable environments for logistics investments, expansion of distribution networks, and integration of supply chains.

7.3. Implications for the Emerging Markets

The findings have particular relevance for the emerging markets, where logistics systems often face structural constraints, infrastructural gaps, and institutional challenges. From a sustainability perspective, these findings highlighted that differences in logistics performance reflected more structural opportunities and constraints in shaping long-term development trajectories in the emerging economies. The results indicated that improvements in logistics performance in the emerging economies required a balanced development strategy that goes beyond the investment in infrastructure alone. While physical and digital infrastructure remains essential, the effectiveness of logistics systems is strongly conditioned by broader economic and institutional foundations. Moreover, the relatively lower weight assigned to digital readiness suggests that initiatives of digital transformation in the emerging markets should be aligned with institutional reforms and business environment improvements to maximize their impact. Policymakers should therefore pursue integrated strategies that combine digitalization, regulatory efficiency, and facilitation of international trade to achieve sustainable logistics performance gains.

Finally, the methodological rigor and robustness of the proposed framework suggest its potential use as a decision-support tool in policy evaluation and strategic planning. The framework enables consistent cross-country comparisons and supports evidence-based policymaking by providing objective and transparent logistics performance assessments. Future policy initiatives aimed at improving logistics competitiveness in the emerging markets could benefit from adopting similar objective and comparative evaluation approaches.

8. Conclusions

This study provided a comparative assessment of logistics performance across 49 emerging market countries based on the 2025 AEMLI dataset, with the aim of identifying structural conditions that shaped development-related opportunities and challenges. The results indicated that differences in logistics performance primarily reflected variations in institutional quality, business environment, and infrastructural conditions, rather than isolated operational factors alone.

Business fundamentals emerged as the most influential determinant of logistics performance, as they underscored the critical role of regulatory stability, governance effectiveness, and investment climate in enabling efficient and resilient logistics systems. Countries exhibiting strong institutional foundations, such as China, demonstrated greater capacity to leverage logistics systems as a development opportunity, whereas persistently low-performing countries, such as Venezuela, faced structural constraints that might hinder sustainable development pathways.

The consistency of country rankings across multiple decision-making methods confirmed the robustness of these findings and supported their use for cross-country development analysis. Rather than emphasizing methodological novelty, the value of the proposed framework lied in its ability to provide objective and transparent insights into how logistics systems conditioned economic integration and development prospects in the emerging markets.

From the sustainability perspective, the findings suggested that improving logistics performance in the emerging economies required integrated strategies that extended beyond the investment in infrastructure alone. Institutional reforms, improvements in the business environment, and coordinated trade facilitation policies are essential for transforming logistics systems into effective enablers of sustainable economic activities.

Overall, this study contributes to the literature by linking logistics performance evaluation with broader development challenges and opportunities, thus offering evidence-based insights to support policy prioritization, strategic planning, and targeted interventions in the emerging markets.

8.1. Future Recommendations and Limitations

Despite the contributions of this study, several limitations should be acknowledged. First, the analysis relied exclusively on the data from the 2025 AEMLI report, which, although comprehensive at the national level, might not fully capture sub-national disparities, informal logistics activities, or region-specific development conditions. As a result, variations in logistics-related opportunities and challenges within countries could not be examined in detail.

Second, the evaluation framework was based on four aggregated criteria, i.e., Business Fundamentals, Domestic Opportunities, International Opportunities, and Digital Readiness. While these dimensions reflected key structural

conditions influencing logistics performance, other development-relevant factors, such as environmental sustainability considerations, institutional reform dynamics, labor quality, and social inclusion aspects were not explicitly incorporated and might further shape logistics-related development outcomes in the emerging economies.

Third, the study adopted a cross-sectional perspective by focusing on a single year, which limited the ability to capture dynamic changes in logistics performance or to assess how improvements or declines in logistics systems influenced long-term development trajectories.

Future research might address these limitations by incorporating multi-year or panel datasets to examine the evolution of logistics performance and its implications for sustainable development over the course of time. In addition, extending the framework to include sustainability-oriented indicators, risk-related dimensions, or characteristics of sector-specific logistics could provide a comprehensive understanding of development-related opportunities and constraints. Finally, applying the proposed evaluation approach at regional, sectoral, or city levels might help reveal intra-country disparities and support targeted and more context-sensitive policy analysis in the emerging markets.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

References

Agility. (2025). *The 2025 Agility Emerging Markets Logistics Index (AEMLI) report—Agility & transport intelligence*. https://emli.agility.com/

Akbulut, E. A., Ulutaş, A., Yürüyen, A. A., & Balalan, S. (2024). Measuring the logistics performance of G20 countries with a hybrid MCDM model. *Bus. Manag. Stud. Int. J.*, *12*, 1–21. https://doi.org/10.15295/bmij.v12i1.2300.

Arvis, J. F., Ojala, L., Shepherd, B., Ulybina, D., & Wiederer, C. (2023). *Connecting to compete 2023: Trade logistics in the global economy—The Logistics Performance Index and its indicators.* World Bank. https://lpi.worldbank.org/sites/default/files/2023-04/LPI_2023_report_with_layout.pdf

Bošković, S., Švadlenka, L., Jovčić, S., Dobrodolac, M., Simić, V., & Bacanin, N. (2023). An alternative ranking order method accounting for two-step normalization (AROMAN)—A case study of the electric vehicle selection problem. *IEEE Access*, *11*, 39496–39507. https://doi.org/10.1109/ACCESS.2023.3265818.

Bulut, E. & Abacıoğlu, S. (2025). How criteria weights influence performance in evaluating logistic productivity: An application in the emerging markets logistics index. *J. Prod.*, 1–28. https://doi.org/10.51551/verimlilik.1518693.

Chakraborty, S. & Zavadskas, E. K. (2014). Applications of WASPAS method in manufacturing decision making. *Informatica*, *25*, 1–20. https://doi.org/10.3233/INF-2014-25(1)01.

Çıray, D., Özdemir, Ü., & Mete, S. (2024). An evaluation of the logistics performance index using the ENTROPY-based ORESTE method. *J. Transp. Logist.*, *9*, 68–82. https://doi.org/10.26650/JTL.2024.1437070.

Diakoulaki, D., Mavrotas, G., & Papayannakis, L. (1995). Determining objective weights in multiple criteria problems: The CRITIC method. *Comput. Oper. Res.*, *22*, 763–770. https://doi.org/10.1016/0305-0548(94)00059-H.

Ekici, Ş. Ö., Kabak, Ö., & Ülengin, F. (2016). Linking to compete: Logistics and global competitiveness interaction. *Transp. Policy*, *48*, 117–128. https://doi.org/10.1016/j.tranpol.2016.01.015.

Gani, A. (2017). The logistics performance effect in international trade. *Asian J. Shipp. Logist.*, *33*, 279–288. https://doi.org/10.1016/j.ajsl.2017.12.012.

Gelmez, E., Güleş, H. K., & Zerenler, M. (2024). Evaluation of logistics performances of G20 countries using SD-based COPRAS and SAW methods. *J. Turk. Oper. Manag.*, *8*, 339–353. https://doi.org/10.56554/jtom.1471209.

Hadzikadunic, A., Stevic, Z., Badi, I., & Roso, V. (2023). Evaluating the logistics performance index of European Union countries: An integrated multi-criteria decision-making approach utilizing the Bonferroni operator. *Int. J. Knowl. Innov. Stud.*, *1*, 44–59. https://doi.org/10.56578/ijkis010104.

Kara, K., Bentyn, Z., & Yalçın, G. C. (2022). Determining the logistics market performance of developing countries by entropy and MABAC methods. *LogForum*, *18*, 421–434. https://doi.org/10.17270/J.LOG.2022.752.

Kara, K. & Yalçın, G. C. (2022). *Digital logistics market performance of developing countries.* https://akademikbirikimdergisi.com/index.php/uabd/article/view/62

Kargı, V. S. A. (2022). Evaluation of logistics performance of the OECD member countries with integrated Entropy and WASPAS method. *J. Manag. Econ.*, *29*, 801–811. https://doi.org/10.18657/yonveek.1067480.
Lai, Y. J., Liu, T. Y., & Hwang, C. L. (1994). TOPSIS for MCDM. *Eur. J. Oper. Res.*, *76*, 486–500. https://doi.org/10.1016/0377-2217(94)90282-8.
Martí, L., Martín, J. C., & Puertas, R. (2017). A DEA-logistics performance index. *J. Appl. Econ.*, *20*, 169–192. https://doi.org/10.1016/S1514-0326(17)30008-9
Miškić, S., Stević, Ž., Tadić, S., Alkhayyat, A., & Krstić, M. (2023). Assessment of the LPI of the EU countries using MCDM model with an emphasis on the importance of criteria. *World Rev. Intermodal Transp. Res.*, *11*, 258–279. https://doi.org/10.1504/WRITR.2023.132501.
Nayak, N., Pant, P., Sarmah, S. P., & Tulshan, R. (2024). Development of in-country logistics performance index for emerging economies: A case of Indian states. *Int. J. Product. Perform. Manag.*, *73*, 2926–2950. https://doi.org/10.1108/IJPPM-03-2023-0122.
Özbek, H. E. & Özekenci, E. K. (2023). Investigation of digital logistics market performance in developing countries with hybrid MCDM methods. *J. Emerg. Econ. Policy*, *8*, 559–576. https://dergipark.org.tr/en/pub/joeep/article/1374277.
Özekenci, E. K. (2023). Assessing the logistics market performance of developing countries by SWARA-CRITIC based CoCoSo methods. *LogForum*, *19*. https://doi.org/10.17270/J.LOG.2023.857.
Özekenci, E. K. (2025). Assessment of green logistics market performance of selected countries: A comprehensive and novel multi-criteria decision-making approach. *Zagreb Int. Rev. Econ. Bus.*, *28*, 255–286. https://doi.org/10.2478/zireb-2025-0024.
Pamučar, D. & Ćirović, G. (2015). The selection of transport and handling resources in logistics centers using Multi-Attributive Border Approximation Area Comparison (MABAC). *Expert Syst. Appl.*, *42*, 3016–3028. https://doi.org/10.1016/j.eswa.2014.11.057.
Pamucar, D., Ecer, F., Gligorić, Z., Gligorić, M., & Deveci, M. (2023). A novel WENSLO and ALWAS multicriteria methodology and its application to green growth performance evaluation. *IEEE Trans. Eng. Manag.*,*71*, 9510–9525. https://doi.org/10.1109/TEM.2023.3321697.
Sheikh, R. & Senfi, S. (2024). A novel opportunity losses-based polar coordinate distance (OPLO-POCOD) approach to multiple criteria decision-making. *J. Math.*, *2024*, 8845886. https://doi.org/10.1155/2024/8845886.
Stević, Ž., Pamučar, D., Puška, A., & Chatterjee, P. (2020). Sustainable supplier selection in healthcare industries using a new MCDM method: Measurement of alternatives and ranking according to compromise solution (MARCOS). *Comput. Ind. Eng.*, *140*, 106231. https://doi.org/10.1016/j.cie.2019.106231.
Tang, C. F. & Abosedra, S. (2019). Logistics performance, exports, and growth: Evidence from Asian economies. *Res. Transp. Econ.*, *78*, 100743. https://doi.org/10.1016/j.retrec.2019.100743.

Appendix

Table A1. Notations for the CRITIC–OPLO-POCOD method

Indices and Sets	
$p = 1,2,\dots,P$	index of emerging markets
$t = 1,2,\dots,T$	index of emerging market logistics performance evaluation criteria
$\text{Å} = \{\text{Å}_1, \text{Å}_2, \dots, \text{Å}_p, \dots, \text{Å}_P\}$	set of emerging markets
$\wp = \{\wp_1, \wp_2, \dots, \wp_t, \dots, \wp_t\}$	set of emerging market logistics performance evaluation criteria
$\wp^- \subseteq \wp$	set of cost-based emerging market logistics performance evaluation criteria,
$\wp^+ \subseteq \wp$	set of benefit-based emerging market logistics performance evaluation criteria
Parameters	
$P \geq 2$	number of emerging markets
$T \geq 2$	number of emerging market logistics performance evaluation criteria
Variables	
$\mathcal{G}_{pt}(p \in \text{Å}, t \in \wp)$	initial score of the emerging market Å_p according to emerging market logistics performance evaluation criterion $\wp_t$
$\mathcal{K}_{pt}(p \in \text{Å}, t \in \wp)$	normalized value of the emerging market Å_p according to emerging market logistics performance evaluation criterion $\wp_t$
$\mathcal{H}_{tt'}(t, t' \in \wp)$	correlation value of the emerging market logistics performance evaluation criterion $\wp_t$ according to emerging market logistics performance evaluation criterion $\wp_{t'}$
$\mathcal{F}_t(t \in \wp)$	information value of the emerging market logistics performance evaluation criterion $\wp_t$
$\varpi_t(t \in \wp)$	weight of the emerging market logistics performance evaluation criterion $\wp_t$

$\mathcal{U}_{pt}(p \in Å, t \in \wp)$	distance value of the emerging market $Å_p$ according to emerging market logistics performance evaluation criterion $\wp_t$
$\mathcal{Q}_{pt}(p \in Å, t \in \wp)$	ordered pairs value of the emerging market $Å_p$ according to emerging market logistics performance evaluation criterion $\wp_t$
$\mathcal{B}_t(\ t \in \wp)$	best ordered value of the emerging market logistics performance evaluation criterion $\wp_t$,
$\mathcal{D}_{pt}(p \in Å, t \in \wp)$	final distance value of the emerging market $Å_p$ according to emerging market logistics performance evaluation criterion $\wp_t$
$\mathcal{X}_{pt}(p \in Å, t \in \wp)$	weighted distance value of the emerging market $Å_p$ according to emerging market logistics performance evaluation criterion $\wp_t$
$\mathcal{Y}_p(p \in Å)$	opportunity loss value of the emerging market $Å_p$
$\mathcal{Z}_p(p \in Å)$	normalized opportunity loss value of the emerging market $Å_p$
$\mathcal{R}_p(p \in Å)$	performance value of the emerging market $Å_p$

Table A2. Normalized matrix $\left(\mathcal{K} = [\mathcal{K}_{pt}]_{pT}\right)$ for the CRITIC method

Code	Country	Domestic Opportunities ($\wp_1$)	International Opportunities ($\wp_2$)	Business Fundamentals ($\wp_3$)	Digital Readiness ($\wp_4$)
$Å_1$	China	1.0000	1.0000	0.7363	1.0000
$Å_2$	India	0.7735	0.6163	0.6947	0.4707
$Å_3$	UAE	0.3021	0.3339	1.0000	0.6250
$Å_4$	Saudi Arabia	0.3204	0.3641	0.8681	0.4824
$Å_5$	Malaysia	0.2403	0.3126	0.9011	0.5977
$Å_6$	Indonesia	0.4462	0.3730	0.6728	0.4023
$Å_7$	Mexico	0.2929	0.4316	0.6435	0.3711
$Å_8$	Qatar	0.2632	0.1599	0.8095	0.5664
$Å_9$	Thailand	0.1922	0.3268	0.6838	0.4824
$Å_{10}$	Vietnam	0.2014	0.3179	0.6923	0.3945
$Å_{11}$	Chile	0.1533	0.1865	0.7985	0.4551
$Å_{12}$	Türkiye	0.2517	0.2469	0.5812	0.4512
$Å_{13}$	Brazil	0.2975	0.3126	0.4689	0.3594
$Å_{14}$	Oman	0.1945	0.1243	0.7790	0.4277
$Å_{15}$	Bahrain	0.1785	0.0835	0.8022	0.4629
$Å_{16}$	Jordan	0.1304	0.1066	0.8315	0.3672
$Å_{17}$	Kuwait	0.1968	0.0888	0.6947	0.3789
$Å_{18}$	Uruguay	0.1373	0.0799	0.7753	0.3652
$Å_{19}$	South Africa	0.1419	0.1723	0.5873	0.3320
$Å_{20}$	Colombia	0.1465	0.1687	0.6300	0.2754
$Å_{21}$	Kenya	0.0778	0.1297	0.6105	0.4082
$Å_{22}$	Philippines	0.1739	0.1652	0.5116	0.3320
$Å_{23}$	Egypt	0.1602	0.1599	0.5812	0.2500
$Å_{24}$	Kazakhstan	0.0778	0.0675	0.6874	0.3848
$Å_{25}$	Morocco	0.0870	0.1314	0.6740	0.2461
$Å_{26}$	Sri Lanka	0.1487	0.1190	0.4701	0.3652
$Å_{27}$	Peru	0.1236	0.1368	0.5751	0.2383
$Å_{28}$	Argentina	0.1579	0.1403	0.3956	0.2891
$Å_{29}$	Cambodia	0.0458	0.0959	0.5775	0.2871
$Å_{30}$	Ghana	0.1030	0.1208	0.5287	0.2246
$Å_{31}$	Iran	0.1625	0.1012	0.4127	0.3086
$Å_{32}$	Pakistan	0.1487	0.1172	0.4518	0.2129
$Å_{33}$	Ecuador	0.0824	0.0995	0.5031	0.2402
$Å_{34}$	Paraguay	0.0755	0.0675	0.4786	0.3262
$Å_{35}$	Tunisia	0.0641	0.1012	0.5910	0.1289
$Å_{36}$	Tanzania	0.1053	0.0391	0.5324	0.2422
$Å_{37}$	Algeria	0.1213	0.1048	0.4945	0.1270
$Å_{38}$	Bangladesh	0.1465	0.0639	0.5201	0.2344
$Å_{39}$	Ukraine	0.0183	0.0728	0.5201	0.2422
$Å_{40}$	Uganda	0.0755	0.0675	0.4396	0.2207
$Å_{41}$	Lebanon	0.1304	0.0426	0.4127	0.2031
$Å_{42}$	Nigeria	0.1396	0.0906	0.3810	0.1230
$Å_{43}$	Bolivia	0.0984	0.0586	0.3553	0.2090

$Å_{44}$	Ethiopia	0.0503	0.1119	0.2967	0.2129
$Å_{45}$	Libya	0.1030	0.0551	0.3895	0.1152
$Å_{46}$	Angola	0.0801	0.0657	0.2503	0.0723
$Å_{47}$	Mozambique	0.0412	0.0480	0.2564	0.1348
$Å_{48}$	Myanmar	0.0000	0.0426	0.4005	0.0000
$Å_{49}$	Venezuela	0.1739	0.0000	0.0000	0.0625

Table A3. Criteria correlation matrix $(\mathcal{H} = [\mathcal{H}_{tt'}]_{TT})$ and criterion information vector $(\mathcal{F} = [\mathcal{F}_t]_T)$ for the CRITIC method

Code	Domestic Opportunities $(\wp_1)$	International Opportunities $(\wp_2)$	Business Fundamentals $(\wp_3)$	Digital Readiness $(\wp_4)$
$\wp_1$	1.0000	0.9262	0.3650	0.7299
$\wp_2$	0.9262	1.0000	0.4472	0.7707
$\wp_3$	0.3650	0.4472	1.0000	0.7391
$\wp_4$	0.7299	0.7707	0.7391	1.0000
$\mathcal{F}_t$	0.1682	0.1468	0.2758	0.1302

Table A4. Distances matrix $\left(\mathcal{U} = [\mathcal{U}_{pt}]_{PT}\right)$ for the OPLO-POCOD method

Code	Country	Domestic Opportunities $(\wp_1)$	International Opportunities $(\wp_2)$	Business Fundamentals $(\wp_3)$	Digital Readiness $(\wp_4)$
$Å_1$	China	0.0000	0.0000	2.1600	0.0000
$Å_2$	India	0.9900	2.1600	2.5000	2.7100
$Å_3$	UAE	3.0500	3.7500	0.0000	1.9200
$Å_4$	Saudi Arabia	2.9700	3.5800	1.0800	2.6500
$Å_5$	Malaysia	3.3200	3.8700	0.8100	2.0600
$Å_6$	Indonesia	2.4200	3.5300	2.6800	3.0600
$Å_7$	Mexico	3.0900	3.2000	2.9200	3.2200
$Å_8$	Qatar	3.2200	4.7300	1.5600	2.2200
$Å_9$	Thailand	3.5300	3.7900	2.5900	2.6500
$Å_{10}$	Vietnam	3.4900	3.8400	2.5200	3.1000
$Å_{11}$	Chile	3.7000	4.5800	1.6500	2.7900
$Å_{12}$	Türkiye	3.2700	4.2400	3.4300	2.8100
$Å_{13}$	Brazil	3.0700	3.8700	4.3500	3.2800
$Å_{14}$	Oman	3.5200	4.9300	1.8100	2.9300
$Å_{15}$	Bahrain	3.5900	5.1600	1.6200	2.7500
$Å_{16}$	Jordan	3.8000	5.0300	1.3800	3.2400
$Å_{17}$	Kuwait	3.5100	5.1300	2.5000	3.1800
$Å_{18}$	Uruguay	3.7700	5.1800	1.8400	3.2500
$Å_{19}$	South Africa	3.7500	4.6600	3.3800	3.4200
$Å_{20}$	Colombia	3.7300	4.6800	3.0300	3.7100
$Å_{21}$	Kenya	4.0300	4.9000	3.1900	3.0300
$Å_{22}$	Philippines	3.6100	4.7000	4.0000	3.4200
$Å_{23}$	Egypt	3.6700	4.7300	3.4300	3.8400
$Å_{24}$	Kazakhstan	4.0300	5.2500	2.5600	3.1500
$Å_{25}$	Morocco	3.9900	4.8900	2.6700	3.8600
$Å_{26}$	Sri Lanka	3.7200	4.9600	4.3400	3.2500
$Å_{27}$	Peru	3.8300	4.8600	3.4800	3.9000
$Å_{28}$	Argentina	3.6800	4.8400	4.9500	3.6400
$Å_{29}$	Cambodia	4.1700	5.0900	3.4600	3.6500
$Å_{30}$	Ghana	3.9200	4.9500	3.8600	3.9700
$Å_{31}$	Iran	3.6600	5.0600	4.8100	3.5400
$Å_{32}$	Pakistan	3.7200	4.9700	4.4900	4.0300
$Å_{33}$	Ecuador	4.0100	5.0700	4.0700	3.8900
$Å_{34}$	Paraguay	4.0400	5.2500	4.2700	3.4500
$Å_{35}$	Tunisia	4.0900	5.0600	3.3500	4.4600
$Å_{36}$	Tanzania	3.9100	5.4100	3.8300	3.8800
$Å_{37}$	Algeria	3.8400	5.0400	4.1400	4.4700
$Å_{38}$	Bangladesh	3.7300	5.2700	3.9300	3.9200
$Å_{39}$	Ukraine	4.2900	5.2200	3.9300	3.8800

$Å_{40}$	Uganda	4.0400	5.2500	4.5900	3.9900
$Å_{41}$	Lebanon	3.8000	5.3900	4.8100	4.0800
$Å_{42}$	Nigeria	3.7600	5.1200	5.0700	4.4900
$Å_{43}$	Bolivia	3.9400	5.3000	5.2800	4.0500
$Å_{44}$	Ethiopia	4.1500	5.0000	5.7600	4.0300
$Å_{45}$	Libya	3.9200	5.3200	5.0000	4.5300
$Å_{46}$	Angola	4.0200	5.2600	6.1400	4.7500
$Å_{47}$	Mozambique	4.1900	5.3600	6.0900	4.4300
$Å_{48}$	Myanmar	4.3700	5.3900	4.9100	5.1200
$Å_{49}$	Venezuela	3.6100	5.6300	8.1900	4.8000

Table A5. Distances matrix $\left(\mathcal{U} = \left[\mathcal{U}_{pt}\right]_{PT}\right)$ and best ordered pair $(\mathcal{B} = [\mathcal{B}_t]_T)$ for the OPLO-POCOD method

Code	Country	Domestic Opportunities ($\wp_1$)		International Opportunities ($\wp_2$)		Business Fundamentals ($\wp_3$)		Digital Readiness ($\wp_4$)	
$Å_1$	China	8.5800	0.0000	9.6500	0.0000	6.3700	2.1600	8.4700	0.0000
$Å_2$	India	7.5900	0.9900	7.4900	2.1600	6.0300	2.5000	5.7600	2.7100
$Å_3$	UAE	5.5300	3.0500	5.9000	3.7500	8.5300	0.0000	6.5500	1.9200
$Å_4$	Saudi Arabia	5.6100	2.9700	6.0700	3.5800	7.4500	1.0800	5.8200	2.6500
$Å_5$	Malaysia	5.2600	3.3200	5.7800	3.8700	7.7200	0.8100	6.4100	2.0600
$Å_6$	Indonesia	6.1600	2.4200	6.1200	3.5300	5.8500	2.6800	5.4100	3.0600
$Å_7$	Mexico	5.4900	3.0900	6.4500	3.2000	5.6100	2.9200	5.2500	3.2200
$Å_8$	Qatar	5.3600	3.2200	4.9200	4.7300	6.9700	1.5600	6.2500	2.2200
$Å_9$	Thailand	5.0500	3.5300	5.8600	3.7900	5.9400	2.5900	5.8200	2.6500
$Å_{10}$	Vietnam	5.0900	3.4900	5.8100	3.8400	6.0100	2.5200	5.3700	3.1000
$Å_{11}$	Chile	4.8800	3.7000	5.0700	4.5800	6.8800	1.6500	5.6800	2.7900
$Å_{12}$	Türkiye	5.3100	3.2700	5.4100	4.2400	5.1000	3.4300	5.6600	2.8100
$Å_{13}$	Brazil	5.5100	3.0700	5.7800	3.8700	4.1800	4.3500	5.1900	3.2800
$Å_{14}$	Oman	5.0600	3.5200	4.7200	4.9300	6.7200	1.8100	5.5400	2.9300
$Å_{15}$	Bahrain	4.9900	3.5900	4.4900	5.1600	6.9100	1.6200	5.7200	2.7500
$Å_{16}$	Jordan	4.7800	3.8000	4.6200	5.0300	7.1500	1.3800	5.2300	3.2400
$Å_{17}$	Kuwait	5.0700	3.5100	4.5200	5.1300	6.0300	2.5000	5.2900	3.1800
$Å_{18}$	Uruguay	4.8100	3.7700	4.4700	5.1800	6.6900	1.8400	5.2200	3.2500
$Å_{19}$	South Africa	4.8300	3.7500	4.9900	4.6600	5.1500	3.3800	5.0500	3.4200
$Å_{20}$	Colombia	4.8500	3.7300	4.9700	4.6800	5.5000	3.0300	4.7600	3.7100
$Å_{21}$	Kenya	4.5500	4.0300	4.7500	4.9000	5.3400	3.1900	5.4400	3.0300
$Å_{22}$	Philippines	4.9700	3.6100	4.9500	4.7000	4.5300	4.0000	5.0500	3.4200
$Å_{23}$	Egypt	4.9100	3.6700	4.9200	4.7300	5.1000	3.4300	4.6300	3.8400
$Å_{24}$	Kazakhstan	4.5500	4.0300	4.4000	5.2500	5.9700	2.5600	5.3200	3.1500
$Å_{25}$	Morocco	4.5900	3.9900	4.7600	4.8900	5.8600	2.6700	4.6100	3.8600
$Å_{26}$	Sri Lanka	4.8600	3.7200	4.6900	4.9600	4.1900	4.3400	5.2200	3.2500
$Å_{27}$	Peru	4.7500	3.8300	4.7900	4.8600	5.0500	3.4800	4.5700	3.9000
$Å_{28}$	Argentina	4.9000	3.6800	4.8100	4.8400	3.5800	4.9500	4.8300	3.6400
$Å_{29}$	Cambodia	4.4100	4.1700	4.5600	5.0900	5.0700	3.4600	4.8200	3.6500
$Å_{30}$	Ghana	4.6600	3.9200	4.7000	4.9500	4.6700	3.8600	4.5000	3.9700
$Å_{31}$	Iran	4.9200	3.6600	4.5900	5.0600	3.7200	4.8100	4.9300	3.5400
$Å_{32}$	Pakistan	4.8600	3.7200	4.6800	4.9700	4.0400	4.4900	4.4400	4.0300
$Å_{33}$	Ecuador	4.5700	4.0100	4.5800	5.0700	4.4600	4.0700	4.5800	3.8900
$Å_{34}$	Paraguay	4.5400	4.0400	4.4000	5.2500	4.2600	4.2700	5.0200	3.4500
$Å_{35}$	Tunisia	4.4900	4.0900	4.5900	5.0600	5.1800	3.3500	4.0100	4.4600
$Å_{36}$	Tanzania	4.6700	3.9100	4.2400	5.4100	4.7000	3.8300	4.5900	3.8800
$Å_{37}$	Algeria	4.7400	3.8400	4.6100	5.0400	4.3900	4.1400	4.0000	4.4700
$Å_{38}$	Bangladesh	4.8500	3.7300	4.3800	5.2700	4.6000	3.9300	4.5500	3.9200
$Å_{39}$	Ukraine	4.2900	4.2900	4.4300	5.2200	4.6000	3.9300	4.5900	3.8800
$Å_{40}$	Uganda	4.5400	4.0400	4.4000	5.2500	3.9400	4.5900	4.4800	3.9900
$Å_{41}$	Lebanon	4.7800	3.8000	4.2600	5.3900	3.7200	4.8100	4.3900	4.0800
$Å_{42}$	Nigeria	4.8200	3.7600	4.5300	5.1200	3.4600	5.0700	3.9800	4.4900
$Å_{43}$	Bolivia	4.6400	3.9400	4.3500	5.3000	3.2500	5.2800	4.4200	4.0500
$Å_{44}$	Ethiopia	4.4300	4.1500	4.6500	5.0000	2.7700	5.7600	4.4400	4.0300
$Å_{45}$	Libya	4.6600	3.9200	4.3300	5.3200	3.5300	5.0000	3.9400	4.5300

$Å_{46}$	Angola	4.5600	4.0200	4.3900	5.2600	2.3900	6.1400	3.7200	4.7500
$Å_{47}$	Mozambique	4.3900	4.1900	4.2900	5.3600	2.4400	6.0900	4.0400	4.4300
$Å_{48}$	Myanmar	4.2100	4.3700	4.2600	5.3900	3.6200	4.9100	3.3500	5.1200
$Å_{49}$	Venezuela	4.9700	3.6100	4.0200	5.6300	0.3400	8.1900	3.6700	4.8000
	$\mathcal{B}_t$	8.5800	0.0000	9.6500	0.0000	8.5300	0.0000	8.4700	0.0000

Table A6. Final distance matrix $\left(\mathcal{D} = \left[\mathcal{D}_{pt}\right]_{PT}\right)$ for the OPLO-POCOD method

Code	*Country*	Domestic Opportunities ($\wp_1$)	International Opportunities ($\wp_2$)	Business Fundamentals ($\wp_3$)	Digital Readiness ($\wp_4$)
$Å_1$	China	0.0000	0.0000	3.0547	0.0000
$Å_2$	India	1.4001	3.0547	3.5355	3.8325
$Å_3$	UAE	4.3134	5.3033	0.0000	2.7153
$Å_4$	Saudi Arabia	4.2002	5.0629	1.5274	3.7477
$Å_5$	Malaysia	4.6952	5.4730	1.1455	2.9133
$Å_6$	Indonesia	3.4224	4.9922	3.7901	4.3275
$Å_7$	Mexico	4.3699	4.5255	4.1295	4.5538
$Å_8$	Qatar	4.5538	6.6892	2.2062	3.1396
$Å_9$	Thailand	4.9922	5.3599	3.6628	3.7477
$Å_{10}$	Vietnam	4.9356	5.4306	3.5638	4.3841
$Å_{11}$	Chile	5.2326	6.4771	2.3335	3.9457
$Å_{12}$	Türkiye	4.6245	5.9963	4.8508	3.9739
$Å_{13}$	Brazil	4.3416	5.4730	6.1518	4.6386
$Å_{14}$	Oman	4.9780	6.9721	2.5597	4.1436
$Å_{15}$	Bahrain	5.0770	7.2973	2.2910	3.8891
$Å_{16}$	Jordan	5.3740	7.1135	1.9516	4.5821
$Å_{17}$	Kuwait	4.9639	7.2549	3.5355	4.4972
$Å_{18}$	Uruguay	5.3316	7.3256	2.6022	4.5962
$Å_{19}$	South Africa	5.3033	6.5902	4.7800	4.8366
$Å_{20}$	Colombia	5.2750	6.6185	4.2851	5.2467
$Å_{21}$	Kenya	5.6993	6.9296	4.5113	4.2851
$Å_{22}$	Philippines	5.1053	6.6468	5.6569	4.8366
$Å_{23}$	Egypt	5.1902	6.6892	4.8508	5.4306
$Å_{24}$	Kazakhstan	5.6993	7.4246	3.6204	4.4548
$Å_{25}$	Morocco	5.6427	6.9155	3.7760	5.4589
$Å_{26}$	Sri Lanka	5.2609	7.0145	6.1377	4.5962
$Å_{27}$	Peru	5.4164	6.8731	4.9215	5.5154
$Å_{28}$	Argentina	5.2043	6.8448	7.0004	5.1477
$Å_{29}$	Cambodia	5.8973	7.1983	4.8932	5.1619
$Å_{30}$	Ghana	5.5437	7.0004	5.4589	5.6144
$Å_{31}$	Iran	5.1760	7.1559	6.8024	5.0063
$Å_{32}$	Pakistan	5.2609	7.0286	6.3498	5.6993
$Å_{33}$	Ecuador	5.6710	7.1701	5.7558	5.5013
$Å_{34}$	Paraguay	5.7134	7.4246	6.0387	4.8790
$Å_{35}$	Tunisia	5.7841	7.1559	4.7376	6.3074
$Å_{36}$	Tanzania	5.5296	7.6509	5.4164	5.4871
$Å_{37}$	Algeria	5.4306	7.1276	5.8548	6.3215
$Å_{38}$	Bangladesh	5.2750	7.4529	5.5579	5.5437
$Å_{39}$	Ukraine	6.0670	7.3822	5.5579	5.4871
$Å_{40}$	Uganda	5.7134	7.4246	6.4912	5.6427
$Å_{41}$	Lebanon	5.3740	7.6226	6.8024	5.7700
$Å_{42}$	Nigeria	5.3174	7.2408	7.1701	6.3498
$Å_{43}$	Bolivia	5.5720	7.4953	7.4670	5.7276
$Å_{44}$	Ethiopia	5.8690	7.0711	8.1459	5.6993
$Å_{45}$	Libya	5.5437	7.5236	7.0711	6.4064
$Å_{46}$	Angola	5.6851	7.4388	8.6833	6.7175
$Å_{47}$	Mozambique	5.9256	7.5802	8.6126	6.2650
$Å_{48}$	Myanmar	6.1801	7.6226	6.9438	7.2408
$Å_{49}$	Venezuela	5.1053	7.9620	11.5824	6.7882

Table A7. Weighted distance matrix $\left(\mathcal{X} = [\mathcal{X}_{pt}]_{PT}\right)$ and the opportunity loss values $\left(\mathcal{Y} = [\mathcal{Y}_p]_P\right)$ and the normalized opportunity loss values $\left(\mathcal{Z} = [\mathcal{Z}_p]_P\right)$ for the OPLO-POCOD method

Code	Country	Domestic Opportunities ($\wp_1$)	International Opportunities ($\wp_2$)	Business Fundamentals ($\wp_3$)	Digital Readiness ($\wp_4$)	$\mathcal{Y}_p$	$\mathcal{Z}_p$
$Å_1$	China	0.0000	0.0000	1.1683	0.0000	1.1683	0.0045
$Å_2$	India	0.3266	0.6221	1.3522	0.6923	2.9931	0.0115
$Å_3$	UAE	1.0061	1.0800	0.0000	0.4905	2.5766	0.0099
$Å_4$	Saudi Arabia	0.9797	1.0311	0.5841	0.6770	3.2719	0.0126
$Å_5$	Malaysia	1.0952	1.1146	0.4381	0.5263	3.1741	0.0122
$Å_6$	Indonesia	0.7983	1.0167	1.4495	0.7817	4.0462	0.0155
$Å_7$	Mexico	1.0193	0.9216	1.5793	0.8226	4.3429	0.0167
$Å_8$	Qatar	1.0622	1.3623	0.8438	0.5671	3.8354	0.0147
$Å_9$	Thailand	1.1645	1.0915	1.4008	0.6770	4.3338	0.0166
$Å_{10}$	Vietnam	1.1513	1.1059	1.3630	0.7919	4.4121	0.0169
$Å_{11}$	Chile	1.2205	1.3191	0.8924	0.7127	4.1448	0.0159
$Å_{12}$	Türkiye	1.0787	1.2212	1.8552	0.7178	4.8729	0.0187
$Å_{13}$	Brazil	1.0127	1.1146	2.3528	0.8379	5.3180	0.0204
$Å_{14}$	Oman	1.1612	1.4199	0.9790	0.7485	4.3085	0.0165
$Å_{15}$	Bahrain	1.1843	1.4861	0.8762	0.7025	4.2491	0.0163
$Å_{16}$	Jordan	1.2535	1.4487	0.7464	0.8277	4.2763	0.0164
$Å_{17}$	Kuwait	1.1579	1.4775	1.3522	0.8124	4.7999	0.0184
$Å_{18}$	Uruguay	1.2436	1.4919	0.9952	0.8303	4.5610	0.0175
$Å_{19}$	South Africa	1.2370	1.3421	1.8281	0.8737	5.2810	0.0203
$Å_{20}$	Colombia	1.2304	1.3479	1.6388	0.9478	5.1649	0.0198
$Å_{21}$	Kenya	1.3294	1.4112	1.7254	0.7741	5.2401	0.0201
$Å_{22}$	Philippines	1.1909	1.3536	2.1635	0.8737	5.5816	0.0214
$Å_{23}$	Egypt	1.2106	1.3623	1.8552	0.9810	5.4091	0.0208
$Å_{24}$	Kazakhstan	1.3294	1.5120	1.3846	0.8047	5.0308	0.0193
$Å_{25}$	Morocco	1.3162	1.4084	1.4441	0.9861	5.1548	0.0198
$Å_{26}$	Sri Lanka	1.2271	1.4285	2.3474	0.8303	5.8333	0.0224
$Å_{27}$	Peru	1.2634	1.3997	1.8822	0.9963	5.5417	0.0213
$Å_{28}$	Argentina	1.2139	1.3940	2.6773	0.9299	6.2151	0.0239
$Å_{29}$	Cambodia	1.3756	1.4660	1.8714	0.9324	5.6454	0.0217
$Å_{30}$	Ghana	1.2931	1.4256	2.0877	1.0142	5.8207	0.0223
$Å_{31}$	Iran	1.2073	1.4573	2.6016	0.9043	6.1706	0.0237
$Å_{32}$	Pakistan	1.2271	1.4314	2.4285	1.0295	6.1165	0.0235
$Å_{33}$	Ecuador	1.3228	1.4602	2.2013	0.9937	5.9781	0.0229
$Å_{34}$	Paraguay	1.3327	1.5120	2.3095	0.8813	6.0356	0.0232
$Å_{35}$	Tunisia	1.3492	1.4573	1.8119	1.1394	5.7578	0.0221
$Å_{36}$	Tanzania	1.2898	1.5581	2.0715	0.9912	5.9107	0.0227
$Å_{37}$	Algeria	1.2667	1.4516	2.2392	1.1419	6.0994	0.0234
$Å_{38}$	Bangladesh	1.2304	1.5178	2.1256	1.0014	5.8753	0.0226
$Å_{39}$	Ukraine	1.4152	1.5034	2.1256	0.9912	6.0354	0.0232
$Å_{40}$	Uganda	1.3327	1.5120	2.4826	1.0193	6.3466	0.0244
$Å_{41}$	Lebanon	1.2535	1.5524	2.6016	1.0423	6.4497	0.0248
$Å_{42}$	Nigeria	1.2403	1.4746	2.7422	1.1470	6.6042	0.0254
$Å_{43}$	Bolivia	1.2997	1.5264	2.8558	1.0346	6.7166	0.0258
$Å_{44}$	Ethiopia	1.3690	1.4400	3.1154	1.0295	6.9539	0.0267
$Å_{45}$	Libya	1.2931	1.5322	2.7043	1.1572	6.6869	0.0257
$Å_{46}$	Angola	1.3261	1.5149	3.3209	1.2134	7.3754	0.0283
$Å_{47}$	Mozambique	1.3822	1.5437	3.2939	1.1317	7.3515	0.0282
$Å_{48}$	Myanmar	1.4416	1.5524	2.6557	1.3080	6.9575	0.0267
$Å_{49}$	Venezuela	1.1909	1.6215	4.4297	1.2262	8.4683	0.0325