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DECONSTRUCTING SDG PERFORMANCE FOR STRATEGIC INSIGHT: QUANTITATIVE INSIGHTS FROM TÜRKİYE AND EUROPEAN COUNTRIES

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Abstract
Significant disparities remain in the achievement of Sustainable Development Goals (SDGs) among European Union (EU) member and candidate countries, despite their common commitments. This article aims to address this issue by examining Türkiye's SDG performance through an in-depth, indicator-based comparative analysis with other EU and non-EU European countries. The methods include standardized scoring of indicators on a 1–10 Likert scale, regression analyses, and comparative visualization techniques. The data comprises quantitative SDG indicators from the EUROSTAT database, gathered from April to August 2024, encompassing 79 indicators related to 16 SDGs. Findings reveal that while Türkiye holds the lowest overall rank, it exhibits notably high performance in specific indicators significantly surpassing the European average in certain areas. These strengths highlight substantial potential areas where Türkiye can leverage existing successes to enhance its overall sustainability performance. However, Türkiye also demonstrates critical weaknesses, with the lowest scores in 32 out of 79 indicators, particularly in SDGs such as gender equality, affordable and clean energy, decent work and economic growth, and no poverty. The study's results provide policymakers with detailed insights into Türkiye's SDG-related strengths and weaknesses, guiding targeted interventions to reinforce and expand upon these areas. This focused analytical approach offers practical guidance for future strategic planning and emphasizes the value of nuanced, indicator-based evaluations in sustainability assessments.

Keywords: *SDGS, Sustainability Performance, SDG Indicators, Regional Sustainability Disparities, Sustainability Measurement.*

JEL Codes: *Q01, Q56, C38.*

Introduction

The Sustainable Development Goals (SDGs) provide a comprehensive framework for addressing a wide range of challenges, from poverty and economic growth to peace, justice, and institutional resilience. Despite a shared commitment, especially among EU members and candidate countries, significant disparities remain in SDG performance across countries. These differences, evident across the 17 SDGs as of 2025, have attracted increasing scholarly attention in the past decade. Recent studies have examined country-level SDG performance, offering diverse approaches to performance evaluation and rankings. These studies are of great importance for several reasons. First, they reveal not only the extent to which SDGs are being achieved but also highlight whether the progress regarding the performance is shared equally among these countries. For instance, Anselmi, D'Adamo, Gastaldi, and Lombardi (2024) found that European countries are advancing unevenly and emphasized the need for stronger cooperation mechanisms. Such findings align with the European Sustainable Development Report 2025, which shows that numerous challenges persist within EU nations (Sustainable Development Solutions Network [SDSN], 2025). Given that sustainable development demands collective action and shared responsibility, fostering strategic cooperation and cohesion remains critical. Second, these studies offer new perspectives, enabling researchers to track progress over time.

Hametner and Kostetckaia (2020), for example, developed a Eurostat-based method to assess progress beyond static rankings. They argued that identifying the best-performing countries alone is insufficient; instead, observing trends-whether countries are advancing, stagnating, or regressing-provides deeper insights. This dynamic approach helps avoid biases inherent in cross-sectional assessments. Other scholars have proposed alternative methods for SDG measurement (e.g., Murphy, Walsh & Murphy, 2023; Šoja et al., 2016; Chodakowska & Nazarko, 2020), further enriching the methodological landscape. Third, academic research in this field contributes to the ongoing re-evaluation of the EU's 2030 Agenda. As emphasized by Rocchi et al. (2022), measuring progress in sustainable development is inherently complex, and a clear and comprehensive approach is essential. Numerous studies highlight the importance of continuously reassessing priorities, strategies, and implementation tools. Contributions from Colglazier (2015), Niestroy (2016), Carrillo (2022), Hametner& Kostetckaia (2020), Szopik-Depczyńska, Kędzierska-Szczepaniak, Szczepaniak, Cheba, Gajda, & Ioppolo (2018), and Ricciolini, Tiralti, Paolotti, Rocchi & Boggia (2024) exemplify the growing academic engagement in this process.

The study is informed by the SDG framework, which provides a structured basis for assessing progress across economic, social, and environmental dimensions. It also draws on a benchmarking approach, which enables the determination of strengths and weaknesses through comparative analysis. In this regard, this study builds upon these three pillars by offering an original framework that integrates them into a unified research design. It argues that SDG scores, while useful, often obscure critical indicator-level variations that reveal a country's specific strengths and weaknesses. A more indicator-based analysis can provide more accurate and meaningful insights, particularly when data availability and time coverage vary across indicators and countries. This is crucial for ensuring the validity and reliability of comparative assessments. By calculating the performance for each indicator and measuring a country's relative distance, this study presents a more nuanced picture of national SDG performance. This method allows for more precise comparisons between countries through visualizations and charts. Applying this approach, the research analyzes Türkiye's relative position among both EU and available non-EU countries. In doing so, it contributes to the broader discourse on comparative sustainable development, following the path of recent contributions by Alpdoğan (2023), Burhan (2024), Elevli & Akış (2025), and Aldalou & Perçin (2025). Ultimately, this study identifies key indicators driving Türkiye's SDG outcomes and paves the way for better-targeted strategies to improve its performance.

To achieve this, the study employs a quantitative and indicator-based comparative analysis. A total of 79 SDG indicators across 16 goals were selected from the EUROSTAT database for the analysis which covers Türkiye and other countries in the data set. The values of these indicators were standardized into a Likert scale with reverse coding where necessary ranging from 1 to 10 to enable comparability. Missing data were addressed by utilizing the most recent available values or by utilizing the arithmetic mean of the corresponding indicator across all included countries. The analysis utilized MATLAB, SPSS and Smart PLS 4 (Ringle et al., 2024) software combining descriptive visualizations with 16 different regression models to identify the most effective indicators within each SDG. This methodological framework allows for both a detailed exploration of Türkiye's and other countries' relative performance and the determination of current strengths and weaknesses.

Methods

Data Collection

The data utilized in this study were entirely obtained from the EUROSTAT database[1] a publicly accessible platform managed by one of the official websites of the European Union. An initial

[1] https://ec.europa.eu/eurostat/web/sdi/database

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screening was conducted for all 17 SDGs and their associated indicators. However, given the study's focus on analyzing the situation specifically within the context of Türkiye, only those goals and indicators for which country-specific data were available for Türkiye were included. The data collection was carried out between April and August 2024. For each relevant indicator, data were downloaded in Excel format and subsequently compiled into a single, unified dataset.

The compiled files contain annual performance data for countries up to the year 2023; however, the time coverage varies considerably across indicators. Some indicators offer continuous annual data from 2000 to 2023, while others present data for a more limited range of years. Based on data availability specific to Türkiye, a total of 79 indicators across 16 SDGs were selected for analysis. The only SDG excluded was Goal 14 (Life Below Water), due to the absence of country-specific data for Türkiye. It is important to note that not all countries in the database report data for every year. For the purposes of this study, the analysis was based primarily on data for the year 2023. This decision was guided by two main considerations. First, the research aims to provide a current snapshot of Türkiye's status concerning the SDGs and the most recent data are most informative. Second, because the temporal coverage of the indicators varies, relying on multi-year averages could compromise the validity and reliability of cross-indicator comparisons. However, upon reviewing the indicator data obtained from the database, it was observed that, in some instances, certain countries lacked data for the year 2023. In such cases, rather than excluding these countries from the analysis outright, data from the most recent preceding year were used. If data for that year were also missing, the process was repeated by moving progressively backwards in time until a valid data point was identified. In instances where no data were available for a given indicator despite these steps, the arithmetic mean of the corresponding indicator across all included countries was calculated and substituted. This approach allowed for the retention of country cases without compromising the overall integrity of the analysis. In addition to individual country-level data, the dataset also included aggregate scores for both the European Union (comprising 27 countries as of 2020) and the European Area (comprising 20 countries as of 2023). In cases where data were missing for one of these two regional aggregates, the corresponding value from the other category was used to maintain consistency and completeness in the analysis.

Data Processing

Given that the indicator scores, consolidated into a single file, belong to various SDGs, they inherently represent widely diverse values, frequencies (annual, etc.), age ranges (under 18, above 18, all ages, etc.), and measurement units (percentage, million euros, kg per hectare, Tonnes of Oil Equivalent (TOE) per capita, Euro per Kilogram of Oil Equivalent (KGOE), etc.). Data for 79 distinct indicators, corresponding to 16 SDGs with available values specific to Türkiye, were compiled into a single Excel file. The dataset encompasses 31 countries, including several non-EU member states like Iceland, Norway, Switzerland, and Türkiye alongside two aggregated EU-level data points. The main challenge in measurement arises from differences in the units of measurement across indicators. To address this issue and enable effective analysis and comparison, the values of the 79 indicators were standardized onto a Likert scale ranging from 1 to 10. This standardization process was performed using MatLab (MatrixLaboratory), a multi-paradigm numerical computing environment and fourth-generation programming language. Specifically, each indicator was converted onto the 1–10 scale by identifying the minimum and maximum values within each dataset column and segmenting this range into intervals of equal size. Subsequently, reverse coding for the indicators was performed using SPSS. Since reverse coding aligns all indicators on the same scale as some indicators would interpret a high number as negative and

others as positive, reverse coding here is not just a technical step, rather it's essential to ensure validity, comparability, and clarity throughout the research. In this way, all the indicators were adjusted so that a score of 1 represents the worst condition and a score of 10 represents the best condition.

Data Analysis

Following data processing, regression analyses were performed. Given the large number of indicators and the relatively small number of sample countries, it was statistically impractical to assess the impact of all indicators within a single regression model. To address this limitation, first, each SDG was treated as a distinct factor, with its associated indicators considered as items. Regression analyses were then conducted to examine the effects of these indicators on their corresponding SDG factors. As this study represents a novel approach at the indicator level-highlighting the unique strengths and weaknesses of each country-analyses focused on identifying the most effective indicators within each SDG. Indicators with the highest standardized regression coefficients within each factor (goal) were determined through regression analyses. Second, individual indicator effect on the overall SDG performance of all countries in the dataset were examined using simple linear regression analyses. In total, 32 regression analyses were conducted-16 for each step. To facilitate these analyses, the arithmetic mean of the indicators corresponding to each goal was computed using SPSS, thereby creating a score for each SDG. Additionally, a general SDG index was created by averaging the scores of all 79 indicators. All regression analyses were carried out using the SMART PLS 4 software package (Ringle et al., 2024).

Results

Identification of most effective indicators across the countries

Table 1 presents the effects of the indicators with the highest coefficients within each SDG Goal (excluding SDG 14) on the overall SDG performance. The regression analysis results focusing on individual indicators yielded significantly strong and informative outcomes. These findings enabled the identification of which specific indicators are most effective in shaping overall SDG performance. First, based on p-values (< 0.05), it was observed that relationships in Model 3, 12,13, 14 and 16 do not have statistical significance. However, the other 11 different models proved to have a significant, positive impact. The indicators showing the highest impact on total SDG performance were found to be 10.4, 1.1, 4.7, 11.1, 9.2 and 16.5, respectively. Another notable finding is that only two models among all significant and non-significant relationships-those of In-16.5 and In-5.5-showed signs of heteroskedasticity, indicating variance irregularity in the residuals. No substantial autocorrelation issues were detected in any of the remaining indicators except for the In-10.4 where the Durbin-Watson statistic was 1.051.

Table 1. Individual Indicator impact on overall SDG performance

Model		Standardized coefficients	T value	P value	97.5 %	R-square	Durbin-Watson test	Breusch-Pagan Test Statistic	Breusch-Pagan Test P-Value
1	In-1.1	0.831	8.311	0.000	345833903,973	0.690	1.647	0.686	0.408
2	In-2.3	0.589	4.061	0.000	343108020.524	0.347	1.859	1.800	0.180
3	In-3.9	0.052	0.289	0.775	118863871.118	0.003	1.660	0.309	0.578
4	In-4.7	0.803	7.511	0.000	326499815.734	0.645	2.099	0.753	0.385
5	In-5.5	0.637	4.605	0.000	268506462.542	0.406	1.984	4.349	0.037

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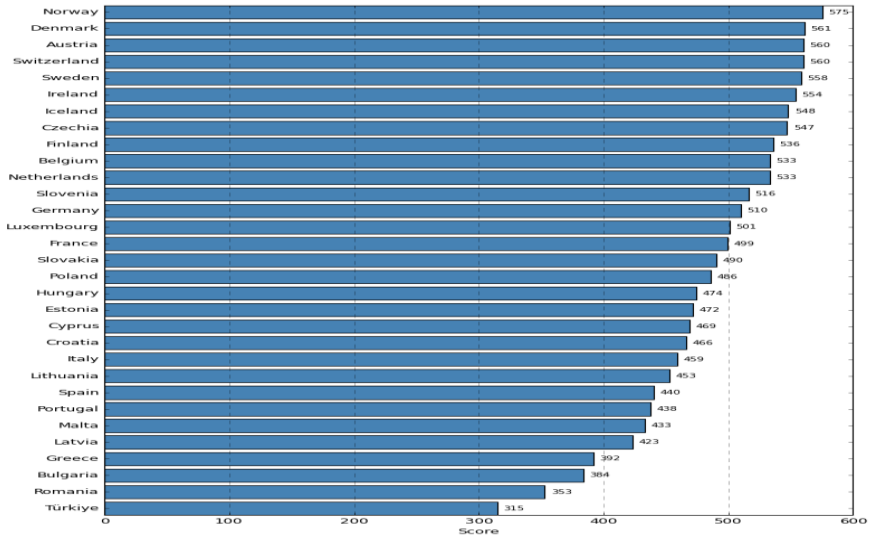
6	In-6.1	0.497	3.191	0.003	366571160.000	0.247	1.783	0.949	0.330
7	In-7.3	0.662	4.923	0.000	372740292.646	0.439	1.998	0.065	0.798
8	In-8.1	0.647	4.726	0.000	287335272.232	0.419	1.708	0.541	0.462
9	In-9.2	0.768	6.681	0.000	299133640.261	0.590	1.884	3.623	0.057
10	In-10.4	0.834	8.425	0.000	425179500.419	0.696	1.051	0.136	0.712
11	In-11.1	0.783	7.012	0.000	392960251.798	0.613	1.814	0.473	0.491
12	In-12.6	0.072	0.401	0.691	156551062.238	0.005	1.687	1.711	0.191
13	In-13.4	-0.041	0.230	0.819	114920526.355	0.002	1.683	1.627	0.202
14	In-15.3	-0.089	0.500	0.621	94275968.543	0.008	1.592	2.449	0.118
15	In-16.5	0.790	7.186	0.000	3200554099.068	0.625	1.699	4.185	0.041
16	In-17.2	0.090	0.504	0.618	161443890.430	0.008	1.679	1.497	0.221

The country-level performances for each indicator

Figure 1 presents a novel ranking (based on this indicator-level analysis) of all countries on their overall SDG performance based on a 10-point Likert scale. Figure 2 illustrates the country-level performances for each indicator used in the study.

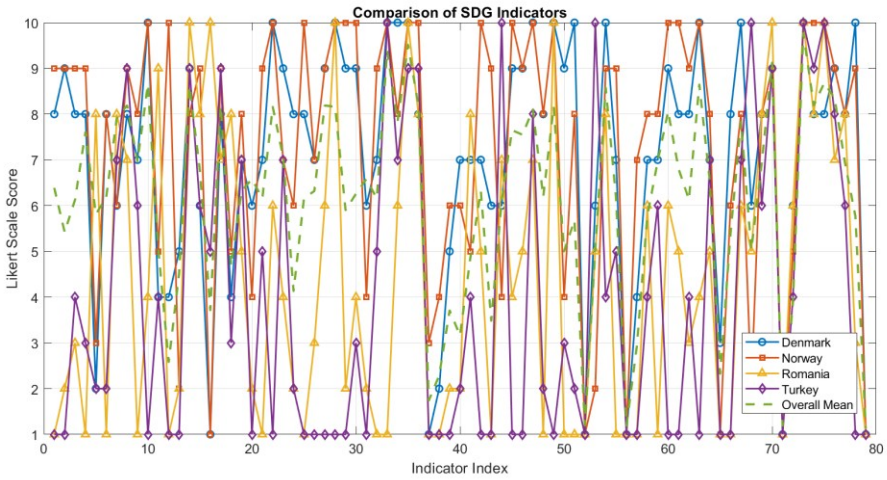
Figure 1. Country rankings based on overall SDG scores



The analysis includes data from 31 countries. Although the methodology employed in the research technically allows for the visualization of indicator performance for all countries, displaying all countries on a single map would result in a complex visual and pose challenges for interpretation. Therefore, Figure 2 includes only the two highest-performing countries, the two lowest-performing countries, and the average performance across all 31 countries. The figure was created on Matlab Software, and it demonstrates the relative performance of these selected countries on each indicator and its associated SDG, along with their distance from the overall average. At this point, it is

noteworthy that Norway, which has the highest overall performance, is not a member of the European Union, as is the case with Türkiye, the lowest-performing country. Among EU member states, Denmark shows the highest performance, while Romania ranks the lowest.

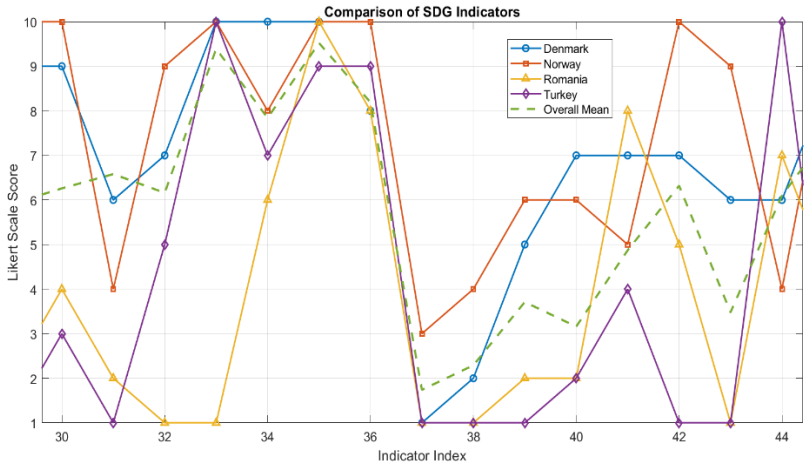
Figure 2. Comparison of SDG Performance Between the Top- and Bottom-Performing Countries



On the other hand, while Figure 1 presents a ranking of countries based on their overall SDG scores, the indicator-based performance visualization in Figure 2 provides a zoom-in and far more detailed and comprehensive insight. This is because the ranking in Figure 1 does not offer enough information regarding the strengths or weaknesses underlying those total performance scores. In contrast, Figure 2 enables a specific detailed examination of each country's SDG-related profile, allowing for an in-depth assessment of both strong and weak areas.

For example, when zooming in on the gap between Türkiye, which ranks last in the overall SDG score, and the average scores, it becomes evident that despite its overall low ranking, Türkiye performs significantly above the average in certain indicators. Specifically, Türkiye exceeds the average score in 11 out of 79 indicators. Figure 3 above provides insight into this variation by highlighting the positive distance between Türkiye and the average in selected indicators, particularly Indicators 6.1, 6.8, 36, and 7.4.

Figure 3. Türkiye's performance in SDG indicators exceeding the European average



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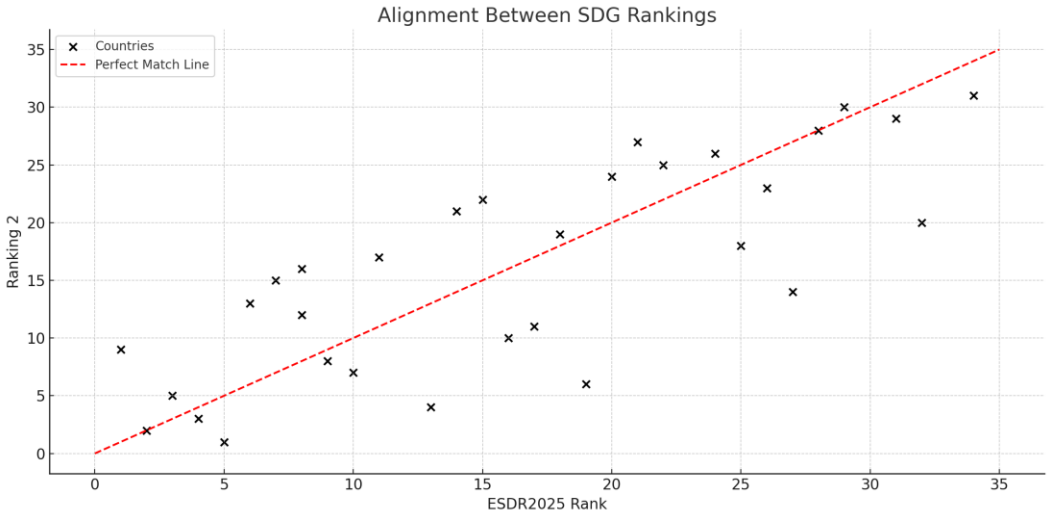
Discussion and Conclusion

The findings highlight existing rankings may not be sufficient alone in identifying countries' strengths and weaknesses, emphasizing the need for alternative nuanced approaches. An important methodological contribution of this research is the integration of indicator scores including 16 SDGs by facilitating the cross-indicator comparisons. In the first phase of the study, important insights were obtained by examining the impact of indicators on the overall SDG performance. The results of regression analyses at the indicator level provided clearer outcomes as all indicators with a few exceptions, demonstrated statistically significant effects on overall SDG performance. These findings suggest that model estimations are quite reliable. Also, the ranking created in this study (see Figure 1) among the countries included in the dataset reveals notable findings.

When comparing the ranking employed in this study with the one presented in the European Sustainable Development Report (2025), significant similarities as well as notable differences can be observed. In both rankings, the Scandinavian countries (Finland, Denmark, Sweden, Norway) and Austria consistently occupy the top positions. Similarly, the countries with the lowest performance (Greece, Romania, Bulgaria, and Türkiye) appear at the bottom in both lists. This indicates that regional patterns are clearly evident in both analyses. A similar consistency is also observed among countries positioned in the middle ranks, such as Germany, France, Poland, Czechia, and Slovenia. Figure 4 prepared using Python to visualize the comparative distribution illustrates the alignment and discrepancies between the two rankings. Here, each "x" represents a country's position in both rankings. The red dashed line denotes the ideal situation in which both rankings are identical. The closer a point is to this line, the more consistent the country's ranking is across both visuals.

Figure 4. Alignment of country rankings between this study and the Europe Sustainable Development Report 2025



On the other hand, despite the regional consistency, there are discrepancies in the exact ranking positions of individual countries. These discrepancies, as emphasized in this study, highlight the importance of evaluating indicators independently and point to the fact that each indicator may contribute differently to the overall SDG performance. Besides, Although Figure 1 provides a straightforward ranking based on SDG scores, Figures 2 and 3 offer a more comprehensive

and detailed analysis at the indicator level. For instance, despite Türkiye's position at the bottom of the overall ranking, the country significantly exceeds the EU average performance in 11 out of 79 SDG indicators (1.9, 2.6, 3.4, 6.1, 6.8, 8.2, 9.4, 11.2, 11.8, 15.3,15.9). Also, out of 79 indicators, Türkiye scored 10 points on six indicators (6.1, 8.2, 9.4, 11.8, 13.4)**,** 9 points on seven indicators (1.9, 2.6, 3.5, 6.6, 6.8, 12.5, 15.3)**,** 8 points on two indicators (8.7, 6.1), and 7 points on six indicators (1.8, 3.9, 4.5, 6.2, 11.2, 11.7). However, Türkiye received the lowest score on the Likert scale (1 point) on 32 out indicators. When these 32 indicators are analyzed, it is observed that the SDGs in which Türkiye demonstrates the lowest performance are, respectively, SDG 5 (5 indicators), SDG 7(4 indicators), SDG 8 (4 indicators), SDG 1,4,10 11 (3 indicators each). For Türkiye, the results offer valuable lessons and a roadmap for targeted policy action, as well as emphasizing Türkiye's relative position and identifying its strengths and weaknesses. Türkiye's strong performance in the indicators given above represents critical leverage points for sustainable development. These strengths could be strategically maintained and leveraged through targeted investments and policies. Similarly, the indicators in which Türkiye demonstrates low performance, along with their corresponding SDGs (5,7,8,1,4,10,11) clearly highlight the areas where the country needs to focus, prioritize, and achieve progress. Besides, in terms of the regression models, addressing heteroscedasticity and enhancing model reliability through improved statistical techniques is recommended for future studies to deepen the understanding of these vulnerabilities.

In light of these findings of the study, it is essential to develop actionable strategies to address the identified challenges within this study. In this regard, the lowest-performing SDGs in Türkiye, which are SDG 5 (Gender Equality), SDG 7 (Affordable and Clean Energy), and SDG 8 (Decent Work and Economic Growth), call for focused and sustained efforts to foster progress. On the other hand, Türkiye's strong indicator performances given above could be used as a foundation for advancing progress in weaker areas. Also, strengthening cooperation with higher-performing countries and adoption of good practices could accelerate this progress. Similarly, for EU member states with relatively low performance, particularly in Eastern and Southern Europe, strengthening cross-country collaboration and aligning national priorities with high-performing peers could help reduce disparities and ensure a more balanced progress towards the 2030 Agenda. The results of this study also have practical value for policymakers, academics, and, to some extent, the business sector. Policymakers could draw on the indicator-level findings of this study to prioritise SDGs where performance is relatively low, whereas taking high-performing areas as reference points for formulating and improving sustainable development strategies. For academics, on the other hand, the approach employed within this study and findings can inform further comparative studies on sustainable development.

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