

FROM GDP to SDGs:
A CROSS-COUNTRY EFFICIENCY ANALYSIS USING DEA
AND THE CASE OF TÜRKİYE



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DECLARATION OF ORIGINALITY

I, Burcu Menekşe Ergezen, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
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ABSTRACT

From GDP to SDGs:

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This thesis evaluates how efficiently countries convert their economic development into sustainable development outcomes, in alignment with the UN Sustainable Development Goals (SDGs). Using data from 167 countries between 2015 and 2023, it uses Principal Component Analysis (PCA) to reduce the dimensionality of SDG indicators, applies an input-oriented Data Envelopment Analysis (DEA) under a Variable Returns to Scale (BCC) model. This DEA–PCA framework allows for a robust, efficiency-based assessment that overcomes multicollinearity and complexity in high-dimensional development data. The findings reveal substantial disparities in efficiency across regions and income groups. While some countries achieve strong SDG outcomes with modest economic inputs, others underperform despite considerable resources. Türkiye exhibits a decline in efficiency, suggesting a structural disconnect between economic growth and sustainable development progress, pointing to policy misalignment or ineffective use of resources. Empirically, the thesis highlights the need to move beyond traditional economic development measures, such as GDP or GDP per capita, and focus more directly on the SDGs, ensuring that economic development is effectively translated into SDGs.

ÖZET

GSYH'den Sürdürülebilir Kalkınma Hedeflerine: DEA ile Ülkelerarası

Verimlilik Analizi ve Türkiye Örneği

Bu tez, ülkelerin ekonomik kapasitelerini Sürdürülebilir Kalkınma Amaçları (SKA) doğrultusunda nasıl etkili bir şekilde kalkınma sonuçlarına dönüştürdüklerini analiz etmektedir. 2015–2023 yılları arasında 167 ülkeyi kapsayan çalışmada, SKA göstergelerinin yüksek boyutluluğunu azaltmak için Temel Bileşenler Analizi (PCA) uygulanmış ve bu bileşenler, Değişken Getiri Ölçeği (BCC) altında girdi odaklı Veri Zarflama Analizi (DEA) modeline çıktı olarak dahil edilmiştir. Bu DEA–PCA yaklaşımı, çok boyutlu kalkınma verilerinde çoklu doğrusal bağlantı ve karmaşıklık sorunlarını aşarak, ekonomik girdilerin kalkınma performansına ne derece etkin dönüştürüldüğünü değerlendirmeyi mümkün kılar. Sonuçlar, bölgeler ve gelir grupları arasında belirgin verimlilik farklarını ortaya koymaktadır. Bazı ülkeler sınırlı ekonomik kaynaklarla yüksek SKA performansı sergilerken, bazıları güçlü ekonomik kapasiteye rağmen düşük başarı göstermektedir. Özellikle Türkiye'nin düşen verimlilik puanları, ekonomik büyümenin sürdürülebilir kalkınma ile orantılı ilerlemediğini, bu durumun ise politika uyumsuzluğu veya kaynakların etkisiz kullanımından kaynaklandığını göstermektedir. Tez, deneysel olarak, gayri safi yurtiçi hasıla veya kişi başına gayri safi yurtiçi hasıla gibi geleneksel ekonomik kalkınma ölçütlerinin ötesine geçilmesi ve ekonomik gelişmenin bu hedeflere etkili bir şekilde dönüştürülmesini sağlayarak, doğrudan SKA'lara odaklanması gerektiğini vurgulamaktadır.

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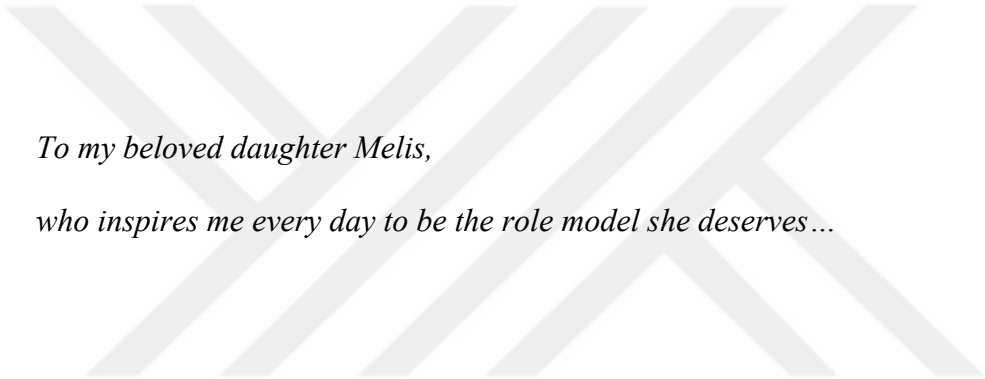
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*To my beloved daughter Melis,
who inspires me every day to be the role model she deserves...*

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ABBREVIATIONS

DEA	Data Envelopment Analysis
EG	Economic Growth
EM	Expected Maximization
EU	European Union
GDP	Gross Domestic Product
GNP	Gross National Product
HD	Human Development
HDI	Human Development Index
IHDI	Inequality Adjusted Human Development Index
OECD	Organization for Economic Co-operation and Development
PCA	Principal Component Analysis
PHDI	Planetary Adjusted Human Development Index
SDG	Sustainable Development Goal
SDR	Sustainable Development Report
SDSN	Sustainable Development Solution Network
UN	United Nations
UNDP	United Nations Development Program
VNR	Voluntary National Review
VRS	Variable Return to Scale

CHAPTER 1

INTRODUCTION

The extent to which countries succeed in translating their economic development into true prosperity, meaning human well-being and societal development within planetary boundaries, remains an open and critical question. For decades, discussions around development were mainly equated with economic growth, with GDP (Gross Domestic Product) and GNP (Gross National Product) serving as the primary measures of national progress. These indicators reflected the expansion of a country's production capacity but offered little insight into whether economic gains are improving people's lives. Indeed, the human development dimension of progress was not considered as important as economic success until the 1990s (Fantom & Serajuddin, 2016). The World Bank only began using GNP per capita to classify countries into four main categories in 1989: low income, lower middle income, upper middle income, and high income (Fantom & Serajuddin, 2016). It is now well established that while economic indicators are associated with some development outcomes, such as improvements in education, health, and poverty reduction, they do not explicitly capture the true well-being of people.

Today, development is increasingly understood not merely as economic advancement but as comprehensive societal progress that fundamentally encompasses health, education, equality, and human well-being (Haq, 1995). This shift highlights the growing recognition that economic development alone does not guarantee improved living conditions and that a holistic understanding of development outcomes is essential.

In parallel, development measures have significantly evolved since the 1990s. The Human Development Index (HDI) is a cornerstone of this evolution and is rooted in Amartya Sen's human capabilities approach (Sen, 2003). Since the 1990s, the United Nations Development Program (UNDP) has reported countries' yearly HDI scores. The HDI has also been expanded with extensions such as the IHDI (Inequality-Adjusted HDI) and the PHDI (Planetary-Adjusted HDI). These indicators represent a fine-tuning of the HDI approach but are insufficient to provide an overall view of a country's development level. In 2000, the United Nations (UN) launched a new development framework, the Millennium Development Goals (MDGs), which included eight development goals. The MDG Framework addressed the gap between economic growth and development goals by focusing on poverty reduction, health and education improvements, and gender equality, thereby offering a time-bound and results-oriented structure. However, the MDGs were criticized for not adequately addressing environmental sustainability, inequality, and governance issues.

After extensive work, the new Sustainable Development Goal (SDG) Framework was launched in 2015. With its 17 primary goals and 169 sub-targets, the SDG Framework provides a well-structured approach to development based on five pillars: people, prosperity, planet, peace, and partnership (United Nations, 2015). Yet, many countries face difficulties implementing the SDGs and translating their economic potential into tangible improvements in human development and environmental sustainability. Therefore, the efficiency of countries' translation of their economic strength into SDG achievement remains an open question.

This thesis seeks to find an answer to that question using real data and cross-country analysis. By focusing on the SDG performance of countries between 2015 and 2023, along with their GDP per capita in purchasing power parity (PPP) terms,

the thesis examines how efficiently countries convert their economic development and strength—seen as their "muscle strength"—into SDG achievement. Just as physical strength does not automatically guarantee effective performance, economic development alone does not ensure successful development outcomes; what matters is how efficiently that strength is applied.

In terms of methodology, an input-oriented Data Envelopment Analysis (DEA) model under Variable Returns to Scale (VRS) is employed to evaluate the efficiency of countries in translating their economic development and capacity into SDG outcomes. GDP per capita is the input variable, while a set of aggregated SDG indicators, derived through Principal Component Analysis (PCA), is used as output variables. DEA is then conducted across all countries in the dataset. This methodology allows for the identification of the best-performing countries in terms of translating economic development into SDG achievement. It also enables benchmarking each country against the most efficient performers in the dataset.

Beyond calculating efficiency scores, the analysis enables several layers of comparative analysis. First, it allows cross-country comparisons to identify regional or income-based efficiency patterns. Second, efficiency trends over time can be analyzed to observe progress. Third, inefficient countries can be examined to determine potential output improvements or input reductions needed to reach the efficient frontier. In addition to cross-country and time-wise analysis, the thesis also conducts an analysis of Türkiye's efficiency performance over the years, comparing it to peers such as upper-middle-income countries, EU candidates, Balkan countries, and Black Sea countries.

Overall, this thesis aims to contribute to the ongoing discourse on SDGs and achievements so far by offering an efficiency-based evaluation of the country's

performance. It seeks to advance the literature by highlighting the problems associated with an isolated focus on economic development and by emphasizing the importance of countries' ability to translate it into SDG achievement using DEA methodology. The findings are expected to provide new insights into how economic capacity and development achievements are aligned. These insights can support policymakers, international organizations, and researchers design more focused and effective development strategies as the 2030 Agenda deadline approaches.

The structure of the thesis is organized as follows: Chapter 2 is the literature review. This chapter covers three distinct areas in the literature. The first part discusses the development literature on the relationship between growth and development, the second part of this section addresses the applications of DEA in the context of development, and the third part focuses on Türkiye and its SDG performance.

The third chapter presents the dataset used in the analysis. The dataset consists of the SDG Index, individual SDG scores published annually by the Sustainable Development Solution Network, and economic indicators such as GDP per capita. It covers a balanced panel of countries over the period 2015–2023 and has been carefully preprocessed to ensure comparability and completeness. The chapter also presents descriptive statistics about GDP per capita and the SDG Index scores of the countries, organized by geographic regions and income groups.

The fourth chapter outlines the methodological approach. It explains how it benefits from PCA to overcome the multicollinearity problem among SDGs and reduce dimensionality. The integration of PCA into DEA ensures that the analysis remains statistically robust while preserving the underlying development dimensions. Following the PCA, there is an explanation of DEA, specifically the input-oriented

Variable Returns to Scale (VRS) model applied in this thesis, and the reasoning behind choosing the Input-Oriented Variable Return to Scale Data Envelopment Analysis.

The fifth chapter presents the main analysis results. Efficiency scores for each country are calculated over multiple years, revealing trends in how efficiently economic development is translated into sustainable development performance over eight years. Regional patterns and country group comparisons (e.g., by income level or institutional structure) are also examined to uncover structural inequalities or success stories.

The sixth chapter describes the robustness check conducted to validate the consistency of the Data Envelopment Analysis results, which outcome with the EM – Expected Maximization approach. This section includes a two-sided filtering model, multiple imputations for missing values using the Expectation-Maximization (EM) algorithm, and comparisons between models with five unrotated principal components. This section ensures the credibility and generalizability of the findings.

The seventh chapter analyzes Türkiye's case and examines its SDG performance and efficiency scores over the years. Additionally, a peer country comparison analysis has been conducted. This chapter aims to identify Türkiye's key challenges and areas for improvement within the SDG framework.

Finally, the conclusion section summarizes the refined research's key findings, discusses their policy implications, and enables discussion of new questions.

CHAPTER 2

LITERATURE REVIEW

The literature review section presents an overview of development theory, the application of Data Envelopment in development theory, and country-based sustainability studies, focusing on the case of Türkiye. As such, the section is structured under three main domains: the evolution of development concepts and critiques of GDP as a sole indicator of progress; the application of DEA in assessing development and sustainability efficiency; and the specific case of Türkiye's Sustainable Development Goal (SDG) performance.

The literature review is the foundation for understanding how and why countries differ in their ability to convert economic capacity into sustainable development.

2.1 Literature on growth and development relationship

The development concept has undergone significant changes over the decades. At the beginning of the 1950s, GDP per capita was the primary focus for all countries. It was believed that once a country achieved essential economic development, this would automatically translate into social well-being. The idea of development was rarely discussed. This economic growth-centric approach began to be criticized in the 1980s and 1990s when Amartya Sen proposed his means vs. ends and capabilities vs. functionalities approach (Sen, 2003). Then, in 1990, the HDI was launched by UNDP with the initiation of Sen's approach. This approach defined development as expanding people's capabilities and their freedom to convert them into functionalities (Sen, 2003). Since then, the literature has explored the relationship between growth

and development while attempting to assess the performance of alternative development measures and indicators.

Stiglitz et al. (2009), for instance, note that GDP is primarily an indicator of production capacity rather than reflecting people's wealth and capabilities. They indicate that it has limitations and, when used improperly, might be a misleading indicator of development. Their report proposed a multidimensional well-being framework that includes income, consumption, health, education, and environmental sustainability. Ranis et al. (2000) have investigated a two-way causal relationship between economic growth (EG) and human development (HD). They analyze four main country trajectories: Virtuous Cycle, Vicious Cycle, HD-lopsided, and EG-lopsided. This research demonstrates a reciprocal relationship between economic growth and development and indicates that policies should evolve as economic growth and human development influence each other. Their findings emphasize that the primary focus should be on human development, not economic growth. Ranis (2004) discusses arguments about human development through Amartya Sen's capabilities approach, stating that health and education should be considered aspects of development.

In a similar vein, Suri et al. (2011) examine the two-way relationship between human development and economic growth finding that upgrading HD for higher economic growth leads to improved human development. Hence, Suri et al. (2011) indicate that solely relying on economic growth without promoting human development will not be sustainable. Countries with early human development, such as health and education, are more likely to sustain this development trend alongside their economic growth.

Grubaugh et al. (2015) investigate the extent to which GDP per capita explains the Human Development Index (HDI). The analysis, conducted on 83 countries using panel data, reveals that HDI growth is influenced by different variables rather than by GDP. Grubaugh et al. (2015) emphasize that GDP and HDI capture various aspects of development. One finding from the empirical analysis is that initial GDP significantly impacts both GDP and HDI growth.

Constantinescu and Frone (2017) have addressed the connection between sustainable and human development. The authors criticize the reliance on GDP as the primary development indicator and highlight the need for a more holistic measurement approach that integrates both quantitative and qualitative indicators. Constantinescu and Frone (2017) emphasize that achieving sustainable development is only possible with a comprehensive global framework.

Indeed, Managi et al. (2024) argue that relying solely on GDP to reflect sustainable development is insufficient, as it overlooks factors like capital depreciation, environmental damage, and intergenerational equity. They introduce the Inclusive Wealth Index (IWI), a framework that incorporates human, natural, and manufactured resources. The authors emphasize that inadequate management of natural resources and capital may lead to considerable long-term wealth loss.

Nowadays, the SDG Framework, with its extensive reach, is officially used as a well-structured model that enables us to monitor each country's development path toward the 2030 Agenda. Through the Sustainable Development Report (SDR), published annually by the Sustainable Development Strategy Network (SDSN), we can track each country's performance since 2015. This thesis aims to contribute further to this literature by linking GDP per capita – economic performance – with sustainable development goal achievements through DEA and assessing how

efficiently countries have transformed their economic strength into sustainable development over the years.

2.2 DEA as a methodology in efficiency and development

Data Envelopment Analysis (DEA) is a robust, non-parametric method that defines efficiency ratios for independent decision-making units (DMUs) by comparing them with one another. It identifies the best performers as efficient and calculates the efficiency rates of others, revealing how far they are from the benchmark DMU (Banker et al., 1984).

Mariano et al. (2015) conducted a structured literature review and positioned DEA as a popular tool for evaluating human development efficiency. In this context, Despotis (2005) reassessed HDI using DEA. The study criticizes the fixed weighting structure and proposes a more flexible, performance-based model with DEA. They use GDP per capita as input and translate this input into SDG achievements in a variable return to scale environment. Their findings reveal that HDI has limitations in projecting real traditional development rankings while positioning DEA as a robust multidimensional benchmarking tool.

In addition, Vierstraete (2012) studied DEA to define how efficiently countries convert their education and health expenditures into human development. The study's main findings revealed a significant variation in efficiency among countries with similar resources, indicating that developing countries are not always worse off compared to developed countries. Mariano and Rebelatto (2014) search for the answer to how efficiently countries convert economic wealth into quality of life. They employ a Triple Index DEA approach, using GDP per capita (PPP) as the input and ten diverse quality-of-life indicators as outputs. The analysis includes 101

countries. A primary finding of the study is that many countries with high GDP per capita are inefficient in translating wealth into quality of life.

Ferraz et al. (2020) conducted DEA to analyze how well 129 Brazilian subregions convert GDP and public expenditures into 14 human development-related social indicators. The study developed four new indices. One of the key findings is again that many poor regions perform better compared to rich regions because they can make better use of resources.

Grochová and Litzman (2021) employ input-oriented Variable Returns to Scale (VRS) DEA—specifically the BCC model—to assess the efficiency with which countries utilize their existing resources to meet the SDGs. Their analysis encompasses 172 countries, drawing on official UN data from 2015 to 2019, and calculates relative efficiencies using well-defined technical benchmarks for each SDG indicator. The study reveals that Finland, Japan, and Iceland are top performers, while the Sub-Saharan region performs poorly.

In their 2024 research, Hu and Cheng (2024) apply a non-oriented Slacks-Based Measure (SBM) of Data Envelopment Analysis (DEA) to assess how efficiently the Association of Southeast Asian Nations (ASEAN) nations are progressing toward the SDGs. Their study encompasses 21 countries, including the USA and India, and categorizes the SDGs into economic, environmental, and social dimensions. They use SDG Index scores scaled from 0 to 100 as outputs while maintaining a constant input of 1 for each country, facilitating an easy output-efficiency evaluation. The study's key findings suggest that some low- and middle-income countries outperform their peers, and efficient ASEAN nations may look to New Zealand, Chile, and Vietnam for policy inspiration.

Keskin et al. (2025) developed a three-stage additive network DEA model to assess the performance of 29 OECD countries in achieving the SDGs between 2015 and 2018. The three-stage DEA allows for the capture of internal structures and the interactions among stages. The study's main finding is that environmental performance lags significantly behind social and socio-economic performance across OECD countries. Türkiye's overall efficiency rate is 0.46, making it one of the lowest-performing countries due to its poor environmental performance.

2.3 The case of Türkiye and its SDG performance

Türkiye has been strongly engaged with the SDG 2030 Agenda and is one of the countries that has undergone two voluntary national review sessions. Although Türkiye has been following up on its SDGs performance since the launch of the SDG Framework, the country's recent reviews and its SDG Index ranking over time haven't changed much (Sachs et al., 2024). This leads experts to try to figure out which part of the implementation of the framework is failing or not performing as intended. Looking at Türkiye's performance throughout its development process, the results of the SDG Index compared to its HDI reveals that the country has primarily focused on economic growth rather than development, with its HDI ranking at 45 out of 193 countries, reflected in its 0.855 HDI score in 2022. In contrast, it ranks 72 out of 167¹ countries with its 70.47 SDG Index for 2024. Note that, Keskin et al. (2025) outcome mentioned earlier support this performance point with a 0.46 efficiency rate.

¹ After Guinea-Bissau is added to the SDR 2024 Report; in total, there are 167 countries in SDR 2024

According to the Second Voluntary National Review (VNR) of Türkiye (Presidency of the Republic of Türkiye, 2019), the country has established a robust plan to implement the SDG framework into its yearly strategic plans and sectoral policies. The government has integrated the SDGs into its National Development Plans (NDPs). It highlighted strong political and governmental ownership of the SDG framework. The results in the report were quite promising in 2019, initiated by the President and broad stakeholder participation, involving over 2,900 representatives from government, Non-Governmental Organizations (NGOs), academia, and private sector bodies. SDG 4 – Quality Education, SDG 8: Decent Work and Economic Growth, SDG 9 – Industry, Innovation and Infrastructure, and SDG 7 – Clean Energy are selected as strategic focal goals and have been integrated into the planning framework.

Although this report on Türkiye's SDG performance is quite promising, challenges remain, such as economic and political instability, the transition to a presidential government system, a lack of financial resources, data gathering and monitoring issues, an absence of a systematic performance tracking system, and the engagement of many stakeholders, which creates a coordination burden and causes the country to lose its overall perspective on the SDG framework implementation.

Like all OECD member countries, Türkiye's SDG performance is closely tracked by the OECD. The OECD (2022), *Measuring Distance to SDG Targets: Türkiye*, assesses Türkiye's current status regarding 123 global targets. Türkiye has successfully met 16 of these targets and is making progress toward five additional ones. However, the country falls short in critical areas such as Reduced Inequality (SDG 10), Gender Equality (SDG 5), Quality Education (SDG 4), and Strong Institutions (SDG 16). Even though Türkiye is among the largest Official

Development Assistance (ODA) donors, contributing 1.12% of GNI, its limitations in data coverage and policy execution diminish its relative position within the OECD. Particularly concerning are the indicators for social protection, lifelong learning, gender-based violence, and judicial trust. Additionally, Türkiye faces challenges with water quality (SDG 6), air pollution (SDG 11.6), and the protection of biodiversity (SDG 14.5, 15.1).

Üçyol (2022) has conducted a comparative analysis of SDGs through BRICS and Türkiye and an analysis of the SDG performance of BRICS countries. The analysis driven by this study reveals that BRICS countries and Türkiye are not performing well according to the 2030 Agenda. Despite their growing economic influence, SDG implementation remains inadequate due to governance gaps, social inequalities, and limited policy effectiveness.

Given this background, this thesis will further contribute to the literature with its PCA-embedded DEA approach to define countries' efficiency rates in transforming their economic strength into sustainable development. As previously mentioned, it will also provide a detailed look at Türkiye's case and its SDG performance over the years, as well as how Türkiye is positioned compared to its peer countries, including European Union candidate countries, Balkan countries, and Black Sea region countries.

CHAPTER 3

COUNTRIES' SDG PERFORMANCES: DESCRIPTIVE STATISTICS

3.1 Overview of the dataset

To address the question of whether countries can transform their economic development into SDG achievements, DEA has been conducted. This thesis utilizes data from 2015 to 2023 for 167 countries across various global regions. The dataset includes each country's GDP per capita (in constant 2021 international dollars, PPP), overall SDG Index score, and scores for all 17 SDGs, illustrating their progress toward the United Nations goals. The main data sources are the SDR 2024 released by SDSN and macroeconomic data from the World Bank.

To evaluate how efficiently countries convert their economic development into SDG achievement, an input-oriented Variable Return to Scale (VRS) Data Envelopment Analysis (DEA) was conducted. Data on SDG performance is sourced from the annual SDRs published by SDSN, aligned with the SDG framework established by the UNDP. This framework, depicted in Figure 1, consists of five pillars, 17 goals, and 169 indicators. GDP per capita information is obtained from the World Bank's database.



Figure 1. 17 SDGs – 5 Pillars

SDSN reports annually on countries' SDG performances by considering all the information provided by the countries to the UN and other organizations, such as the WHO, World Bank, and OECD, while conducting a detailed comparative analysis. Due to changes in indicators and methods, SDG Index results from different editions cannot be directly compared. In each report, time series have been recalculated retroactively to facilitate comparisons over time. Because of these differences, SDSN suggests that a comparative analysis between yearly reports should not be conducted (Sachs et al., 2024). Although gaps still exist between national and international data sources, global data sources have been designated as the primary source of data.

3.2 Sustainable Development Report 2024 methodology overview

SDR 2024 evaluates countries' progress toward the SDG Framework annually, using a standardized comparison technique. The Report calculates indices ranging from 0 to 100 for all 17 SDGs, reflecting a country's overall performance across these goals, with 100 points indicating full achievement.

The SDG Trend Dashboards indicate whether a country is on track to achieve each SDG by 2030, based on its historical performance. The analysis employs annual growth rates from 2015 and projects these forward to 2030. Trends are aggregated at the goal level to provide an overall view of the country's progress toward each SDG. Countries that submit less than 80% of the required data are excluded from the SDG ranking.

SDSN calculation focuses on three main steps, using the 2030 Targets as a reference point. Best-in-class performance defines the threshold for each indicator. Each country's values under the SDGs are normalized between 0 and 100. Finally, the SDG Index is calculated as the average of all 17 SDGs. No weight is assigned to different SDGs because the main approach emphasizes that every SDG is equally important.

In 2019, Lafortune et al. (2018) conducted a detailed statistical audit of the SDSN methodology. The audit outlines the selection of indicators, data normalization processes, and aggregation methods used to assess countries' progress toward the SDGs. This study emphasizes transparency and reproducibility in the methodology, ensuring that the index serves as a reliable tool for policymakers and researchers.

The data represents panel data from 2015 to 2023, grouped by geographical region and income groups. The World Bank's classification is utilized for further analysis. This structure enables temporal and regional comparisons to observe patterns and disparities in economic capacity and progress toward the SDGs.

3.3 Cross-country comparisons

3.3.1 Region-based comparisons – year 2015 and year 2023

In 2015, as indicated in Table 1, there were clear differences in GDP per capita and SDG Index scores across regions. North America had the highest average GDP per capita at \$60,073.74, followed by Europe and Central Asia with \$37,766.11, and the Middle East and North Africa with \$33,127.31. On the other hand, Sub-Saharan Africa recorded the lowest average at only \$5,081.71. The GDP per capita variations within the regions were also significant. For example, in the East Asia and Pacific region, GDP per capita ranged from \$4,154.52 to \$108,483.21, demonstrating considerable diversity in economic development among countries in this region.

Regarding the SDG Index, Europe and Central Asia achieved the highest average score of 75.90, indicating relatively strong performance in SDG achievement. Sub-Saharan Africa recorded the lowest score, with an average of 53.32, highlighting ongoing challenges in sustainable development. The standard deviations (SD) also provide essential insights; for example, South Asia exhibited the greatest variation among countries' SDG scores (SD = 8.56). In contrast, North America displayed the least variation (SD = 2.98), suggesting that the US and Canada had more comparable results than those of other regions.

These results indicate that both economic growth and progress on the SDGs are highly dependent on the region; some areas continue to face long-term structural challenges.

Table 1. World Region Summary Statistics, year 2015

GDP per capita						
	Number of Observations	Mean	Median	Min	Max	SD
East Asia & Pacific	18	\$28,482.99	\$14,275.27	\$4,154.52	\$108,483.21	\$29,411.68
Europe & Central Asia	48	\$37,766.11	\$32,574.62	\$3,041.44	\$129,293.71	\$24,259.13
Latin America & Caribbean	25	\$17,895.13	\$16,791.38	\$3,422.10	\$39,528.42	\$9,257.29
Middle East & North Africa	18	\$33,127.31	\$15,109.77	\$4,940.63	\$123,070.89	\$30,789.64
North America	2	\$60,073.74	\$60,073.74	\$55,572.07	\$64,575.41	\$6,366.32
South Asia	8	\$8,455.56	\$5,920.43	\$2,967.69	\$18,715.32	\$5,668.23
Sub-Saharan Africa	44	\$5,081.71	\$3,049.20	\$918.56	\$22,335.28	\$5,009.43

SDG_Index						
	Number of Observations	Mean	Median	Min	Max	SD
East Asia & Pacific	18	66.92	67.19	51.48	78.56	7.33
Europe & Central Asia	48	75.90	77.64	63.02	85.50	5.16
Latin America & Caribbean	27	67.24	67.11	51.35	77.33	5.73
Middle East & North Africa	19	62.77	63.84	46.77	75.22	7.84
North America	2	75.13	75.13	73.02	77.24	2.98
South Asia	8	59.78	61.14	41.51	67.50	8.56
Sub-Saharan Africa	45	53.32	53.65	38.14	68.33	6.46

Source: Author's own compilation and elaboration

In 2023, the gaps between regions in terms of economic output and SDG performance were still quite significant. North America again had the highest average GDP per capita at \$65,632.21 (see, Table 2). Europe and Central Asia follows with \$44,079.86, and the Middle East and North Africa reaches \$36,708.59. Sub-Saharan Africa and South Asia stay at the bottom, with averages of \$5,288.89 and \$9,287.20, indicating that economic inequality between regions hasn't changed significantly.

The differences inside regions also remained, such as in East Asia and the Pacific, GDP per capita went from as low as \$4,174.44 to as high as \$127,543.55, showing that this region still includes both very rich and very poor countries.

Europe and Central Asia had the highest average score of 77.76, followed closely by North America at 76.63. Sub-Saharan Africa recorded the lowest score again, averaging 56.39. South Asia showed some progress compared to 2015, reaching 63.94 (up from 59.78), but it is still far behind the more developed regions.

The standard deviation values indicated that inequality in SDG performance remains an issue, particularly in the Middle East & North Africa (SD = 7.2) and South Asia (SD = 7.92), where country scores vary widely.

Table 2. World Region Summary Statistics, year 2023

GDP per capita						
	Number of Observations	Mean	Median	Min	Max	SD
East Asia & Pacific	18	\$32,064.30	\$18,682.76	\$4,174.44	\$127,543.55	\$31,975.43
Europe & Central Asia	48	\$44,079.86	\$40,683.78	\$4,472.32	\$130,373.48	\$25,727.58
Latin America & Caribbean	25	\$20,120.58	\$19,018.24	\$2,956.46	\$49,315.16	\$10,844.42
Middle East & North Africa	16	\$36,708.59	\$27,501.28	\$6,400.62	\$116,159.14	\$30,263.69
North America	2	\$65,632.21	\$65,632.21	\$56,686.92	\$74,577.51	\$12,650.56
South Asia	7	\$9,287.20	\$8,242.40	\$1,992.42	\$22,286.98	\$6,729.66
Sub-Saharan Africa	44	\$5,288.89	\$3,470.53	\$828.86	\$26,590.42	\$5,278.76
SDG_Index						
	Number of Observations	Mean	Median	Min	Max	SD
East Asia & Pacific	18	69.87	70.14	51.99	79.87	6.85
Europe & Central Asia	48	77.76	78.76	67.13	86.35	4.59
Latin America & Caribbean	27	68.48	69.19	52.68	77.82	5.75
Middle East & North Africa	19	65.92	66.11	46.87	76.95	7.20
North America	2	76.63	76.63	74.43	78.83	3.11
South Asia	8	63.94	65.71	48.24	72.52	7.92
Sub-Saharan Africa	45	56.39	56.75	40.14	70.45	6.40

Source: Author's own compilation and elaboration

Comparing 2015 and 2023, it is evident that while there has been some improvement in SDG scores—especially in regions like South Asia—the overall pattern of regional inequality in both economic output and sustainable development progress remains largely unchanged, and SDG performances overall did not make significant progress.

3.3.2 Income-based comparison – year 2015 and year 2023

The 2015 data shown in Table 3 indicate that there were significant differences between income groups in terms of both economic development and sustainable development progress. High-income countries had the highest average GDP per

capita at \$50,183.45. They also performed best on the SDG Index, with an average score of 74.34. The median score was 76.7, with a standard deviation of 7.32, indicating that most of these countries made strong and consistent progress toward the goals.

In contrast, low-income countries still faced major economic struggles, with an average GDP per capita of just \$2,173.45. Their SDG Index average was 49.17. The standard deviation was 5.5, showing that most of them were performing at similar levels and making only limited progress.

Lower middle-income countries had an average GDP per capita of \$6,549.46 and an SDG Index average of 59.2. This group showed important gap in economic conditions, with a standard deviation of \$3,201.88. Their SDG scores were also more spread out (SD = 6.48), meaning the progress varied more from country to country.

Upper-middle-income countries were doing much better, with an average GDP per capita of \$17,084.32 and an SDG Index average of 68.7. Their SDG Index standard deviation was the lowest among all income groups (SD = 4.54), meaning their progress was more balanced and steadier.

Table 3. World Income Group Summary Statistics, year 2015

GDP per capita						
	Number of Observations	Mean	Median	Min	Max	SD
High income	54	\$50,183.45	\$44,184.96	\$12,040.08	\$129,293.71	\$23,581.81
Low income	22	\$2,173.45	\$2,135.21	\$918.56	\$5,302.07	\$999.53
Lower middle income	44	\$6,549.46	\$5,603.79	\$2,869.85	\$14,980.02	\$3,201.88
Upper middle income	43	\$17,084.32	\$15,239.52	\$9,646.15	\$30,893.76	\$5,262.28
SDG Index						
	Number of Observations	Mean	Median	Min	Max	SD
High income	54	74.34	76.70	55.37	85.50	7.32
Low income	24	49.17	50.43	38.14	58.03	5.50
Lower middle income	44	59.20	59.09	46.77	71.78	6.48
Upper middle income	44	68.70	68.90	57.50	77.83	4.54

Source: Author's own compilation and elaboration

The 2023 data presented in Table 4 reveal clear differences between income groups in both economic power and SDG performance. High-income countries led with an average GDP per capita of \$56,136.49 and the highest SDG Index average of 76.3. Their performance was consistent, as indicated by a low standard deviation of 6.43, with scores ranging from 61.83 to 86.35. This suggests that even the lower-performing high-income countries still achieved a strong level of sustainable development.

On the other hand, low-income countries had an average GDP per capita of only \$2,089.68, with very little variation among them ($SD = \$679.04$). Their average SDG Index score was 52.41, and although their economies were weaker, the SDG scores still demonstrated some differences across countries, ranging from 40.14 to 60.87. The lower-middle-income group had an average GDP per capita of \$6,979.17 and an SDG Index average of 62.24. This group showed a bit more variation than in 2015, with a standard deviation of 6.57, which might be due to different national strategies or differences in international support.

Finally, upper-middle-income countries continued to improve, achieving an average GDP per capita of \$19,626.73 and an SDG Index average of 70.79. With the lowest standard deviation in SDG scores at 4.2, this group demonstrated stable and balanced performance, suggesting that most of its countries are steadily moving toward sustainability targets.

Table 4. World Income Group Summary Statistics, year 2023

GDP per capita						
	Number of Observations	Mean	Median	Min	Max	SD
High income	54	\$56,136.49	\$49,655.32	\$19,224.46	\$130,373.48	\$23,660.41
Low income	21	\$2,089.68	\$1,992.42	\$828.86	\$3,060.03	\$679.04
Lower middle income	42	\$6,979.17	\$6,401.88	\$2,595.83	\$16,691.13	\$3,157.55
Upper middle income	43	\$19,626.73	\$18,846.25	\$10,105.51	\$34,703.23	\$6,218.96

SDG Index						
	Number of Observations	Mean	Median	Min	Max	SD
High income	54	76.30	78.71	61.83	86.35	6.43
Low income	24	52.41	52.70	40.14	60.87	5.55
Lower middle income	44	62.24	62.98	51.68	74.19	6.57
Upper middle income	44	70.79	70.66	59.41	78.81	4.20

Source: Author's own compilation and elaboration

Between 2015 and 2023, all income groups slightly improved their average SDG Index scores. The most significant improvements were observed in lower-middle-income countries, which increased from 59.2 to 62.24, and in upper-middle-income countries, which grew from 68.7 to 70.79. High-income countries remained at the top, rising from 74.34 to 76.3, while low-income countries also made progress, increasing from 49.17 to 52.41.

In terms of the economy, GDP per capita rose in every group, with upper-middle-income countries demonstrating the most substantial growth. The reduction in standard deviation for some groups, such as high-income and upper-middle-income countries, indicates that these countries are becoming more similar in their development. However, in lower-income groups, inequality still persists, meaning that development remains uneven, and some countries continue to face ongoing structural problems.

3.4 Evolution of the GDP per capita – SDG relationship

The scatterplots (see, Figure 2 and Figure 3) for 2015 and 2023 clearly show a strong and positive link between a country's wealth (GDP per capita) and its performance on the SDG Index. Countries with greater economic power typically excel in sustainable development. However, closer examination reveals some significant changes over time.

Between 2015 and 2023, more countries appeared in the middle-income range (between \$5,000 and \$20,000), especially those from Latin America, East Asia and Pacific, and the Middle East and North Africa. This shows that some developing countries moved to higher income levels and slightly improved their SDG scores.

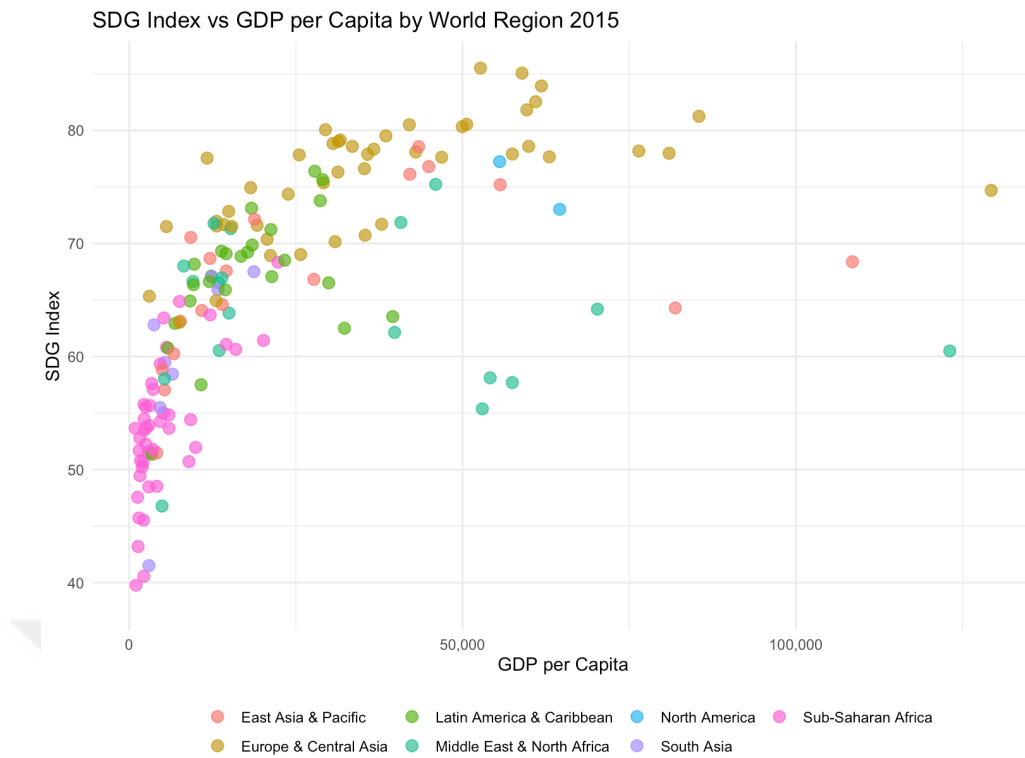


Figure 2. SDG Index vs. GDP per Capita, Year 2015 by Region

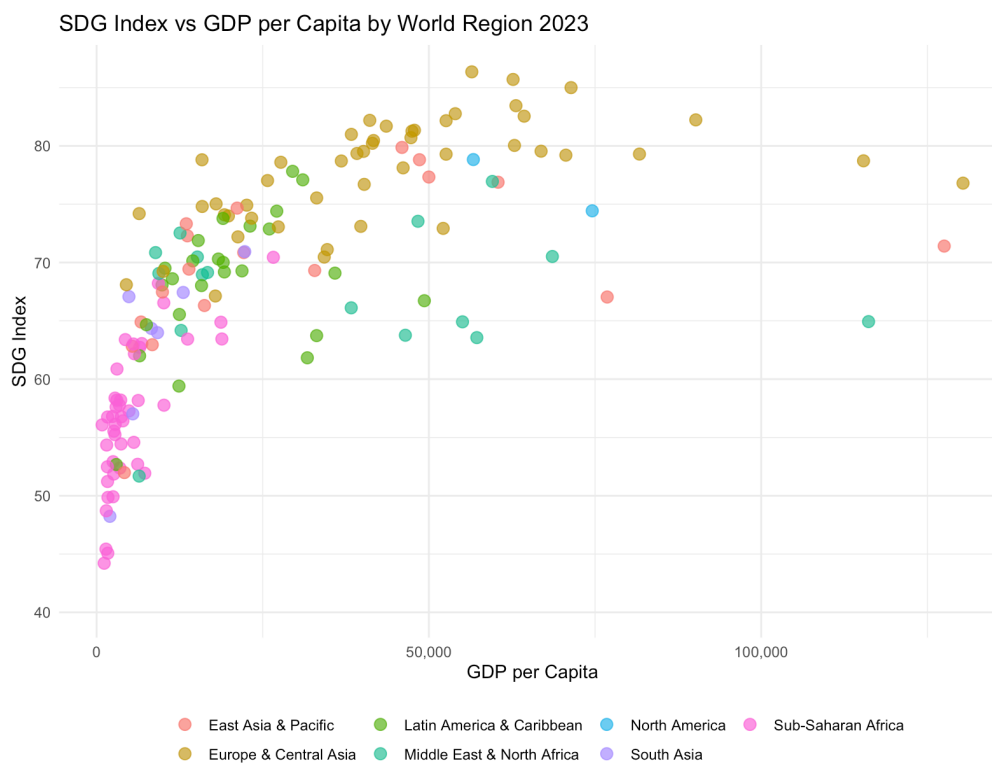


Figure 3. SDG Index vs. GDP per Capita, Year 2023 by Region

Sub-Saharan African countries are still mostly at the lower end of the income scale, but their SDG results were more spread out in 2023 than in 2015. This means that the differences in SDG progress between countries in that region are growing. Europe and Central Asia, on the other hand, remained the most stable and high-performing region. Their position didn't change much, which shows that they have already reached a strong and steady level of performance.

Another thing that stands out is the smoother shape of the curve in 2023, which indicates that the relationship between GDP per capita and SDG success has become clearer. This may be due to improved data and more effective policies in recent years.

Overall, these graphs indicate that although economic development is beneficial in achieving the SDGs, regional disparities persist. Not all countries convert their economic power into sustainable development equally.

3.4.1 Income group analysis of GDP per capita – SDG relationship

The scatterplots in Figure 4 and Figure 5, grouped by income levels, still show a strong connection between higher income and better SDG results, but they also provide new insights into how this relationship has evolved. Between 2015 and 2023, high-income countries maintained their position in the top-right part of the graph, demonstrating both robust economies and high SDG Index scores. In 2023, their points appear closer together, indicating that these countries have become more similar in performance, with fewer nations lagging behind.

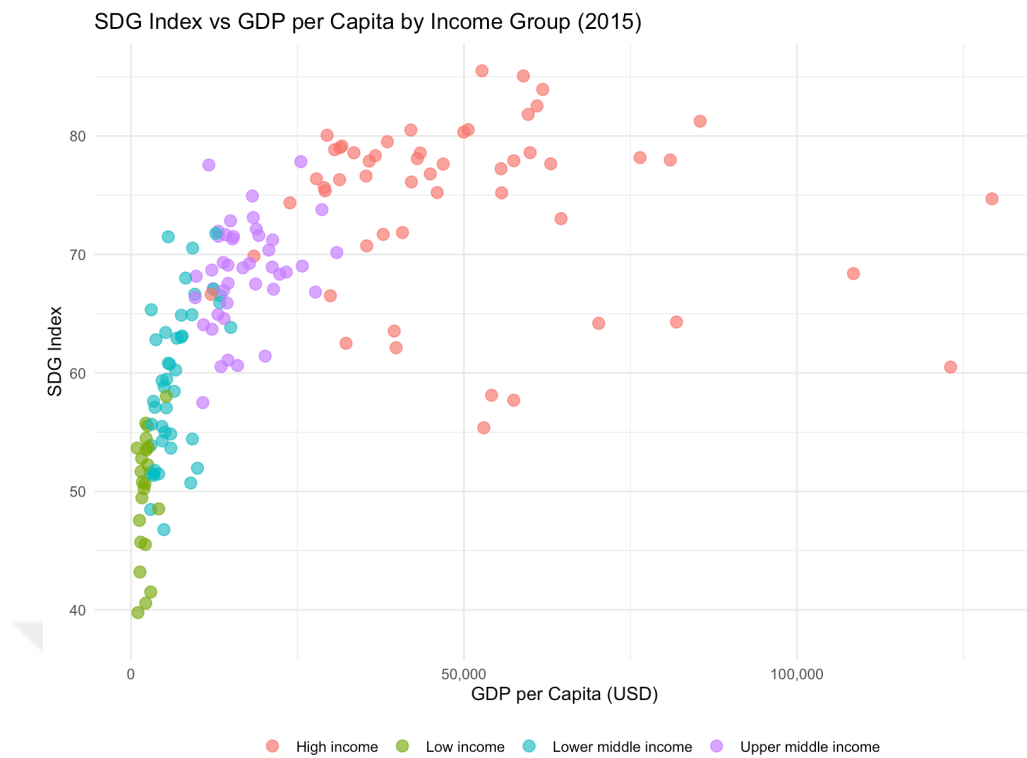


Figure 4. SDG Index vs. GDP per Capita, Year 2015 by Income Group

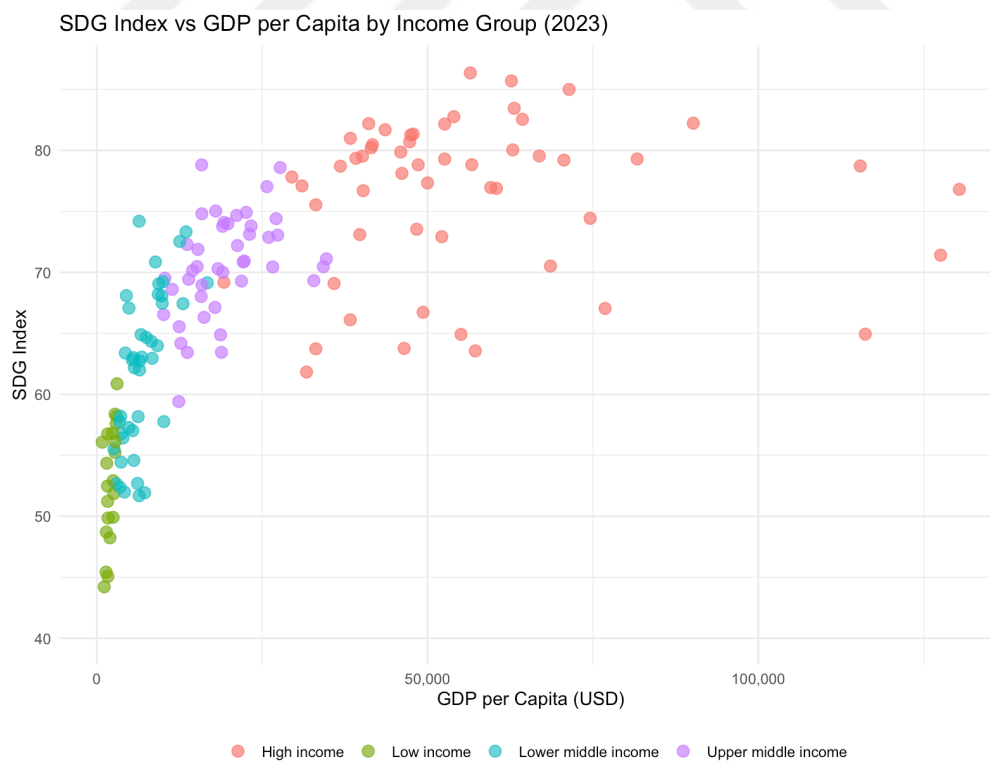


Figure 5. SDG Index vs. GDP per Capita, Year 2023 by Income Group

The 2023 graph, depicted in Figure 5, shows clear progress for upper-middle-income countries. Many now have SDG scores of 70 or higher, representing a considerable improvement compared to 2015, when their results were more varied and generally lower. The tighter cluster also indicates that these countries are increasingly aligning their sustainability policies and advancing together.

Lower-middle-income countries continue to face challenges due to their limited economic resources; however, their SDG Index scores show slight improvement in 2023. While the scores are still unevenly distributed, indicating that not all countries are performing equally, the overall trend remains positive. This implies that some countries are gradually translating economic development into improved development outcomes.

Low-income countries are still grouped in the lower left corner of the graphs, indicating that they face strong structural problems. Still, in 2023, a few of these countries have started to move slightly above the previous baseline, which might suggest early progress in their SDG performance, despite little change in their income levels.

This comparison confirms that income level remains a key factor for SDG success. However, the changes within each income group—especially in the middle-income categories—demonstrate that countries are progressing at different rates. This underscores the need for tailored strategies that address the specific needs and challenges of each income group to enhance their ability to transform economic growth into sustainable development.

3.4.2 SDG performance comparison by income group

The radar charts, depicted in Figure 6 and Figure 7, illustrate how various income groups performed on the 17 SDGs in 2015 and 2023. One prominent pattern emerges: countries with higher income levels generally achieve broader and more balanced success across the goals. Nevertheless, significant changes are observed over time, along with variations in specific goals.

In general, high-income countries had the best overall results in both years. Their 2023 radar shape is even more balanced and circular, which means they made steady progress across most goals. Their strongest results were in SDG1 (No Poverty), SDG3 (Good Health), SDG4 (Quality Education), and SDG16 (Peace and Institutions). Upper-middle-income countries made visible progress between 2015 and 2023, especially in goals like SDG1, SDG4, and SDG6 (Clean Water). These countries have started to close the gap with high-income countries, although they still fall behind in SDG9 (Industry and Infrastructure) and SDG12 (Responsible Consumption).

Lower-middle-income countries also improved, primarily in SDG2 (Zero Hunger) and SDG3. However, their performance remains uneven as they grapple with SDG7 (Affordable Energy) and SDG9, indicating that access and infrastructure are still significant challenges. Low-income countries continue to be the most disadvantaged group. In 2023, they made slight progress in goals such as SDG1, SDG4, and SDG13 (Climate Action), but their overall status is still narrow and irregular. They scored the lowest in SDG7, SDG9, SDG10 (Reduced Inequality), and SDG17 (Partnerships), highlighting the persistent gap.

SDG Performance Radar Chart by Income - 2015

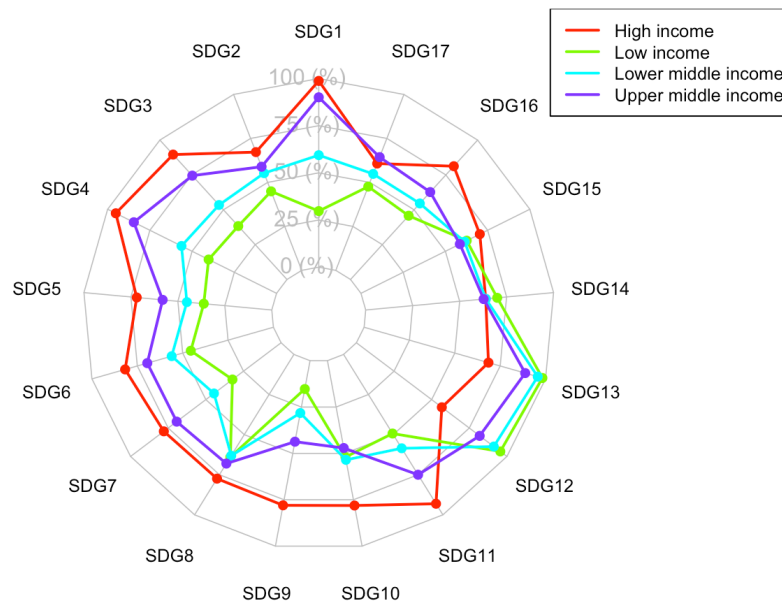


Figure 6. Income Group SDG Performance 2015

SDG Performance Radar Chart by Income - 2023

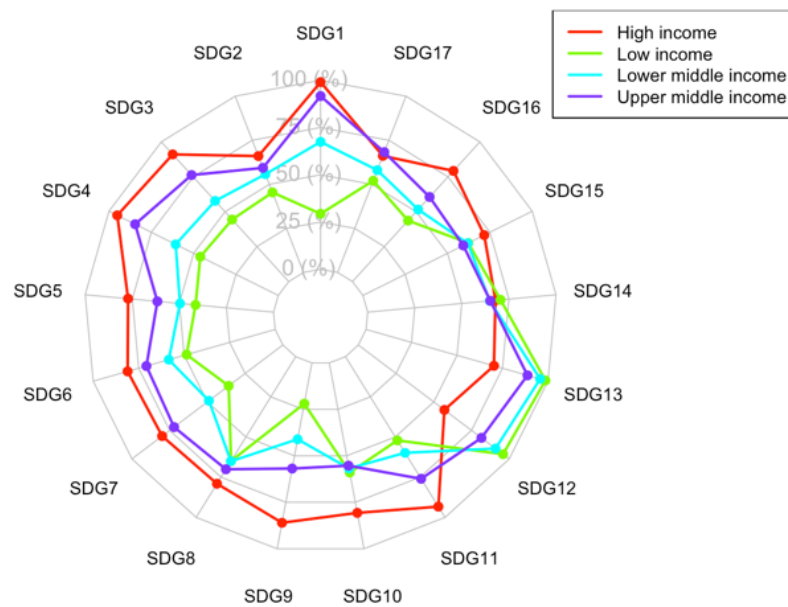


Figure 7. Income Group SDG Performance 2023

Some key changes between 2015 and 2023 are worth noting. SDG9 continues to be one of the most challenging goals for low- and lower-middle-income countries, with slight improvement, which shows that gaps in technology and infrastructure are still significant problems. SDG10 and SDG12 had the most minor differences between income groups but also the least progress overall, which suggests they may not be getting enough global attention. On the other hand, SDG13 (Climate Action) is now being taken more seriously across all income levels, including by low-income countries, which is a positive development.

In summary, income still significantly affects how well countries perform on the SDGs. The gap between upper-middle- and high-income countries is narrowing, particularly in basic needs and education. However, low-income countries continue to lag in many areas. Infrastructure, energy, and industrial growth goals still exhibit significant disparities between groups. This indicates that while some progress is being made, not all goals are advancing at the same pace, and those that require greater investment or international cooperation remain the most difficult to achieve.

CHAPTER 4

METHODOLOGY

4.1 Research design

This thesis employs a quantitative, comparative research design to assess how efficiently countries convert economic capacity into sustainable development outcomes between 2015 and 2023. The central analytical tool is Data Envelopment Analysis (DEA), a non-parametric method used to evaluate the relative efficiency of decision-making units (DMUs), specifically countries in this context. To address issues of multicollinearity and dimensionality in the SDG data, Principal Component Analysis (PCA) is conducted prior to DEA, reducing the 17 SDGs into a smaller number of uncorrelated components.

For the DEA, one input of GDP per capita PPP (constant international 2021 USD) and 17 SDG indices as output—calculated by the SDSN at SDR 2024—are processed. The thesis explicitly isolates GDP per capita, PPP, as a single input to reveal the ability of a country to translate its economic strength into sustainable development performance. The adjusted economic growth indicator under the SDG 8 index has been extracted from the analysis, and a new SDG 8 index has been calculated to avoid any ambiguities regarding one part of the input, is also in the output. Mainly, economic growth is the driver of the quantitative analysis rather than being a goal as an SDG outcome. By excluding growth-related metrics, the model isolates how well countries translate their economic power into sustainable development, independent of mere growth effects.

4.1.1 Imputation approach – Expectation Maximization

As the thesis aims to find countries' efficiency rates between 2015 and 2023 in transforming their economic development into SDGs, it was important to ensure consistency in the dataset. Sixty-two countries lack information on four main topics: GDP per capita, SDG 1, SDG 10, and SDG 14. To avoid losing nearly forty percent of the benchmark dataset and to protect all the information from the seventeen SDGs in the SDR 2024, the Expectation Maximization methodology has been employed in the main analysis to estimate the missing SDG values. On the other hand, there are countries for which GDP per capita PPP (constant international 2021, USD) has not been reported due to economic instability, such as Venezuela. Therefore, to ensure comparability between years, countries without reported GDP per capita are excluded from the main analysis. The excluded countries are Bhutan, Cuba, Lebanon, South Sudan, the Syrian Arab Republic, Venezuela, and Yemen.

Selecting an imputation method that maintains realistic value ranges while respecting multivariate relationships among the indicators was essential. To ensure analytical consistency in the DEA, missing data were handled using the Expectation-Maximization (EM) algorithm available in SPSS (IBM Corp., 2020). This algorithm estimates missing values by iteratively calculating expected values based on observed data and maximizing the likelihood function under multivariate normality assumptions. EM is particularly well-suited for PCA preparation as it preserves the underlying covariance structure of the data, essential for principal component extraction. (IBM Corp., 2020) The Expectation Maximization Method doesn't impose a cap on the values. Still, since our output sets consist of indices between 0 and 100, 100 has been set as a strict upper limit for the Expectation Maximization

Model. After conducting the Expectation-Maximization technique, the optimum number of principal components was chosen, and DEA was executed.

4.1.2 Dimensionality reduction - Principal Component Analysis

Due to the high correlations among the SDG indicators, as indicated in Figure 9, Principal Component Analysis has been conducted to address the multicollinearity problem of the DEA Model. PCA extracts a reduced set of orthogonal, independent components that maintain a significant portion of the original variance.

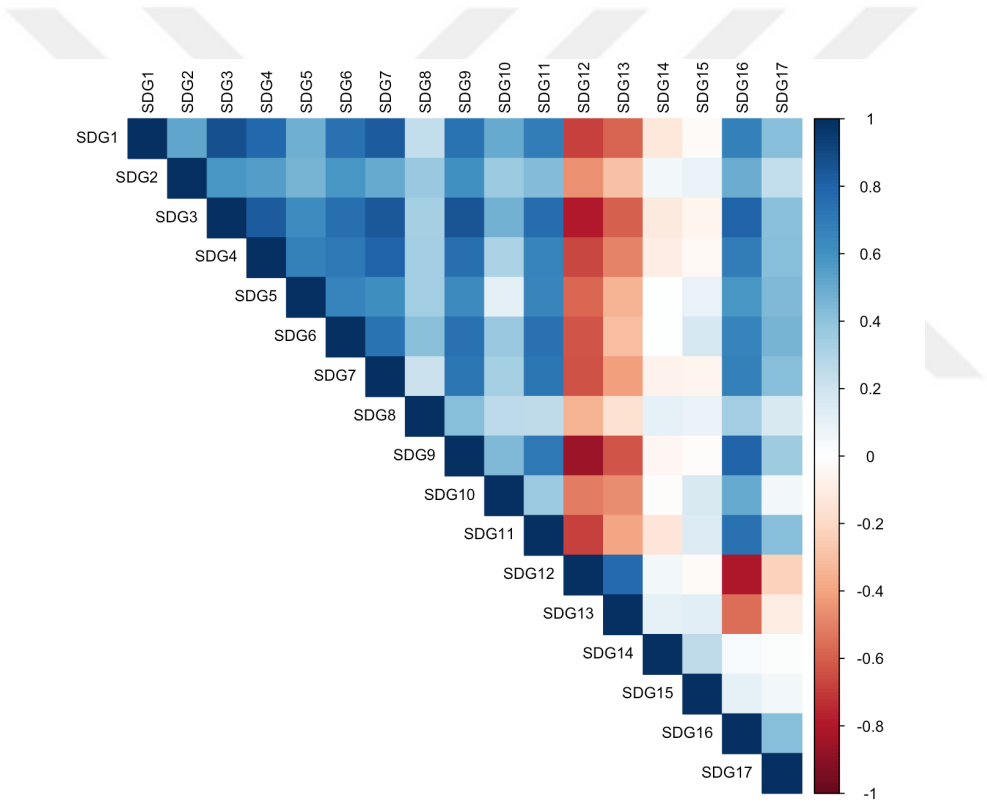


Figure 9. SDG Correlation Table

4.1.2.1 PCA variance coverage and rotation principle

PCA is conducted on the pooled dataset, and unrotated components are preferred to maintain the variance-maximizing property essential for DEA consistency. The goal is to preserve most of the data variance (information held within the dataset) while improving DEA's discrimination by reducing dimensionality. Adler and Yazhemsky (2010) provide guidance tailored to DEA; the thesis indicates that for DEA VRS models, retaining components that capture around 75%-80% of the total variance is most effective for capturing the information of the original dataset. At this threshold, the principal components still reflect most of the information, and efficiency scores remain robust.

Another important consideration when applying PCA is whether to use a rotation, such as Varimax, in principal component analysis or to rely on unrotated principal components. The reasoning behind using unrotated principal components is that they capture the variance in descending order. Jolliffe (2002) indicates that by rotating the components, the total variance still remains unchanged, but it is redistributed amongst the rotated components. Hence, the information about the dominant components will be lost through rotation, significantly affecting the results of Data Envelopment Analysis. Based on this information, this thesis addresses a variance between 75% and 80% with five principal components and does not use rotated components (see, Appendix A), but rather unrotated ones, to conduct Data Envelopment Analysis.

4.1.2.2 Selection of the number of Principle Components

The total variance they explained was analyzed to determine how many principal components to use in the DEA. The first five components accounted for

approximately 79.5% of the total variance (see, Appendix A). Although this is slightly lower than the typical 85% threshold, it was still considered sufficient for developing a robust model. In complex datasets like the SDG indicators, it is common for much of the remaining variance to be distributed among small and less significant components.

Focusing on the first five principal components, the model highlights important, long-term patterns such as a country's economic strength, institutions, and social systems. Simultaneously, this approach helps reduce the impact of random fluctuations, short-term issues, or data errors. Adding more components beyond the fifth would not significantly assist and could potentially destabilize the DEA results. Therefore, retaining five unrotated components provides a good balance between encompassing sufficient information and maintaining clarity and reliability in the model.

4.2 Data Envelopment Analysis

After determining the output variables—five principal components—DEA has been conducted to measure countries' efficiency in translating their economic development into sustainable development.

Given the nature of the SDG indices, which are capped at a maximum score of 100, an output-oriented DEA model would have been inappropriate. Maximizing outputs is structurally limited by this upper bound and attempting to push scores beyond 100 is not feasible within the SDG framework. Therefore, an input-oriented DEA model was selected. This model focuses on minimizing inputs—in this case, GDP per capita—relative to the achieved levels of sustainable development performance. This approach aligns with the central research question: how efficiently

countries utilize their economic resources (GDP per capita) to achieve progress across sustainable development goals.

An input-oriented model thus provides a more meaningful evaluation of countries' abilities to leverage their economic capacity toward sustainable success within the natural boundaries imposed by the SDG scoring system. An input-oriented Variable Returns to Scale (VRS) DEA model is used to assess how efficiently countries utilize their GDP per capita to achieve the SDG-related outputs. The VRS assumption accounts for the heterogeneity in countries' sizes, resource endowments, and governance systems. Given resource constraints, the input-oriented model reflects the policy interest in minimizing economic inputs (or maximizing outcomes from fixed inputs).

This thesis applies the input-oriented DEA model under variable returns to scale (VRS), as introduced by Banker et al. (1984), which allows for assessing technical efficiency while accounting for scale inefficiencies. Since the main question is how efficient countries use their economic resources to achieve sustainability, it is chosen to run an input-oriented DEA model to find out how much of the current input can be used to maintain the same level of SDG performance. This approach enables us to understand how much economic resources are dedicated to sustainable development and whether countries could do better. As the DEA will be conducted among all countries with GDP per capita figures from 2015 to 2023, and since the scale of the countries varies, the DEA model is implemented under variable returns to scale (VRS).

BCC Data Envelopment Mathematical Model:

Min θ

$$\sum_{j=1}^{\{n\}} \lambda_j x_{ij} \leq \theta x_{i0}, \quad \text{for all } i = 1, \dots, m \text{ (} x_{ij} \text{ - Input } i \text{ of DMU } j \text{)}$$

$$\sum_{j=1}^{\{n\}} \lambda_j y_{rj} \leq y_{r0}, \quad \text{for all } r = 1, \dots, s \text{ (} y_{rj} \text{ - Output } r \text{ of DMU } j \text{)}$$

$$\sum_{j=1}^{\{n\}} \lambda_j = 1, \quad \lambda_j \geq 0, \text{ for all } j = 1, \dots, n \text{ (} \lambda_j \text{ - Intensity of DMU } j \text{)}$$

Countries are grouped based on their DEA scores. Those with a score of 1 are considered efficient, meaning they are making the best use of their economic resources. Countries with a score below 1 are seen as inefficient, as they are not performing as well as other countries with similar or even lower GDP per capita. These results are also looked at in relation to regions, income levels, and focus areas within the SDGs.

In this thesis, unrotated principal components were used as the outputs for DEA to keep the original structure of the SDG data. Unrotated PCA keeps the full spread of statistical information without changing the weight of the themes, which makes the DEA results more stable and fair across different dimensions of development.

On the other hand, Varimax rotation changes how the information is spread across the components and focuses more on certain areas, like environmental or social topics. This can significantly change the efficiency scores and might favor countries that are doing well only in specific areas rather than showing balanced development overall. Since this research aims to measure how well countries turn

their economic development into overall sustainable development, using unrotated components is more suitable. It gives a more complete, reliable, and fair picture of efficiency.



CHAPTER 5

KEY FINDINGS

This section presents the main findings of the DEA analysis performed. The main analysis was conducted across 160 countries from 2015 to 2023. When comparing average efficiency rates, the overall performance of the regions has not changed significantly over time.

In this chapter, section 5.1 will report first key findings based on a detailed analysis of region-based country groups. Section 5.2 will look at the comparisons and key findings from an income-based grouping perspective.

5.1 Key findings, regional DEA efficiency results

The regional Data Envelopment Analysis results provide important insights into global patterns of sustainable development efficiency and how efficiency scores differ across regions over nine years. These efficiency scores reflect how efficiently regions translate their economic development into sustainable development. While these figures represent average efficiency, they do not indicate the gap between countries; nevertheless, they serve as good indicators of how regions are performing over the years and how the world converts economic strength into SDG achievements.

As indicated in Table 5, Europe and Central Asia is the top performer over the years, boasting a remarkable average efficiency score of 0.78. This region stands out as the most efficient throughout the observed years, with its score ranging from 0.77 to 0.79. This performance indicates that countries in this region are more

successful at implementing the SDG framework and properly channeling their economic resources for sustainable development.

Table 5. Regional Efficiency Performances, 2015-2023

	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub- Saharan Africa	Total
2015	0.65	0.78	0.73	0.40	0.65	0.58	0.71	0.69
2016	0.63	0.78	0.73	0.39	0.68	0.57	0.69	0.68
2017	0.63	0.77	0.73	0.38	0.67	0.56	0.70	0.68
2018	0.62	0.79	0.73	0.39	0.67	0.56	0.70	0.69
2019	0.63	0.78	0.71	0.39	0.66	0.54	0.69	0.68
2020	0.63	0.78	0.76	0.41	0.66	0.59	0.69	0.69
2021	0.63	0.77	0.72	0.38	0.63	0.57	0.71	0.68
2022	0.61	0.77	0.73	0.39	0.65	0.60	0.70	0.68
2023	0.62	0.77	0.72	0.38	0.64	0.59	0.71	0.68
Total	0.63	0.78	0.73	0.39	0.66	0.57	0.70	0.68

Source: Own analysis and calculation

In this thesis, countries that were efficient during the period 2015-2023 will be referred to as the “Best Performers” of the group. In total, there are forty-eight countries in this group. The group's best performers are Croatia, Denmark, Finland, Hungary, Latvia, Norway, Portugal, Sweden, Kyrgyz Republic, Tajikistan, Albania, Belarus, and Moldova. Turkmenistan, Kazakhstan, and Azerbaijan are the worst-performing countries, with an average efficiency score of 0.33 (see, Appendix B). This gap between best and worst performers can be attributed to a structured implementation approach, mature institutional frameworks, an established welfare system, and a robust governance structure in the best-performing countries.

The average efficiency score for Latin America and the Caribbean is 0.73, below Europe and Central Asia. Overall, the scores remain stable within the range of 0.71 to 0.76. Despite economic volatility in some Latin American countries, the region generally efficiently transforms economic potential into developmental outputs. An examination of specific country performances in Appendix B shows that

while some countries are underperforming, the overall performance among the region's countries is similar, thanks to their ongoing sustainability agenda and civil society engagement.

In total, there are twenty-five countries in this region, with Chile, Guyana, Brazil, and El Salvador being the group's best performers. The Bahamas, with 0.17; Panama, with 0.25; and Trinidad and Tobago, with 0.31, are the three lowest performers in the group (see, Appendix B).

According to the DEA results, Sub-Saharan Africa exhibits strong performance; however, these results should be analyzed in light of the dynamics of DEA. This means that these results are merely the efficiency performance scores of the countries in converting their economic development into sustainable development. For example, Burundi has an average GDP per capita of 861 USD and an average SDG Index of 54.5, whereas its average DEA result is “1.00” over nine years. Thus, this country is an example of strong efficiency performance compared to others with the same SDG Index but greater economic level of development. This analysis allows us to assess the actual performance of countries in their context. It should be understood that the DEA results are relative to the input-output values of others and serve as a robust comparison tool between decision-making units, considering each country’s unique capacity limitations.

With this technical insight, Sub-Saharan Africa achieves an average efficiency score of 0.70, ranking third among all regions. Its scores have remained highly stable from 2015 to 2023, with no year falling below 0.69. In total, there are forty-four countries in this group. The best performers are Burundi, Mali, Mozambique, Rwanda, Somalia, Benin, Cabo Verde, Comoros, Ghana, Guyana,

Lesotho, and Namibia. Angola, with 0.18, Gabon, with 0.23, and Congo, with 0.27, are the least performers in the group (see also, Appendix B).

North America's average efficiency score is 0.66, which is lower than expected, particularly given its high GDP per capita. Canada's average efficiency score is 0.87, while the United States' efficiency score is 0.45 (see Appendix B). This primarily indicates a lack of commitment to implementing the SDG Framework. The results may also reflect challenges in social equity, environmental sustainability, or institutional trust that remain unaddressed despite economic abundance. In line with the literature, the findings suggest that economic development alone does not guarantee sustainable development efficiency. Indeed, this perspective is discussed in SDR 2024, which includes an additional index called the UN-based Multilateralism Index, evaluating nations' commitment to international cooperation through UN institutions. This low ranking underscores a significant retreat from multilateral engagement and a diminished prioritization of the SDG framework by the United States (US). The US, for instance, continues to underperform in its sustainable development outcomes, primarily due to the absence of a coherent national strategy for implementing the SDG Framework. Despite being a high-income country with substantial resources, the US seems not devoted to multilateral SDG coordination. This highlights that sustainable development is not one of its primary national policy priorities, contributing to its lower efficiency scores compared to peer countries. Again, the findings imply that economic growth and development alone do not guarantee sustainable development efficiency.

With an average score of 0.63, East Asia and the Pacific perform at a mediocre level in sustainable development. The trend remains essentially flat, with 2023 slightly declining to a score of 0.62. Considering the economic development in

the region, the DEA results indicate an imbalance between economic development and social and environmental outcomes. Rapid industrialization, without simultaneous investments in inclusive growth or sustainability, might explain the efficiency gap. There are eighteen countries in the group, with Japan, New Zealand, and Vietnam ranking as the top performers. In contrast, Papua New Guinea, with 0.21, Malaysia, with 0.28, and Brunei Darussalam, with 0.31, are the least effective performers in the group (see, Appendix B).

Southeast Asia began with a relatively low score of 0.58 in 2015. After a slowdown in 2019, it decreased to 0.54; currently, it performs at 0.59. Over the last two years, Afghanistan and Nepal have reached an efficiency level of 1 relative to their peers. The region's overall average remains 0.57, highlighting significant room for improvement in the effectiveness of sustainable development strategies. There are seven countries in the region, and there is no best-performing country among this group. Sri Lanka, at 0.30, the Maldives at 0.44, and Pakistan at 0.46 are the lowest performers (see, Appendix B).

The Middle East and North Africa are the least efficient regions. This region's lowest average score of 0.39 demonstrates a persistent efficiency gap. This group has sixteen countries, and none stand out as performers. Saudi Arabia, with a score of 0.16, Qatar, 0.19, and Bahrain, 0.21, rank as the group's worst performers (Appendix B). This inefficiency score can be attributed to long-lasting political instability, conflicts, and underinvestment in public services. Although certain economies enjoy high GDP per capita, the benefits appear unevenly distributed and misaligned with SDG priorities.

The world average efficiency score fluctuates slightly between 0.68 and 0.69 over the years, showing no significant upward or downward trend. This indicates

that, at an aggregated level, global progress in leveraging economic capacity to achieve SDG targets has reached a standstill. While certain regions make progress, others stagnate or decline, resulting in an overall balance that conceals regional imbalances. This finding highlights the necessity for a tailored policy focus at the regional level, rather than depending solely on global averages.

5.2 Key findings, income group DEA efficiency results

This section investigates the relationship between countries' income levels and their DEA efficiency scores. Countries are grouped by World Bank income categories, and the performance of higher-income countries compared to lower-income countries is also considered. This approach seeks to better understand whether greater individual economic power leads to a more efficient development analysis.

According to the analysis (see, Table 6), low-income countries display the highest average scores; however, this result should be interpreted cautiously. As previously underline, these efficiency scores reveal how well each country converts its economic development into sustainable growth, as exemplified by the case of Burundi. The model necessitates achieving the optimum efficiency score based on the resources available to a country. Therefore, a country with limited economic resource means that the model does not assess the best performance achievable; instead, it evaluates the best performer among peer countries and establishes a ranking. Conversely, these high efficiency scores demonstrate a strong capacity to convert limited resources into sustainable outcomes compared to their peers. Many low-income countries, such as Burundi, Mali, Mozambique, Rwanda, and Somalia, achieved a DEA score of “1.00” throughout 2015-2023, indicating efficiency in reaching the SDG frontier relative to their income peers.

Table 6: Income Group Efficiency Performances, 2015-2023

	High income	Low income	Lower middle income	Upper middle income	Total
2015	0.71	0.75	0.70	0.62	0.69
2016	0.71	0.74	0.68	0.61	0.68
2017	0.71	0.75	0.67	0.62	0.68
2018	0.73	0.71	0.68	0.62	0.69
2019	0.71	0.71	0.67	0.62	0.68
2020	0.73	0.71	0.68	0.65	0.69
2021	0.70	0.75	0.68	0.63	0.68
2022	0.70	0.73	0.67	0.64	0.68
2023	0.70	0.74	0.67	0.63	0.68
Total	0.71	0.73	0.68	0.63	0.68

Source: Own analysis and calculation

High-income countries consistently perform the best due to their high income and strong SDG scores. This group should serve as a benchmark for developing countries, given their structural implementation of the SDG framework and the high well-being level of their people, such as Finland, Denmark, France, and Germany. However, some countries, like the United States, Saudi Arabia, and Kuwait, consistently underperform because of their strategies, how they position the SDG framework, and how much they prioritize it.

Lower-middle-income countries demonstrate moderate performance, with an average score of 0.68. This group includes high-performing countries such as Vietnam and inefficiencies found in large economies like India and Nigeria. Upper-middle-income countries exhibit the lowest efficiency performance, with an average score of 0.63. Persistent inefficiencies are evident in many large economies, including China, Brazil, and South Africa.

Comparing the efficiency scores for the years 2015 and 2023 on a scatter plot, depicted in Figure 10, Figure 11, Figure 12 and Figure 13, will help us determine whether countries are better off or worse off after nine years. The 45% trend line on the figures symbolizes the boundary between countries that have

performed better and those that have performed worse. In examining the Upper-Middle-Income Countries chart, the red dot indicates Türkiye; unfortunately, Türkiye is worse off after nine years of SDG framework implementation efforts. In Chapter 7, Türkiye Case will be examined in depth and Türkiye's efficiency position compared to its peers will be displayed.



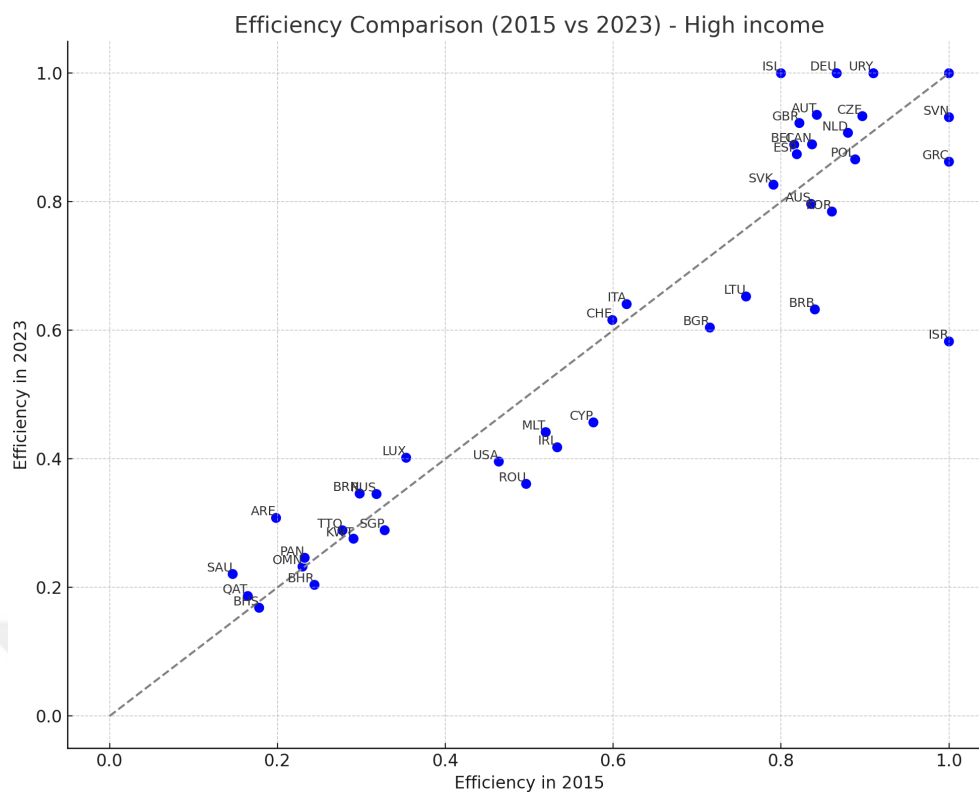


Figure 10. Efficiency Comparison 2015 vs. 2023 – High Income Group

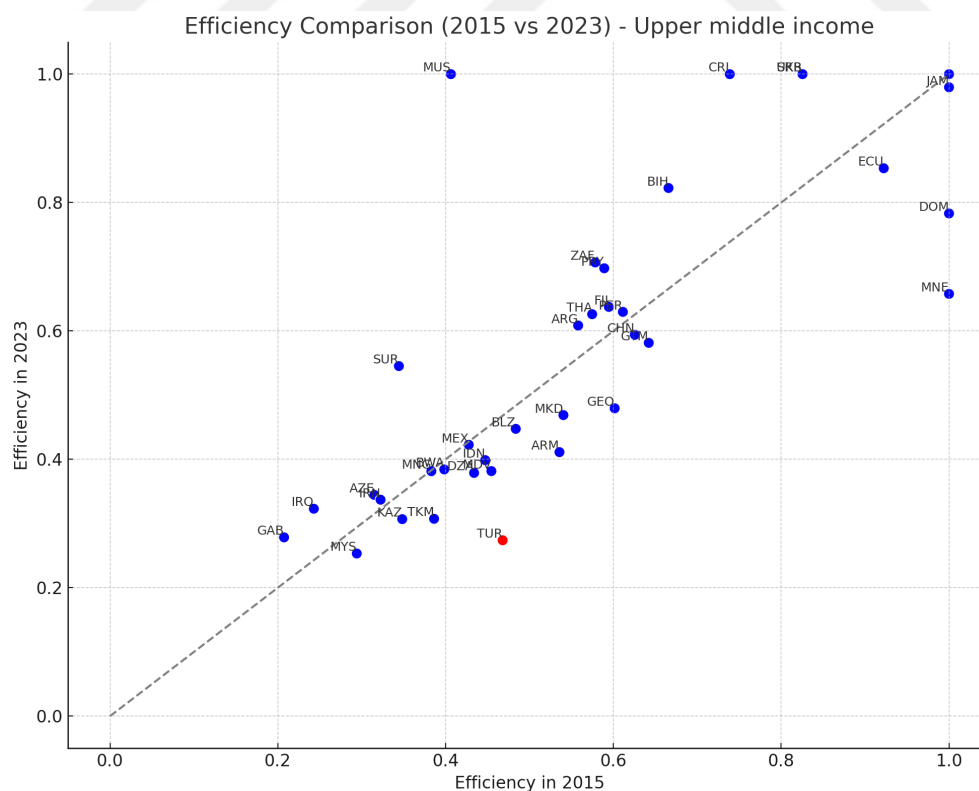


Figure 11. Efficiency Comparison 2015 vs. 2023 – Upper-middle Income Group

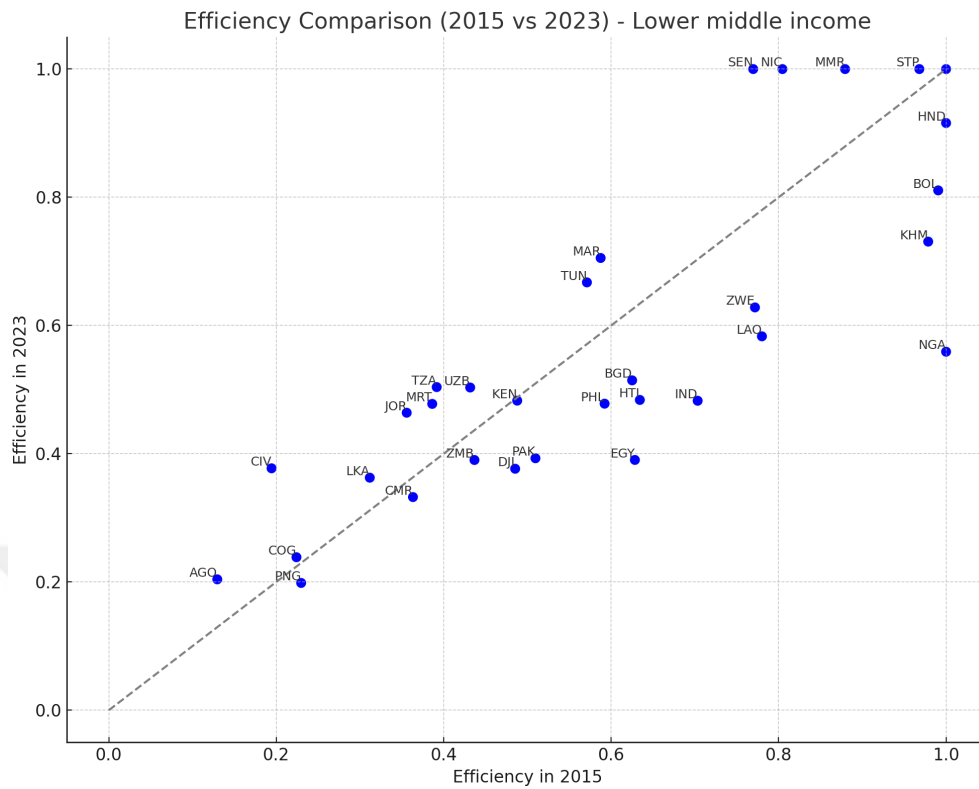


Figure 12. Efficiency Comparison 2015 vs. 2023 – Lower-middle Income Group

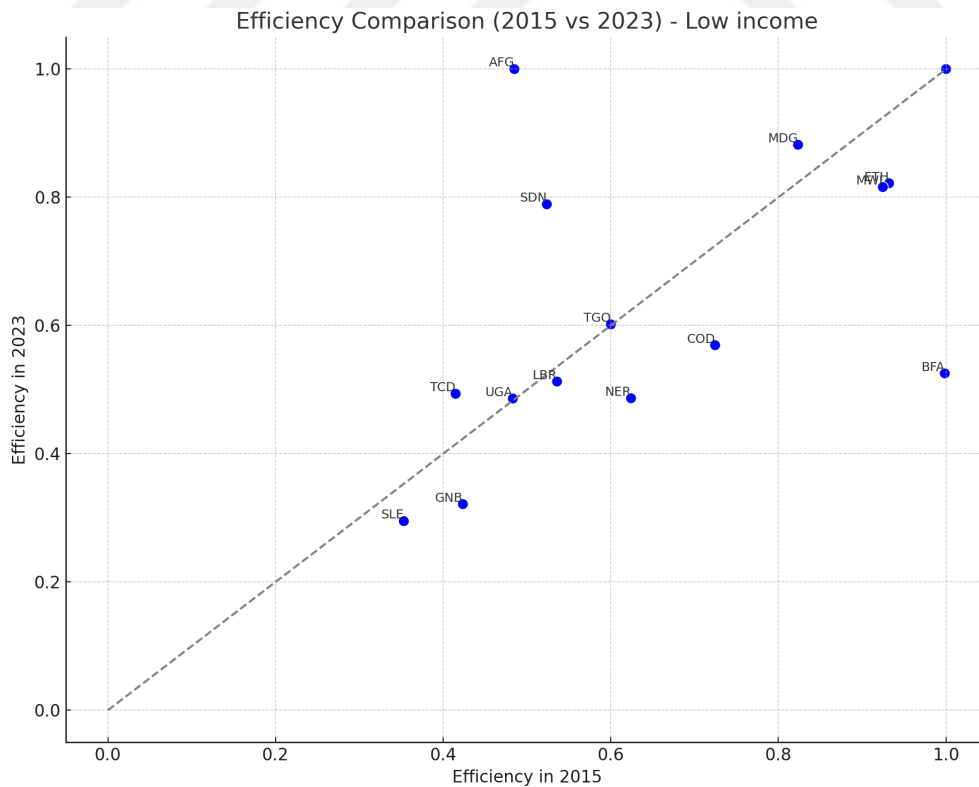


Figure 13. Efficiency Comparison 2015 vs. 2023 – Low Income Group

CHAPTER 6

ROBUSTNESS ANALYSIS

The main analysis, reported in Chapter 5, was based on estimating the missing values for SDG1, SDG 10, and SDG 14 using the Expectation Maximization approach. This Chapter uses a two-sided filtration² technique to evaluate this approach's robustness. Countries lacking values for GDP per capita and SDG1 have been removed from the dataset, as well as SDG 10 and SDG 14 from the output set. This two-sided filtration method has been chosen to create a contingent second approach. With this approach, only nineteen countries are eliminated, and the analysis has been run on one hundred forty-eight countries. If all countries with missing values were excluded, 37% of the dataset would be removed. Since DEA is primarily based on peer comparison, the second filtration method has not been chosen over the two-sided filtration method to maintain a complete baseline for the entire world.

Comparing the results of both approaches (main vs. the alternative for robustness check) reveals that the outcomes of the main analysis are quite promising, and both results are very close to each other (see, Appendix C). Most of the changes arise from the positioning of the country's SDG 10 and SDG 14 scores relative to its overall SDG Index. For example, according to the robustness analysis, Türkiye is slightly better off than in the main analysis because Türkiye's SDG 10 and SDG 14 performances are below its overall SDG Index. Removing these two SDG goals, where countries perform poorly, allows them to achieve a better score in the robustness analysis and vice versa.

² Excluded Countries in Robustness Analysis are Bahamas, Bahrain, Barbados, Bhutan, Brunei, Cambodia, Cuba, Kuwait, Lebanon, New Zealand, Oman, Qatar, Saudi Arabia, Singapore, South Sudan, Syrian Arab Rep., Ukraine, Venezuela, Yemen.

The correlation between the results of the two analyses is 0.69. This also strengthens the argument for using the Expectation Maximization Method in the main analysis, which enables us to achieve efficiency scores for 160 countries without losing 37% of the dataset.

When comparing the efficiency scores of the main approach and the robustness check approach, we observe a similar pattern across both regional and income-based groupings. However, the robustness scores tend to be slightly higher overall, particularly for high-income countries and regions with advanced institutional infrastructure.

Europe and Central Asia maintain high levels of efficiency in both models (0.78 for main versus 0.80 for robustness), confirming their consistent performance regardless of model specification (see, Table 7).

On the other hand, the Middle East and North Africa demonstrate one of the largest discrepancies between the two models, scoring only 0.39 in the main analysis but 0.47 in the robustness check. A similar pattern is noted in South Asia, where the efficiency score increases from 0.57 to 0.65, suggesting that some countries in this region may perform better under alternative data treatments or model adjustments.

Table 7. Regional Efficiency Performances – Robustness Analysis

	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub- Saharan Africa	Total
2015	0.78	0.80	0.66	0.57	0.67	0.64	0.70	0.72
2016	0.77	0.79	0.65	0.45	0.69	0.63	0.66	0.69
2017	0.75	0.79	0.66	0.42	0.69	0.54	0.66	0.69
2018	0.75	0.80	0.67	0.45	0.69	0.62	0.69	0.71
2019	0.72	0.79	0.66	0.46	0.66	0.62	0.69	0.70
2020	0.75	0.80	0.67	0.47	0.67	0.68	0.73	0.72
2021	0.80	0.80	0.68	0.47	0.65	0.72	0.75	0.74
2022	0.77	0.79	0.66	0.46	0.65	0.69	0.73	0.72
2023	0.77	0.80	0.67	0.47	0.64	0.69	0.73	0.72
Total	0.76	0.80	0.66	0.47	0.67	0.65	0.70	0.71

Source: Own analysis and calculation

High-income countries score approximately 0.71 in the main analysis (see, Table 8); in the robustness check, they perform significantly better with an average of 0.80. As indicated above, this improvement is primarily due to the low scores in SDG 10 – Reduced Inequalities and SDG 14 – Life Below Water. Removing SDG 10 and SDG 14 scores from the analysis makes countries with better scores for these goals worse off, and vice versa.

From the income group perspective, depicted in Table 8, low-income countries show an increase from 0.73 in the main analysis to 0.79 in the robustness check, possibly indicating that the robustness model smooths out annual fluctuations or missing data, providing a more optimistic yet still reasonable view of their progress. Meanwhile, upper middle-income countries display a much more stable pattern between the two models (0.63 vs. 0.63), implying that their results are not significantly affected by model assumptions.

Table 8. Income Group Efficiency Performances – Robustness Analysis

	High income	Low income	Lower middle income	Upper middle income	Total
2015	0.80	0.77	0.68	0.66	0.72
2016	0.80	0.72	0.64	0.62	0.69
2017	0.81	0.73	0.61	0.62	0.69
2018	0.82	0.77	0.65	0.62	0.71
2019	0.80	0.77	0.64	0.62	0.70
2020	0.80	0.83	0.66	0.64	0.72
2021	0.81	0.86	0.70	0.63	0.74
2022	0.79	0.81	0.68	0.65	0.72
2023	0.79	0.81	0.68	0.65	0.72
Total	0.80	0.79	0.66	0.63	0.71

Source: Own analysis and calculation

Overall, the direction and rank order of efficiency among regions and income groups remain aligned mainly between the two analyses. However, the robustness analysis, as expected, slightly boosts scores, especially for higher-income and institutionally strong countries, due to the performance differences in SDG 10 and SDG 14. It is important to note that the primary source of difference between the two analyses comes from the treatment of SDG 10 and SDG 14. These two goals often face lower data availability and higher year-to-year variability, particularly in developing regions. This robustness analysis ensures that both models are consistent, and the main analysis results are robust. Given this robustness, the next chapter focuses on the case of Türkiye and its efficiency in translating its economic development into SDG achievement.

CHAPTER 7

THE CASE OF TÜRKİYE

7.1 Türkiye's SDG Performance – an overview

Türkiye is one of the countries that has developed a specific plan to integrate the SDG Framework into its national strategies, supported by significant government backing. It has undergone two VNRs, in 2016 and 2019. Türkiye's 2019 VNR presented an optimistic outlook on the country's progress toward achieving the SDGs, emphasizing strong institutional frameworks, policy alignment, and national commitment (Presidency of the Republic of Türkiye, 2019). However, comparing Türkiye's policy commitments in VNR 2019 with the OECD (2022) Türkiye Assessment Report reveals significant discrepancies between what was planned and what has been achieved.

The VNR emphasized integrated planning, innovation, and awareness-raising as key levers for environmental sustainability and presented a comprehensive, committed environmental agenda with a main focus on the SDGs.

- SDG 2 and SDG 15: Developing sustainable agriculture policies, conserving biodiversity and genetic resources
- SDG 6: Focusing on balanced water resource development and conservation.
- SDG 7: Improving energy efficiency in buildings, transport, and industry.
- SDG 9 and SDG 12: Supporting sustainable industrial practices, promoting eco-innovation, bioplastics, eco-labeling.
- SDG 13: Adaptation to climate change and emission controls with new technologies.

- SDG 14: Prevention marine litter, aquaculture protection, and sustainable use of marine resources.
- SDG 15: Holistic terrestrial ecosystem management and high-value forest ecosystems.

Despite these policy commitments, OECD (2022) finds important gaps in actual progress on many environmentally related SDGs:

- SDG 2: Access to food is not an issue, but ensuring its sustainability means developing sustainable agriculture strategies. Türkiye lags in agricultural sustainability, particularly in pesticide use and nitrogen balance.
- SDG 6: Performance is below target in areas like water quality and efficient water use. The share of safely treated wastewater is low.
- SDG 7: Türkiye performs well in energy access, but lags in renewable energy and needs to improve in energy efficiency.
- SDG 9 and SDG 12: Innovation outputs and sustainable industrial practices are limited, and waste recycling rates remain very low.
- SDG 13: Although some progress has been made in policy planning, GHG emissions are rising, and climate adaptation efforts are not yet translating into measurable outcomes.
- SDG 14: This is one of Türkiye's worst-performing goals — with major concerns in marine biodiversity, overfishing, and marine protection areas.
- SDG 15: While forest area has increased, broader ecosystem protection and integration of biodiversity into policies remain inadequate.

While VNR 2019 (Presidency of the Republic of Türkiye, 2019) suggests a positive outlook, OECD (2022) indicates that Türkiye's performance on the SDGs is insufficient to achieve its targeted goals. A closer comparison with peer countries shows that Türkiye lags in sustainable development.

7.2 Data Envelopment Analysis for Türkiye

Analyzing the efficiency score outcomes of Türkiye in both analyses reveals that Türkiye is not performing well, with its performance declining over the years, as indicated in Table 9. In the primary Data Envelopment Analysis (DEA), Türkiye's performance shows a concerning trend with an average efficiency score of 0.369 over the 2015–2023. The country's ability to convert its economic development into SDG outcomes has demonstrated a clear downward trajectory, from 0.47 in 2015 to only 0.27 in 2023. This nearly 0.20-point drop highlights growing inefficiencies and places Türkiye among the lowest performers within its peer groups.

Table 9: Türkiye's Efficiency Performance, 2015-2023

Year	Turkey Efficiency Scores	
	Main Scenario	Robustness
2015	0.47	0.45
2016	0.41	0.40
2017	0.39	0.40
2018	0.41	0.40
2019	0.43	0.41
2020	0.37	0.39
2021	0.30	0.37
2022	0.27	0.38
2023	0.27	0.38

Source: Own calculation

Türkiye consistently underperforms among European Union Candidate Countries, depicted in Table 10³, with an average efficiency score of 0.74. The top performers in this group are Albania, Moldova, and Montenegro, which maintained efficiency scores of 1.00 in many evaluated years. Serbia also shows an upward trend, increasing from 0.82 in 2015 to full efficiency in 2018. Ukraine stands out as well with its efficient performance in 2022 and 2023. Compared to these countries, Türkiye's gap has widened since 2019.

Table 10. EU Candidate Performance, 2015-2023

	Albania	Bosnia and Herzegovina	Georgia	Moldova	Montenegro	North Macedonia	Serbia	Türkiye	Ukraine	Total
2015	1.00	0.67	0.60	1.00	1.00	0.54	0.82	0.47	0.83	0.77
2016	1.00	0.66	0.66	1.00	1.00	0.54	0.98	0.41	0.59	0.76
2017	1.00	0.65	0.60	1.00	1.00	0.51	0.78	0.39	0.55	0.72
2018	1.00	0.66	0.64	1.00	1.00	0.51	1.00	0.41	0.69	0.77
2019	1.00	0.72	0.63	1.00	0.58	0.49	1.00	0.43	0.58	0.72
2020	1.00	0.72	0.59	1.00	0.77	0.45	1.00	0.37	0.60	0.72
2021	1.00	0.72	0.63	1.00	0.77	0.48	1.00	0.30	0.73	0.74
2022	1.00	0.89	0.50	1.00	0.73	0.47	1.00	0.27	1.00	0.76
2023	1.00	0.82	0.48	1.00	0.66	0.47	1.00	0.27	1.00	0.74
Total	1.00	0.72	0.59	1.00	0.84	0.49	0.95	0.37	0.73	0.74

Source: Own calculation

Examining the performances of Balkan countries, depicted in Table 11, with an average efficiency of 0.75, Türkiye once again ranks as the lowest performer in the group. Albania and Croatia stand out as the best performers, followed by Serbia and Slovenia. Romania is the second lowest-performing country after Türkiye, while Romania and Bulgaria show relatively stable performances with minor fluctuations. In contrast, Türkiye's performance reflects structural shortcomings that hinder its progress, despite being in a similar regional and economic context.

³ Kosovo is not included in the Sachs et al. (2024), that is why Kosovo is not part of the comparison

Table 11. Balkan Countries Performance, 2015-2023

	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Montenegro	North Macedonia	Romania	Serbia	Slovenia	Türkiye	Total
2015	1.00	0.67	0.72	1.00	1.00	0.54	0.50	0.82	1.00	0.47	0.77
2016	1.00	0.66	0.67	1.00	1.00	0.54	0.49	0.98	1.00	0.41	0.77
2017	1.00	0.65	0.70	1.00	1.00	0.51	0.49	0.78	1.00	0.39	0.75
2018	1.00	0.66	1.00	1.00	1.00	0.51	0.50	1.00	1.00	0.41	0.81
2019	1.00	0.72	0.76	1.00	0.58	0.49	0.46	1.00	0.95	0.43	0.74
2020	1.00	0.72	0.70	1.00	0.77	0.45	0.43	1.00	1.00	0.37	0.74
2021	1.00	0.72	0.61	1.00	0.77	0.48	0.39	1.00	0.97	0.30	0.72
2022	1.00	0.89	0.58	1.00	0.73	0.47	0.36	1.00	0.92	0.27	0.72
2023	1.00	0.82	0.60	1.00	0.66	0.47	0.36	1.00	0.93	0.27	0.71
Total	1.00	0.72	0.70	1.00	0.84	0.49	0.44	0.95	0.97	0.37	0.75

Source: Own calculation

Even in the Black Sea Region, depicted in Table 12, where the overall average is lower at 0.533, Türkiye is among the weakest-performing countries. Within this group, Ukraine has significantly improved its efficiency, and Bulgaria is also performing well. Only Russia consistently falls below Türkiye throughout the entire period. As a future research topic, it would be interesting to check and determine whether it is due to a lack of a structural approach to the SDG framework or a lack of commitment, as indicated by the UN Multilateralism score (Sachs et al., 2024). The Russian Federation ranks among the ten countries least committed to UN-based multilateralism, with a score below 50%.

Table 12. Black Sea Countries Performance, 2015-2023

	Bulgaria	Georgia	Romania	Russian Federation	Türkiye	Ukraine	Total
2015	0.72	0.60	0.50	0.32	0.47	0.83	0.57
2016	0.67	0.66	0.49	0.34	0.41	0.59	0.53
2017	0.70	0.60	0.49	0.37	0.39	0.55	0.52
2018	1.00	0.64	0.50	0.39	0.41	0.69	0.60
2019	0.76	0.63	0.46	0.38	0.43	0.58	0.54
2020	0.70	0.59	0.43	0.39	0.37	0.60	0.51
2021	0.61	0.63	0.39	0.35	0.30	0.73	0.50
2022	0.58	0.50	0.36	0.36	0.27	1.00	0.51
2023	0.60	0.48	0.36	0.35	0.27	1.00	0.51
Total	0.70	0.59	0.44	0.36	0.37	0.73	0.53

Source: Own calculation

The consistently low performance may be explained in part by poor results in key SDGs such as SDG 5 (Gender Inequality), SDG 10 (Reduced Inequalities), and SDG 14 (Life Below Water), which are notably weak in Türkiye's SDG profile (see, Table 13). These results underline the need for targeted policy action to address specific development bottlenecks and realign efforts toward more inclusive and sustainable progress, to build a performance tracking management dashboard that sets key performance indicators specific to SDGs at sectors and even at the entity level. The management dashboard will enable the authorities to act proactively and strictly follow up on these key performance indicators.

Table 13. Türkiye SDG Performance, 2015-2023

	2015	2016	2017	2018	2019	2020	2021	2022	2023
SDG Index	69.02	68.92	69.13	69.73	69.86	70.35	70.00	70.12	70.47
SDG1	96.86	97.57	97.77	97.90	97.12	97.26	97.87	98.34	98.45
SDG2	64.52	63.13	63.94	64.82	64.91	64.12	63.27	64.14	64.14
SDG3	81.45	81.54	82.25	82.20	82.19	81.40	80.48	82.08	82.86
SDG4	87.48	85.54	88.70	90.79	91.28	92.51	85.41	85.41	85.41
SDG5	41.09	42.08	42.74	43.37	45.44	44.89	45.36	46.19	47.54
SDG6	71.83	71.26	71.10	70.76	71.62	71.67	72.13	71.97	71.60
SDG7	71.53	71.50	70.42	70.68	72.22	71.96	71.96	71.96	71.96
SDG8	64.14	63.87	63.98	64.65	63.30	64.96	65.72	65.92	66.23
SDG9	64.44	65.11	67.52	67.26	68.12	70.34	73.26	74.30	79.02
SDG10	46.75	48.16	46.99	50.34	45.03	49.09	49.09	49.09	49.09
SDG11	83.59	84.63	84.17	84.27	84.31	84.66	84.63	83.88	83.88
SDG12	76.79	75.51	74.83	75.31	75.34	75.15	74.92	74.86	74.49
SDG13	85.90	85.65	85.18	86.09	86.60	86.84	85.50	85.90	85.90
SDG14	51.88	54.59	54.13	53.22	57.19	57.63	58.21	58.17	58.05
SDG15	51.98	51.98	51.98	51.98	51.40	51.40	51.35	52.77	52.77
SDG16	65.20	60.82	61.01	62.67	62.91	63.29	62.86	61.76	61.28
SDG17	67.89	68.75	68.54	69.18	68.59	68.82	67.98	65.27	65.27

Source: SDR 2024

Investigating the trends of countries that have either a declining or increasing trend over nine years, Türkiye is one of the ten countries exhibiting a declining trend (see, Appendix C). Due to this declining trend, it is among the worst-performing countries in 2023 (see, Appendix D). All these analyses indicate that Türkiye's

efficiency in converting growth and economic development into sustainable development progress has been weakening, particularly since 2020. This decline is especially striking when compared to peers who have made significant gains. Another reason for this efficiency performance decline can be achieving economic growth over years with underlying fragilities such as, increasing external debt and deepening current account deficits. As Orhangazi and Yeldan (2021) argue in their paper, this illusion of economic growth failed to translate into sustainable development, as it was not accompanied by structural improvements in productivity, industrial capacity, or equitable income distribution.

It should be interesting to better understand why Türkiye wastes so much of its economic resources instead of channeling them into sustainable development. A deep dive analysis should be conducted to find gaps between policies and applications in the field. VNR 2019 would be a good reference point to analyze what went wrong within six years, and why all these promising plans didn't work. Extensive effort on the four least performing SDGs, SDG 5 (Gender Equality), SDG 10 (Reduced Inequality), SDG 14 (Life Below Water), and SDG 15 (Life on Land), should be strictly prioritized, while pinpointing the pitfalls for the rest of the SDG set by making a detailed self-assessment.

Without making these examinations and without having concrete plans for our least performing SDGs and a structured system to follow up on the progress for those, we can not talk about a long-term sustainable development plan. Only then can Türkiye's SDG performance improve, and we can reach our peer countries' development levels.

CHAPTER 8

CONCLUSION

The thesis investigates how efficiently countries transform their economic development into sustainable development within the global SDG Framework of the United Nations. Data Envelopment Analysis (DEA) has been applied to cross-country panel data from 2015 to 2023, using GDP per capita as input and seventeen SDGs as the output set. The thesis assessed the relative efficiency of 167 countries. To address the problem of multicollinearity and the curse of dimensionality among the seventeen SDG variables, Principal Component Analysis was employed. This ensures that the DEA remains robust and statistically valid.

According to the analysis, there are significant disparities in efficiency across countries, regions, and income groups. Countries with a similar level of economic development displayed markedly different levels of efficiency in transforming their economic strength into sustainable development. High-income countries do not always perform efficiently, whereas a low-income country with limited economic resources demonstrated strong relative efficiency by achieving balanced progress across the SDGs. It was efficient in its own context.

A particularly important finding of the thesis is the case of Türkiye, which experienced a decline in efficiency scores over the observed period despite apparent economic development. This discrepancy indicates a macroeconomic imbalance; while GDP per capita is growing, progress in core development areas such as education, health, and climate action has lagged. Türkiye is dedicated to enhancing its economic performance, but this growth does not translate into sustainable development at all. The Data Envelopment Analysis results emphasize the risks of

relying on economic indicators to assess development and imply that there is a need for structured, multidimensional policy interventions.

From a methodological standpoint, integrating PCA and DEA proved to be a valuable approach to reducing noise in the dataset while still maintaining information, especially regarding highly correlated variables, such as SDGs. The robustness checks and model variations confirmed that the preferred methodology captures both structural and temporal efficiency dynamics.

The policy implications of this thesis are as follows: Governments should not focus solely on economic expansion; they must prioritize sustainable development quality and balance. These efficiency assessments can help policymakers identify underperforming areas relative to a country's economic potential, allowing for more targeted interventions. Furthermore, this approach aligns with the SDG principle "Leaving No One Behind" by highlighting the blind spots often overlooked in traditional economic performance reporting.

In conclusion, this thesis emphasizes that economic development alone is an inadequate and often misleading indicator of true development. While GDP per capita may reflect a country's economic potential, it fails to capture the quality and sustainability of outcomes that define meaningful progress. The findings demonstrate that many countries with substantial economic power still perform inefficiently in translating that power into improvements across the SDGs. By applying DEA in combination with PCA, this research provides a more nuanced and multidimensional framework for assessing sustainable development performance. This approach highlights the critical need to move beyond traditional growth metrics toward analytical tools that evaluate how well countries convert their economic resources

into inclusive, resilient, and sustainable results. DEA–PCA should, therefore, be considered a valuable methodology in future global development diagnostics, policy monitoring, and strategic planning.



APPENDIX A

PCA VARIANCE COVERAGE AND LOADINGS

MAIN ANALYSIS							
Loadings						Cumulative Variance Coverage	
SDG	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5		
SDG1	86%	-22%	9%	10%	15%	PC1	52.46%
SDG2	67%	21%	-10%	-20%	36%	PC2	62.06%
SDG3	95%	-10%	5%	-1%	1%	PC3	69.88%
SDG4	88%	2%	18%	-7%	1%	PC4	75.11%
SDG5	72%	32%	21%	-8%	-25%	PC5	79.55%
SDG6	84%	28%	11%	4%	9%	PC6	83.66%
SDG7	85%	-2%	24%	7%	-1%	PC7	87.30%
SDG8	44%	38%	-24%	-59%	25%	PC8	90.20%
SDG9	91%	-6%	-10%	-10%	-7%	PC9	92.36%
SDG10	52%	-34%	-54%	16%	34%	PC10	94.08%
SDG11	83%	9%	16%	24%	-5%	PC11	95.47%
SDG12	-85%	20%	28%	0%	24%	PC12	96.62%
SDG13	-63%	46%	32%	6%	32%	PC13	97.48%
SDG14	-16%	55%	-49%	-16%	-40%	PC14	98.28%
SDG15	5%	62%	-40%	58%	12%	PC15	98.99%
SDG16	86%	1%	-16%	11%	-11%	PC16	99.51%
SDG17	50%	37%	41%	7%	-5%	PC17	100.00%

ROBUSTNESS ANALYSIS							
Loadings						Cumulative Variance Coverage	
SDG	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5		
SDG1	85%	-25%	-1%	-10%	24%	PC1	60.06%
SDG2	67%	17%	4%	38%	39%	PC2	67.87%
SDG3	94%	-12%	-3%	-3%	11%	PC3	74.42%
SDG4	88%	-17%	1%	8%	10%	PC4	80.49%
SDG5	76%	4%	12%	11%	-29%	PC5	84.98%
SDG6	89%	4%	12%	9%	8%	PC6	88.16%
SDG7	86%	-29%	10%	-5%	21%	PC7	91.14%
SDG8	45%	43%	-33%	62%	-15%	PC8	93.35%
SDG9	92%	7%	-15%	1%	0%	PC9	94.88%
SDG11	86%	2%	15%	-19%	-4%	PC10	96.17%
SDG12	-87%	-20%	23%	24%	12%	PC11	97.21%
SDG13	-72%	-14%	37%	33%	25%	PC12	98.11%
SDG15	10%	77%	55%	-23%	12%	PC13	98.91%
SDG16	86%	10%	2%	-14%	-11%	PC14	99.48%
SDG17	51%	-31%	54%	26%	-43%	PC15	100.00%

APPENDIX B

DEA MAIN ANALYSIS RESULTS

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
East Asia & Pacific	0.65	0.63	0.63	0.62	0.63	0.63	0.63	0.61	0.62	0.63
High income	0.72	0.72	0.71	0.71	0.71	0.70	0.70	0.70	0.70	0.71
Australia	0.84	0.86	0.87	0.84	0.85	0.79	0.81	0.82	0.80	0.83
Brunei Darussalam	0.30	0.29	0.30	0.32	0.30	0.30	0.33	0.34	0.35	0.31
Japan	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Korea, Rep.	0.86	0.84	0.81	0.82	0.81	0.77	0.77	0.76	0.78	0.80
New Zealand	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Singapore	0.33	0.32	0.31	0.31	0.30	0.32	0.28	0.28	0.29	0.30
Lower middle income	0.74	0.71	0.72	0.70	0.69	0.68	0.68	0.67	0.67	0.69
Cambodia	0.98	0.89	0.86	0.79	0.77	0.77	0.77	0.76	0.73	0.81
Lao PDR	0.78	0.69	0.72	0.72	0.65	0.63	0.63	0.58	0.58	0.66
Myanmar	0.88	0.86	0.94	1.00	1.00	1.00	1.00	1.00	1.00	0.96
Papua New Guinea	0.23	0.22	0.20	0.21	0.20	0.20	0.21	0.20	0.20	0.21
Philippines	0.59	0.58	0.59	0.50	0.50	0.48	0.46	0.47	0.48	0.52
Vietnam	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upper middle income	0.49	0.48	0.47	0.45	0.48	0.50	0.51	0.48	0.48	0.48
China	0.63	0.63	0.60	0.59	0.66	0.64	0.59	0.60	0.59	0.62
Fiji	0.59	0.58	0.60	0.53	0.69	0.77	0.80	0.63	0.64	0.65
Indonesia	0.45	0.44	0.42	0.42	0.37	0.37	0.39	0.40	0.40	0.41
Malaysia	0.29	0.27	0.28	0.25	0.29	0.30	0.29	0.26	0.25	0.28
Mongolia	0.38	0.37	0.36	0.36	0.36	0.36	0.38	0.39	0.38	0.37
Thailand	0.57	0.58	0.55	0.55	0.55	0.58	0.60	0.58	0.63	0.58
Total	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Europe & Central Asia	0.78	0.78	0.77	0.79	0.78	0.78	0.77	0.77	0.77	0.78
High income	0.82	0.82	0.83	0.85	0.83	0.84	0.82	0.82	0.82	0.83
Austria	0.84	0.87	0.88	0.91	0.92	0.97	0.98	0.94	0.94	0.92
Belgium	0.82	1.00	1.00	1.00	0.87	0.90	0.91	0.89	0.89	0.92
Bulgaria	0.72	0.67	0.70	1.00	0.76	0.70	0.61	0.58	0.60	0.70
Croatia	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cyprus	0.58	0.54	0.55	0.56	0.54	0.54	0.52	0.46	0.46	0.53
Czechia	0.90	0.89	0.86	0.89	0.86	0.90	0.92	0.96	0.93	0.90
Denmark	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Estonia	1.00	0.98	1.00	1.00	1.00	0.99	0.95	1.00	1.00	0.99
Finland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
France	1.00	0.83	0.89	1.00	1.00	1.00	1.00	1.00	1.00	0.97
Germany	0.87	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
Greece	1.00	0.85	0.92	0.92	0.90	0.97	0.91	0.83	0.86	0.91
Hungary	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Iceland	0.80	0.80	0.80	0.80	1.00	1.00	1.00	1.00	1.00	0.91
Ireland	0.53	0.56	0.54	0.50	0.50	0.46	0.39	0.39	0.42	0.48
Italy	0.62	0.63	0.65	0.67	0.66	0.70	0.63	0.64	0.64	0.65
Latvia	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lithuania	0.76	0.74	0.71	0.65	0.63	0.64	0.61	0.64	0.65	0.67
Luxembourg	0.35	0.35	0.36	0.39	0.39	0.42	0.39	0.39	0.40	0.38
Netherlands	0.88	0.88	0.87	1.00	0.86	0.91	0.92	0.91	0.91	0.90
Norway	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Poland	0.89	0.95	0.98	0.89	0.89	0.84	0.78	0.91	0.87	0.89
Portugal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Romania	0.50	0.49	0.49	0.50	0.46	0.43	0.39	0.36	0.36	0.44
Russian Federation	0.32	0.34	0.37	0.39	0.38	0.39	0.35	0.36	0.35	0.36
Slovak Republic	0.79	0.80	0.79	0.80	0.81	0.84	0.79	0.80	0.83	0.80
Slovenia	1.00	1.00	1.00	1.00	0.95	1.00	0.97	0.92	0.93	0.97
Spain	0.82	0.83	0.81	0.88	0.85	0.93	0.90	0.87	0.87	0.86
Sweden	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Switzerland	0.60	0.61	0.63	0.63	0.64	0.65	0.61	0.62	0.62	0.62
United Kingdom	0.82	0.85	0.87	1.00	1.00	1.00	0.93	0.90	0.92	0.92
Lower middle income	0.81	0.80	0.79	0.79	0.80	0.82	0.82	0.83	0.83	0.81
Kyrgyz Republic	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Tajikistan	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uzbekistan	0.43	0.39	0.36	0.38	0.40	0.45	0.47	0.49	0.50	0.43
Upper middle income	0.68	0.67	0.64	0.67	0.64	0.64	0.65	0.66	0.65	0.65
Albania	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Armenia	0.54	0.55	0.42	0.41	0.43	0.51	0.42	0.40	0.41	0.45
Azerbaijan	0.32	0.33	0.33	0.35	0.37	0.34	0.35	0.33	0.34	0.34
Belarus	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bosnia and Herzegovina	0.67	0.66	0.65	0.66	0.72	0.72	0.72	0.89	0.82	0.72
Georgia	0.60	0.66	0.60	0.64	0.63	0.59	0.63	0.50	0.48	0.59
Kazakhstan	0.35	0.36	0.37	0.35	0.37	0.32	0.32	0.30	0.31	0.34
Moldova	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Montenegro	1.00	1.00	1.00	1.00	0.58	0.77	0.77	0.73	0.66	0.84
North Macedonia	0.54	0.54	0.51	0.51	0.49	0.45	0.48	0.47	0.47	0.49
Serbia	0.82	0.98	0.78	1.00	1.00	1.00	1.00	1.00	1.00	0.95
Turkiye	0.47	0.41	0.39	0.41	0.43	0.37	0.30	0.27	0.27	0.37
Turkmenistan	0.39	0.37	0.33	0.32	0.34	0.30	0.31	0.31	0.31	0.33
Ukraine	0.83	0.59	0.55	0.69	0.58	0.60	0.73	1.00	1.00	0.73

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Latin America & Caribbean	0.73	0.73	0.73	0.73	0.71	0.76	0.72	0.73	0.72	0.73
High income	0.63	0.65	0.65	0.64	0.62	0.66	0.64	0.62	0.62	0.64
Bahamas, The	0.18	0.18	0.17	0.17	0.17	0.22	0.18	0.17	0.17	0.18
Barbados	0.84	0.82	0.79	0.72	0.62	0.69	0.75	0.62	0.63	0.72
Chile	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Guyana	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Panama	0.23	0.24	0.23	0.24	0.22	0.33	0.28	0.25	0.25	0.25
Trinidad and Tobago	0.28	0.31	0.33	0.32	0.32	0.36	0.30	0.28	0.29	0.31
Uruguay	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
Lower middle income	0.86	0.86	0.82	0.84	0.83	0.88	0.82	0.83	0.80	0.84
Bolivia	0.99	0.96	0.88	0.87	0.76	0.96	0.86	0.82	0.81	0.88
Haiti	0.63	0.58	0.51	0.49	0.56	0.55	0.48	0.49	0.48	0.53
Honduras	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.92	0.98
Nicaragua	0.80	0.90	0.90	0.99	1.00	1.00	1.00	1.00	1.00	0.96
Upper middle income	0.74	0.73	0.74	0.74	0.73	0.78	0.74	0.75	0.75	0.74
Argentina	0.56	0.61	0.63	0.61	0.63	0.63	0.65	0.62	0.61	0.62
Belize	0.48	0.60	0.64	0.74	0.68	0.72	0.54	0.43	0.45	0.59
Brazil	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Colombia	1.00	0.80	1.00	0.81	1.00	1.00	1.00	1.00	1.00	0.96
Costa Rica	0.74	0.65	0.68	0.67	0.71	1.00	1.00	1.00	1.00	0.83
Dominican Republic	1.00	1.00	1.00	1.00	0.82	0.97	0.56	0.79	0.78	0.88
Ecuador	0.92	0.90	0.86	0.91	0.84	0.92	0.86	0.84	0.85	0.88
El Salvador	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Guatemala	0.64	0.57	0.56	0.58	0.54	0.53	0.53	0.58	0.58	0.57
Jamaica	1.00	1.00	1.00	0.90	0.87	0.89	1.00	0.99	0.98	0.96
Mexico	0.43	0.45	0.42	0.40	0.42	0.45	0.41	0.43	0.42	0.43
Paraguay	0.59	0.58	0.57	0.61	0.64	0.61	0.59	0.69	0.70	0.62
Peru	0.61	0.59	0.57	0.61	0.58	0.65	0.60	0.63	0.63	0.61
Suriname	0.34	0.41	0.43	0.49	0.47	0.53	0.56	0.53	0.55	0.48
	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Middle East & North Africa	0.40	0.39	0.38	0.39	0.39	0.41	0.38	0.39	0.38	0.39
High income	0.35	0.35	0.35	0.35	0.32	0.37	0.30	0.34	0.31	0.34
Bahrain	0.24	0.24	0.22	0.21	0.22	0.22	0.20	0.19	0.20	0.22
Israel	1.00	1.00	1.00	1.00	0.65	1.00	0.59	1.00	0.58	0.87
Kuwait	0.29	0.26	0.31	0.33	0.33	0.31	0.25	0.23	0.28	0.29
Malta	0.52	0.53	0.48	0.48	0.50	0.47	0.44	0.41	0.44	0.47
Oman	0.23	0.24	0.25	0.22	0.26	0.27	0.24	0.20	0.23	0.24
Qatar	0.16	0.17	0.18	0.20	0.20	0.21	0.18	0.18	0.19	0.19
Saudi Arabia	0.15	0.14	0.12	0.11	0.15	0.16	0.20	0.19	0.22	0.16
United Arab Emirates	0.20	0.21	0.21	0.23	0.28	0.33	0.32	0.29	0.31	0.26
Lower middle income	0.53	0.49	0.48	0.52	0.54	0.54	0.54	0.51	0.52	0.52
Djibouti	0.49	0.47	0.38	0.39	0.41	0.42	0.41	0.39	0.38	0.41
Egypt, Arab Rep.	0.63	0.52	0.51	0.47	0.49	0.48	0.45	0.39	0.39	0.48
Jordan	0.36	0.36	0.44	0.43	0.43	0.43	0.43	0.45	0.46	0.42
Morocco	0.59	0.56	0.52	0.73	0.72	0.78	0.80	0.68	0.71	0.68
Tunisia	0.57	0.57	0.54	0.58	0.63	0.60	0.61	0.63	0.67	0.60
Upper middle income	0.33	0.29	0.28	0.31	0.31	0.31	0.33	0.34	0.35	0.32
Algeria	0.43	0.41	0.36	0.37	0.37	0.35	0.36	0.38	0.38	0.38
Iran, Islamic Rep.	0.32	0.30	0.28	0.31	0.34	0.33	0.33	0.34	0.34	0.32
Iraq	0.24	0.18	0.20	0.24	0.21	0.25	0.29	0.29	0.32	0.25
North America	0.65	0.68	0.67	0.67	0.66	0.66	0.63	0.65	0.64	0.66
High income	0.65	0.68	0.67	0.67	0.66	0.66	0.63	0.65	0.64	0.66
Canada	0.84	0.88	0.87	0.87	0.86	0.88	0.83	0.87	0.89	0.87
United States	0.46	0.48	0.47	0.47	0.45	0.45	0.43	0.42	0.40	0.45
	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
South Asia	0.58	0.57	0.56	0.56	0.54	0.59	0.57	0.60	0.59	0.57
Low income	0.49	0.53	0.62	0.56	0.56	0.70	0.89	1.00	1.00	0.71
Afghanistan	0.49	0.53	0.62	0.56	0.56	0.70	0.89	1.00	1.00	0.71
Lower middle income	0.63	0.61	0.58	0.60	0.57	0.55	0.53	0.55	0.55	0.58
Bangladesh	0.63	0.58	0.56	0.60	0.59	0.58	0.53	0.52	0.51	0.57
India	0.70	0.68	0.67	0.63	0.51	0.51	0.50	0.50	0.48	0.58
Nepal	1.00	1.00	0.97	1.00	0.93	0.91	0.89	1.00	1.00	0.97
Pakistan	0.51	0.48	0.48	0.51	0.51	0.44	0.42	0.40	0.39	0.46
Sri Lanka	0.31	0.33	0.25	0.28	0.29	0.31	0.31	0.35	0.36	0.31
Upper middle income	0.45	0.42	0.38	0.34	0.40	0.67	0.48	0.41	0.38	0.44
Maldives	0.45	0.42	0.38	0.34	0.40	0.67	0.48	0.41	0.38	0.44

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Sub-Saharan Africa	0.71	0.69	0.70	0.70	0.69	0.69	0.71	0.70	0.71	0.70
Low income	0.77	0.75	0.75	0.72	0.72	0.71	0.74	0.72	0.73	0.73
Burkina Faso	1.00	0.96	0.78	0.37	0.43	0.35	0.63	0.55	0.53	0.62
Burundi	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Central African Republic	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00
Chad	0.41	0.45	0.47	0.46	0.46	0.47	0.49	0.49	0.49	0.47
Congo, Dem. Rep.	0.72	0.72	0.70	0.68	0.66	0.65	0.64	0.60	0.57	0.66
Ethiopia	0.93	0.77	0.80	0.62	0.63	0.59	0.70	0.74	0.82	0.73
Gambia, The	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	1.00	0.99
Guinea-Bissau	0.42	0.40	0.39	0.38	0.36	0.35	0.34	0.33	0.32	0.37
Liberia	0.54	0.54	0.53	0.53	0.54	0.56	0.54	0.53	0.51	0.54
Madagascar	0.82	0.95	1.00	1.00	1.00	1.00	0.99	0.86	0.88	0.94
Malawi	0.92	0.92	0.86	0.82	0.77	0.75	0.76	0.80	0.82	0.82
Mali	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mozambique	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Niger	0.62	0.60	0.60	0.55	0.53	0.52	0.53	0.48	0.49	0.55
Rwanda	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sierra Leone	0.35	0.33	0.32	0.31	0.32	0.35	0.45	0.28	0.29	0.34
Somalia	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sudan	0.52	0.49	0.55	0.58	0.60	0.57	0.59	0.58	0.79	0.59
Togo	0.60	0.39	0.68	0.57	0.62	0.57	0.64	0.61	0.60	0.59
Uganda	0.48	0.48	0.41	0.48	0.48	0.47	0.54	0.49	0.49	0.48
Lower middle income	0.69	0.68	0.67	0.69	0.68	0.68	0.69	0.69	0.69	0.69
Angola	0.13	0.14	0.14	0.21	0.19	0.22	0.20	0.19	0.20	0.18
Benin	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cabo Verde	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cameroon	0.36	0.36	0.32	0.33	0.37	0.33	0.34	0.33	0.33	0.34
Comoros	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Congo, Rep.	0.22	0.24	0.29	0.32	0.32	0.31	0.29	0.24	0.24	0.27
Cote d'Ivoire	0.19	0.26	0.23	0.36	0.37	0.38	0.38	0.37	0.38	0.32
Eswatini	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ghana	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Guinea	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Kenya	0.49	0.46	0.46	0.46	0.45	0.45	0.46	0.48	0.48	0.47
Lesotho	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mauritania	0.39	0.42	0.41	0.43	0.41	0.41	0.45	0.48	0.48	0.43
Nigeria	1.00	0.62	0.60	0.61	0.56	0.58	0.57	0.56	0.56	0.63
Sao Tome and Principe	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Senegal	0.77	0.75	0.60	0.69	0.73	0.77	1.00	1.00	1.00	0.81
Tanzania	0.39	0.39	0.39	0.42	0.43	0.43	0.45	0.48	0.50	0.43
Zambia	0.44	0.47	0.47	0.75	0.51	0.47	0.42	0.41	0.39	0.48
Zimbabwe	0.77	0.75	0.75	0.60	0.60	0.65	0.64	0.63	0.63	0.67
Upper middle income	0.52	0.53	0.65	0.64	0.63	0.66	0.66	0.67	0.67	0.63
Botswana	0.40	0.40	0.43	0.36	0.35	0.36	0.38	0.37	0.38	0.38
Gabon	0.21	0.20	0.24	0.25	0.25	0.23	0.23	0.27	0.28	0.24
Mauritius	0.41	0.42	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87
Namibia	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
South Africa	0.58	0.61	0.60	0.60	0.55	0.72	0.67	0.69	0.71	0.64
Total	0.69	0.68	0.68	0.69	0.68	0.69	0.68	0.68	0.68	0.68

APPENDIX C

MAIN ANALYSIS vs. ROBUSTNESS ANALYSIS

Year	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis
2015	Afghanistan	0.49	0.50	Gambia, The	1.00	0.61	Netherlands	0.88	0.90
2016	Afghanistan	0.53	0.50	Gambia, The	1.00	0.48	Netherlands	0.88	0.91
2017	Afghanistan	0.62	0.48	Gambia, The	1.00	0.42	Netherlands	0.87	0.90
2018	Afghanistan	0.56	0.59	Gambia, The	1.00	0.57	Netherlands	1.00	1.00
2019	Afghanistan	0.56	0.58	Gambia, The	1.00	0.39	Netherlands	0.86	1.00
2020	Afghanistan	0.70	0.72	Gambia, The	0.93	0.63	Netherlands	0.91	0.95
2021	Afghanistan	0.89	1.00	Gambia, The	1.00	1.00	Netherlands	0.92	1.00
2022	Afghanistan	1.00	1.00	Gambia, The	1.00	0.95	Netherlands	0.91	0.90
2023	Afghanistan	1.00	1.00	Gambia, The	1.00	0.88	Netherlands	0.91	0.91
2015	Albania	1.00	1.00	Georgia	0.60	0.65	Nicaragua	0.80	0.59
2016	Albania	1.00	0.71	Georgia	0.66	0.71	Nicaragua	0.90	0.60
2017	Albania	1.00	1.00	Georgia	0.60	0.65	Nicaragua	0.90	0.60
2018	Albania	1.00	1.00	Georgia	0.64	0.69	Nicaragua	0.99	0.61
2019	Albania	1.00	1.00	Georgia	0.63	0.67	Nicaragua	1.00	0.64
2020	Albania	1.00	1.00	Georgia	0.59	0.66	Nicaragua	1.00	0.61
2021	Albania	1.00	1.00	Georgia	0.63	0.64	Nicaragua	1.00	0.58
2022	Albania	1.00	1.00	Georgia	0.50	0.54	Nicaragua	1.00	0.60
2023	Albania	1.00	1.00	Georgia	0.48	0.52	Nicaragua	1.00	0.60
2015	Algeria	0.43	0.57	Germany	0.87	1.00	Niger	0.62	0.62
2016	Algeria	0.41	0.58	Germany	1.00	1.00	Niger	0.60	0.60
2017	Algeria	0.36	0.47	Germany	1.00	1.00	Niger	0.60	0.58
2018	Algeria	0.37	0.44	Germany	1.00	1.00	Niger	0.55	0.55
2019	Algeria	0.37	0.35	Germany	1.00	1.00	Niger	0.53	0.53
2020	Algeria	0.35	0.35	Germany	1.00	1.00	Niger	0.52	0.52
2021	Algeria	0.36	0.36	Germany	1.00	1.00	Niger	0.53	0.53
2022	Algeria	0.38	0.36	Germany	1.00	1.00	Niger	0.48	0.48
2023	Algeria	0.38	0.36	Germany	1.00	1.00	Niger	0.49	0.49
2015	Angola	0.13	0.16	Ghana	1.00	1.00	Nigeria	1.00	1.00
2016	Angola	0.14	0.17	Ghana	1.00	1.00	Nigeria	0.62	0.50
2017	Angola	0.14	0.17	Ghana	1.00	1.00	Nigeria	0.60	0.33
2018	Angola	0.21	0.18	Ghana	1.00	1.00	Nigeria	0.61	0.80
2019	Angola	0.19	0.20	Ghana	1.00	1.00	Nigeria	0.56	0.67
2020	Angola	0.22	0.20	Ghana	1.00	1.00	Nigeria	0.58	1.00
2021	Angola	0.20	0.24	Ghana	1.00	1.00	Nigeria	0.57	1.00
2022	Angola	0.19	0.25	Ghana	1.00	1.00	Nigeria	0.56	1.00
2023	Angola	0.20	0.25	Ghana	1.00	1.00	Nigeria	0.56	1.00
2015	Argentina	0.56	0.58	Greece	1.00	1.00	North Macedonia	0.54	0.86
2016	Argentina	0.61	0.59	Greece	0.85	0.89	North Macedonia	0.54	0.62
2017	Argentina	0.63	0.63	Greece	0.92	0.89	North Macedonia	0.51	0.48
2018	Argentina	0.61	0.65	Greece	0.92	0.91	North Macedonia	0.51	0.50
2019	Argentina	0.63	0.67	Greece	0.90	0.91	North Macedonia	0.49	0.51
2020	Argentina	0.63	0.68	Greece	0.97	0.96	North Macedonia	0.45	0.51
2021	Argentina	0.65	0.74	Greece	0.91	0.97	North Macedonia	0.48	0.51
2022	Argentina	0.62	0.75	Greece	0.83	0.98	North Macedonia	0.47	0.51
2023	Argentina	0.61	0.75	Greece	0.86	0.99	North Macedonia	0.47	0.55
2015	Armenia	0.54	0.64	Guatemala	0.64	0.21	Norway	1.00	1.00
2016	Armenia	0.55	0.61	Guatemala	0.57	0.21	Norway	1.00	1.00
2017	Armenia	0.42	0.47	Guatemala	0.56	0.20	Norway	1.00	1.00
2018	Armenia	0.41	0.43	Guatemala	0.58	0.22	Norway	1.00	1.00
2019	Armenia	0.43	0.42	Guatemala	0.54	0.23	Norway	1.00	1.00
2020	Armenia	0.51	0.47	Guatemala	0.53	0.23	Norway	1.00	1.00
2021	Armenia	0.42	0.44	Guatemala	0.53	0.23	Norway	1.00	1.00
2022	Armenia	0.40	0.44	Guatemala	0.58	0.23	Norway	1.00	1.00
2023	Armenia	0.41	0.45	Guatemala	0.58	0.23	Norway	1.00	1.00
2015	Australia	0.84	0.91	Guinea	1.00	0.64	Pakistan	0.51	0.63
2016	Australia	0.86	0.91	Guinea	1.00	0.57	Pakistan	0.48	0.47
2017	Australia	0.87	0.96	Guinea	1.00	0.54	Pakistan	0.48	0.47
2018	Australia	0.84	0.93	Guinea	1.00	0.59	Pakistan	0.51	0.54
2019	Australia	0.85	0.90	Guinea	1.00	0.54	Pakistan	0.51	0.48
2020	Australia	0.79	0.87	Guinea	1.00	0.54	Pakistan	0.44	0.54
2021	Australia	0.81	0.91	Guinea	1.00	0.62	Pakistan	0.42	0.53
2022	Australia	0.82	0.88	Guinea	1.00	0.67	Pakistan	0.40	0.48
2023	Australia	0.80	0.84	Guinea	1.00	0.61	Pakistan	0.39	0.52
2015	Austria	0.84	0.87	Guinea-Bissau	0.42	0.43	Panama	0.23	0.27
2016	Austria	0.87	1.00	Guinea-Bissau	0.40	0.40	Panama	0.24	0.27
2017	Austria	0.88	0.89	Guinea-Bissau	0.39	0.39	Panama	0.23	0.25
2018	Austria	0.91	1.00	Guinea-Bissau	0.38	0.38	Panama	0.24	0.22
2019	Austria	0.92	1.00	Guinea-Bissau	0.36	0.36	Panama	0.22	0.21
2020	Austria	0.97	1.00	Guinea-Bissau	0.35	0.36	Panama	0.33	0.21
2021	Austria	0.98	1.00	Guinea-Bissau	0.34	0.34	Panama	0.28	0.27
2022	Austria	0.94	0.97	Guinea-Bissau	0.33	0.33	Panama	0.25	0.25
2023	Austria	0.94	0.98	Guinea-Bissau	0.32	0.32	Panama	0.25	0.26
2015	Azerbaijan	0.32	0.37	Guyana	1.00	1.00	Papua New Guinea	0.23	0.24
2016	Azerbaijan	0.33	0.39	Guyana	1.00	1.00	Papua New Guinea	0.22	0.21
2017	Azerbaijan	0.33	0.37	Guyana	1.00	1.00	Papua New Guinea	0.20	0.21
2018	Azerbaijan	0.35	0.34	Guyana	1.00	1.00	Papua New Guinea	0.21	0.21
2019	Azerbaijan	0.37	0.35	Guyana	1.00	1.00	Papua New Guinea	0.20	0.20
2020	Azerbaijan	0.34	0.33	Guyana	1.00	0.70	Papua New Guinea	0.20	0.20
2021	Azerbaijan	0.35	0.35	Guyana	1.00	0.61	Papua New Guinea	0.21	0.21
2022	Azerbaijan	0.33	0.34	Guyana	1.00	0.42	Papua New Guinea	0.20	0.20
2023	Azerbaijan	0.34	0.35	Guyana	1.00	0.35	Papua New Guinea	0.20	0.20

Year	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis
2015	Bangladesh	0.63	1.00	Haiti	0.63	0.50	Paraguay	0.59	0.77
2016	Bangladesh	0.58	1.00	Haiti	0.58	0.47	Paraguay	0.58	0.84
2017	Bangladesh	0.56	0.99	Haiti	0.51	0.47	Paraguay	0.57	0.93
2018	Bangladesh	0.60	1.00	Haiti	0.49	0.47	Paraguay	0.61	0.80
2019	Bangladesh	0.59	1.00	Haiti	0.56	0.54	Paraguay	0.64	0.84
2020	Bangladesh	0.58	1.00	Haiti	0.55	0.63	Paraguay	0.61	0.92
2021	Bangladesh	0.53	1.00	Haiti	0.48	0.84	Paraguay	0.59	0.72
2022	Bangladesh	0.52	1.00	Haiti	0.49	0.94	Paraguay	0.69	0.75
2023	Bangladesh	0.51	1.00	Haiti	0.48	1.00	Paraguay	0.70	0.72
2015	Belarus	1.00	1.00	Honduras	1.00	0.61	Peru	0.61	0.87
2016	Belarus	1.00	1.00	Honduras	1.00	0.61	Peru	0.59	0.83
2017	Belarus	1.00	1.00	Honduras	1.00	0.58	Peru	0.57	0.75
2018	Belarus	1.00	1.00	Honduras	1.00	0.58	Peru	0.61	0.98
2019	Belarus	1.00	1.00	Honduras	1.00	0.59	Peru	0.58	0.90
2020	Belarus	1.00	1.00	Honduras	1.00	0.61	Peru	0.65	0.98
2021	Belarus	1.00	1.00	Honduras	0.95	0.56	Peru	0.60	1.00
2022	Belarus	1.00	1.00	Honduras	1.00	0.54	Peru	0.63	1.00
2023	Belarus	1.00	1.00	Honduras	0.92	0.56	Peru	0.63	1.00
2015	Belgium	0.82	0.74	Hungary	1.00	0.84	Philippines	0.59	0.75
2016	Belgium	1.00	0.77	Hungary	1.00	0.94	Philippines	0.58	0.67
2017	Belgium	1.00	0.76	Hungary	1.00	1.00	Philippines	0.59	0.55
2018	Belgium	1.00	0.81	Hungary	1.00	0.89	Philippines	0.50	0.51
2019	Belgium	0.87	0.81	Hungary	1.00	0.82	Philippines	0.50	0.58
2020	Belgium	0.90	0.85	Hungary	1.00	0.82	Philippines	0.48	0.59
2021	Belgium	0.91	0.85	Hungary	1.00	0.87	Philippines	0.46	0.73
2022	Belgium	0.89	0.83	Hungary	1.00	0.82	Philippines	0.47	0.68
2023	Belgium	0.89	0.81	Hungary	1.00	1.00	Philippines	0.48	0.67
2015	Belize	0.48	0.51	Iceland	0.80	0.74	Poland	0.89	0.95
2016	Belize	0.60	0.60	Iceland	0.80	0.74	Poland	0.95	1.00
2017	Belize	0.64	0.67	Iceland	0.80	0.76	Poland	0.98	1.00
2018	Belize	0.74	0.51	Iceland	0.80	0.71	Poland	0.89	0.97
2019	Belize	0.68	0.46	Iceland	1.00	0.68	Poland	0.89	0.93
2020	Belize	0.72	0.48	Iceland	1.00	0.72	Poland	0.84	1.00
2021	Belize	0.54	0.42	Iceland	1.00	0.70	Poland	0.78	0.94
2022	Belize	0.43	0.41	Iceland	1.00	0.69	Poland	0.91	1.00
2023	Belize	0.45	0.43	Iceland	1.00	0.66	Poland	0.87	1.00
2015	Benin	1.00	1.00	India	0.70	0.37	Portugal	1.00	0.83
2016	Benin	1.00	1.00	India	0.68	0.35	Portugal	1.00	0.84
2017	Benin	1.00	1.00	India	0.67	0.36	Portugal	1.00	0.85
2018	Benin	1.00	1.00	India	0.63	0.38	Portugal	1.00	0.87
2019	Benin	1.00	1.00	India	0.51	0.40	Portugal	1.00	0.80
2020	Benin	1.00	1.00	India	0.51	0.44	Portugal	1.00	0.88
2021	Benin	1.00	1.00	India	0.50	0.44	Portugal	1.00	0.89
2022	Benin	1.00	1.00	India	0.50	0.46	Portugal	1.00	0.85
2023	Benin	1.00	1.00	India	0.48	0.47	Portugal	1.00	0.83
2015	Bolivia	0.99	0.75	Indonesia	0.45	0.58	Romania	0.50	0.79
2016	Bolivia	0.96	0.76	Indonesia	0.44	0.56	Romania	0.49	0.72
2017	Bolivia	0.88	0.78	Indonesia	0.42	0.54	Romania	0.49	1.00
2018	Bolivia	0.87	1.00	Indonesia	0.42	0.62	Romania	0.50	0.80
2019	Bolivia	0.76	0.88	Indonesia	0.37	0.58	Romania	0.46	0.72
2020	Bolivia	0.96	0.87	Indonesia	0.37	0.61	Romania	0.43	0.63
2021	Bolivia	0.86	1.00	Indonesia	0.39	0.65	Romania	0.39	1.00
2022	Bolivia	0.82	0.92	Indonesia	0.40	0.60	Romania	0.36	1.00
2023	Bolivia	0.81	0.86	Indonesia	0.40	0.60	Romania	0.36	1.00
2015	Bosnia and Herzegovina	0.67	0.83	Iran, Islamic Rep.	0.32	0.95	Russian Federation	0.32	0.38
2016	Bosnia and Herzegovina	0.66	0.69	Iran, Islamic Rep.	0.30	0.62	Russian Federation	0.34	0.39
2017	Bosnia and Herzegovina	0.65	0.66	Iran, Islamic Rep.	0.28	0.54	Russian Federation	0.37	0.42
2018	Bosnia and Herzegovina	0.66	0.71	Iran, Islamic Rep.	0.31	0.58	Russian Federation	0.39	0.42
2019	Bosnia and Herzegovina	0.72	0.72	Iran, Islamic Rep.	0.34	0.66	Russian Federation	0.38	0.42
2020	Bosnia and Herzegovina	0.72	0.84	Iran, Islamic Rep.	0.33	0.70	Russian Federation	0.39	0.43
2021	Bosnia and Herzegovina	0.72	0.70	Iran, Islamic Rep.	0.33	0.67	Russian Federation	0.35	0.39
2022	Bosnia and Herzegovina	0.89	1.00	Iran, Islamic Rep.	0.34	0.66	Russian Federation	0.36	0.39
2023	Bosnia and Herzegovina	0.82	1.00	Iran, Islamic Rep.	0.34	0.65	Russian Federation	0.35	0.39
2015	Botswana	0.40	0.28	Iraq	0.24	0.19	Rwanda	1.00	1.00
2016	Botswana	0.40	0.28	Iraq	0.18	0.16	Rwanda	1.00	1.00
2017	Botswana	0.43	0.29	Iraq	0.20	0.17	Rwanda	1.00	1.00
2018	Botswana	0.36	0.26	Iraq	0.24	0.19	Rwanda	1.00	1.00
2019	Botswana	0.35	0.28	Iraq	0.21	0.19	Rwanda	1.00	1.00
2020	Botswana	0.36	0.29	Iraq	0.25	0.22	Rwanda	1.00	1.00
2021	Botswana	0.38	0.29	Iraq	0.29	0.25	Rwanda	1.00	1.00
2022	Botswana	0.37	0.27	Iraq	0.29	0.27	Rwanda	1.00	1.00
2023	Botswana	0.38	0.29	Iraq	0.32	0.30	Rwanda	1.00	1.00
2015	Brazil	1.00	1.00	Ireland	0.53	0.52	Sao Tome and Principe	0.97	1.00
2016	Brazil	1.00	1.00	Ireland	0.56	0.58	Sao Tome and Principe	1.00	1.00
2017	Brazil	1.00	1.00	Ireland	0.54	0.54	Sao Tome and Principe	1.00	1.00
2018	Brazil	1.00	1.00	Ireland	0.50	0.51	Sao Tome and Principe	1.00	1.00
2019	Brazil	1.00	1.00	Ireland	0.50	0.50	Sao Tome and Principe	1.00	1.00
2020	Brazil	1.00	1.00	Ireland	0.46	0.47	Sao Tome and Principe	1.00	1.00
2021	Brazil	1.00	1.00	Ireland	0.39	0.40	Sao Tome and Principe	1.00	1.00
2022	Brazil	1.00	1.00	Ireland	0.39	0.39	Sao Tome and Principe	1.00	1.00
2023	Brazil	1.00	1.00	Ireland	0.42	0.41	Sao Tome and Principe	1.00	1.00

Year	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis
2015	Bulgaria	0.72	1.00	Israel	1.00	0.59	Senegal	0.77	0.58
2016	Bulgaria	0.67	1.00	Israel	1.00	0.61	Senegal	0.75	0.70
2017	Bulgaria	0.70	1.00	Israel	1.00	0.57	Senegal	0.60	1.00
2018	Bulgaria	1.00	1.00	Israel	1.00	0.55	Senegal	0.69	1.00
2019	Bulgaria	0.76	1.00	Israel	0.65	0.54	Senegal	0.73	1.00
2020	Bulgaria	0.70	1.00	Israel	1.00	0.54	Senegal	0.77	1.00
2021	Bulgaria	0.61	1.00	Israel	0.59	0.53	Senegal	1.00	1.00
2022	Bulgaria	0.58	1.00	Israel	1.00	0.51	Senegal	1.00	1.00
2023	Bulgaria	0.60	1.00	Israel	0.58	0.50	Senegal	1.00	1.00
2015	Burkina Faso	1.00	1.00	Italy	0.62	0.60	Serbia	0.82	0.87
2016	Burkina Faso	0.96	0.97	Italy	0.63	0.61	Serbia	0.98	0.91
2017	Burkina Faso	0.78	1.00	Italy	0.65	0.61	Serbia	0.78	0.82
2018	Burkina Faso	0.37	1.00	Italy	0.67	0.65	Serbia	1.00	0.97
2019	Burkina Faso	0.43	1.00	Italy	0.66	0.62	Serbia	1.00	1.00
2020	Burkina Faso	0.35	1.00	Italy	0.70	0.66	Serbia	1.00	1.00
2021	Burkina Faso	0.63	1.00	Italy	0.63	0.67	Serbia	1.00	1.00
2022	Burkina Faso	0.55	1.00	Italy	0.64	0.64	Serbia	1.00	1.00
2023	Burkina Faso	0.53	1.00	Italy	0.64	0.64	Serbia	1.00	1.00
2015	Burundi	1.00	1.00	Jamaica	1.00	0.87	Sierra Leone	0.35	0.38
2016	Burundi	1.00	1.00	Jamaica	1.00	0.80	Sierra Leone	0.33	0.34
2017	Burundi	1.00	1.00	Jamaica	1.00	0.77	Sierra Leone	0.32	0.32
2018	Burundi	1.00	1.00	Jamaica	0.90	0.81	Sierra Leone	0.31	0.31
2019	Burundi	1.00	1.00	Jamaica	0.87	0.89	Sierra Leone	0.32	0.43
2020	Burundi	1.00	1.00	Jamaica	0.89	0.90	Sierra Leone	0.35	1.00
2021	Burundi	1.00	1.00	Jamaica	1.00	0.88	Sierra Leone	0.45	1.00
2022	Burundi	1.00	1.00	Jamaica	0.99	0.88	Sierra Leone	0.28	0.38
2023	Burundi	1.00	1.00	Jamaica	0.98	0.88	Sierra Leone	0.29	0.36
2015	Cabo Verde	1.00	0.63	Japan	1.00	1.00	Slovak Republic	0.79	0.77
2016	Cabo Verde	1.00	0.63	Japan	1.00	1.00	Slovak Republic	0.80	0.80
2017	Cabo Verde	1.00	0.62	Japan	1.00	1.00	Slovak Republic	0.79	0.78
2018	Cabo Verde	1.00	0.61	Japan	1.00	1.00	Slovak Republic	0.80	0.81
2019	Cabo Verde	1.00	0.58	Japan	1.00	1.00	Slovak Republic	0.81	0.77
2020	Cabo Verde	1.00	0.69	Japan	1.00	1.00	Slovak Republic	0.84	0.79
2021	Cabo Verde	1.00	0.93	Japan	1.00	1.00	Slovak Republic	0.79	0.83
2022	Cabo Verde	1.00	0.76	Japan	1.00	1.00	Slovak Republic	0.80	0.84
2023	Cabo Verde	1.00	0.72	Japan	1.00	1.00	Slovak Republic	0.83	0.89
2015	Cameroon	0.36	0.67	Jordan	0.36	0.38	Slovenia	1.00	0.98
2016	Cameroon	0.36	0.56	Jordan	0.36	0.37	Slovenia	1.00	0.99
2017	Cameroon	0.32	0.53	Jordan	0.44	0.34	Slovenia	1.00	0.95
2018	Cameroon	0.33	0.56	Jordan	0.43	0.37	Slovenia	1.00	0.97
2019	Cameroon	0.37	0.86	Jordan	0.43	0.40	Slovenia	0.95	0.89
2020	Cameroon	0.33	0.67	Jordan	0.43	0.42	Slovenia	1.00	0.93
2021	Cameroon	0.34	0.88	Jordan	0.43	0.43	Slovenia	0.97	0.89
2022	Cameroon	0.33	0.77	Jordan	0.45	0.46	Slovenia	0.92	0.85
2023	Cameroon	0.33	0.79	Jordan	0.46	0.47	Slovenia	0.93	0.84
2015	Canada	0.84	0.86	Kazakhstan	0.35	0.36	Somalia	1.00	0.90
2016	Canada	0.88	0.89	Kazakhstan	0.36	0.38	Somalia	1.00	0.85
2017	Canada	0.87	0.90	Kazakhstan	0.37	0.41	Somalia	1.00	0.75
2018	Canada	0.87	0.89	Kazakhstan	0.35	0.39	Somalia	1.00	0.81
2019	Canada	0.86	0.87	Kazakhstan	0.37	0.39	Somalia	1.00	0.79
2020	Canada	0.88	0.89	Kazakhstan	0.32	0.34	Somalia	1.00	0.90
2021	Canada	0.83	0.86	Kazakhstan	0.32	0.35	Somalia	1.00	0.85
2022	Canada	0.87	0.86	Kazakhstan	0.30	0.35	Somalia	1.00	0.86
2023	Canada	0.89	0.86	Kazakhstan	0.31	0.36	Somalia	1.00	0.92
2015	Central African Republic	1.00	1.00	Kenya	0.49	1.00	South Africa	0.58	0.36
2016	Central African Republic	1.00	1.00	Kenya	0.46	1.00	South Africa	0.61	0.36
2017	Central African Republic	0.98	1.00	Kenya	0.46	0.81	South Africa	0.60	0.34
2018	Central African Republic	1.00	1.00	Kenya	0.46	0.84	South Africa	0.60	0.31
2019	Central African Republic	1.00	1.00	Kenya	0.45	0.50	South Africa	0.55	0.33
2020	Central African Republic	0.99	1.00	Kenya	0.45	0.50	South Africa	0.72	0.36
2021	Central African Republic	1.00	1.00	Kenya	0.46	0.44	South Africa	0.67	0.38
2022	Central African Republic	1.00	1.00	Kenya	0.48	0.60	South Africa	0.69	0.39
2023	Central African Republic	1.00	1.00	Kenya	0.48	0.58	South Africa	0.71	0.41
2015	Chad	0.41	0.44	Korea, Rep.	0.86	1.00	Spain	0.82	0.73
2016	Chad	0.45	0.46	Korea, Rep.	0.84	1.00	Spain	0.83	0.78
2017	Chad	0.47	0.50	Korea, Rep.	0.81	0.90	Spain	0.81	0.72
2018	Chad	0.46	0.52	Korea, Rep.	0.82	0.84	Spain	0.88	0.85
2019	Chad	0.46	0.46	Korea, Rep.	0.81	0.80	Spain	0.85	0.77
2020	Chad	0.47	0.47	Korea, Rep.	0.77	0.79	Spain	0.93	0.90
2021	Chad	0.49	0.49	Korea, Rep.	0.77	1.00	Spain	0.90	0.91
2022	Chad	0.49	0.49	Korea, Rep.	0.76	1.00	Spain	0.87	0.82
2023	Chad	0.49	0.49	Korea, Rep.	0.78	1.00	Spain	0.87	0.82
2015	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.31	0.58
2016	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.33	0.70
2017	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.25	0.37
2018	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.28	0.53
2019	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.29	0.52
2020	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.31	0.58
2021	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.31	0.65
2022	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.35	0.52
2023	Chile	1.00	1.00	Kyrgyz Republic	1.00	1.00	Sri Lanka	0.36	0.49

Year	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis
2015	China	0.63	1.00	Lao PDR	0.78	1.00	Sudan	0.52	0.29
2016	China	0.63	1.00	Lao PDR	0.69	1.00	Sudan	0.49	0.28
2017	China	0.60	1.00	Lao PDR	0.72	1.00	Sudan	0.55	0.29
2018	China	0.59	1.00	Lao PDR	0.72	0.86	Sudan	0.58	0.31
2019	China	0.66	1.00	Lao PDR	0.65	0.71	Sudan	0.60	0.34
2020	China	0.64	1.00	Lao PDR	0.63	0.73	Sudan	0.57	0.43
2021	China	0.59	1.00	Lao PDR	0.63	0.70	Sudan	0.59	0.52
2022	China	0.60	1.00	Lao PDR	0.58	0.63	Sudan	0.58	0.51
2023	China	0.59	1.00	Lao PDR	0.58	0.62	Sudan	0.79	0.62
2015	Colombia	1.00	0.61	Latvia	1.00	1.00	Suriname	0.34	0.54
2016	Colombia	0.80	0.56	Latvia	1.00	1.00	Suriname	0.41	0.37
2017	Colombia	1.00	0.55	Latvia	1.00	1.00	Suriname	0.43	0.49
2018	Colombia	0.81	0.54	Latvia	1.00	1.00	Suriname	0.49	0.60
2019	Colombia	1.00	0.56	Latvia	1.00	1.00	Suriname	0.47	0.50
2020	Colombia	1.00	0.48	Latvia	1.00	1.00	Suriname	0.53	0.64
2021	Colombia	1.00	0.56	Latvia	1.00	1.00	Suriname	0.56	0.60
2022	Colombia	1.00	0.57	Latvia	1.00	1.00	Suriname	0.53	0.62
2023	Colombia	1.00	0.65	Latvia	1.00	1.00	Suriname	0.55	0.62
2015	Comoros	1.00	0.79	Lesotho	1.00	1.00	Sweden	1.00	1.00
2016	Comoros	1.00	0.63	Lesotho	1.00	1.00	Sweden	1.00	1.00
2017	Comoros	1.00	0.70	Lesotho	1.00	1.00	Sweden	1.00	1.00
2018	Comoros	1.00	0.71	Lesotho	1.00	1.00	Sweden	1.00	1.00
2019	Comoros	1.00	0.84	Lesotho	1.00	1.00	Sweden	1.00	1.00
2020	Comoros	1.00	0.84	Lesotho	1.00	1.00	Sweden	1.00	1.00
2021	Comoros	1.00	0.85	Lesotho	1.00	1.00	Sweden	1.00	1.00
2022	Comoros	1.00	0.84	Lesotho	1.00	1.00	Sweden	1.00	1.00
2023	Comoros	1.00	0.80	Lesotho	1.00	1.00	Sweden	1.00	1.00
2015	Congo, Dem. Rep.	0.72	1.00	Liberia	0.54	0.70	Switzerland	0.60	0.60
2016	Congo, Dem. Rep.	0.72	1.00	Liberia	0.54	0.73	Switzerland	0.61	0.64
2017	Congo, Dem. Rep.	0.70	1.00	Liberia	0.53	0.65	Switzerland	0.63	0.66
2018	Congo, Dem. Rep.	0.68	1.00	Liberia	0.53	0.69	Switzerland	0.63	1.00
2019	Congo, Dem. Rep.	0.66	1.00	Liberia	0.54	0.67	Switzerland	0.64	1.00
2020	Congo, Dem. Rep.	0.65	1.00	Liberia	0.56	0.75	Switzerland	0.65	1.00
2021	Congo, Dem. Rep.	0.64	1.00	Liberia	0.54	0.77	Switzerland	0.61	0.67
2022	Congo, Dem. Rep.	0.60	1.00	Liberia	0.53	0.73	Switzerland	0.62	0.70
2023	Congo, Dem. Rep.	0.57	1.00	Liberia	0.51	0.75	Switzerland	0.62	0.70
2015	Congo, Rep.	0.22	0.20	Lithuania	0.76	0.79	Tajikistan	1.00	1.00
2016	Congo, Rep.	0.24	0.19	Lithuania	0.74	0.80	Tajikistan	1.00	1.00
2017	Congo, Rep.	0.29	0.28	Lithuania	0.71	0.77	Tajikistan	1.00	1.00
2018	Congo, Rep.	0.32	0.36	Lithuania	0.65	0.74	Tajikistan	1.00	1.00
2019	Congo, Rep.	0.32	0.41	Lithuania	0.63	0.69	Tajikistan	1.00	1.00
2020	Congo, Rep.	0.31	0.44	Lithuania	0.64	0.69	Tajikistan	1.00	1.00
2021	Congo, Rep.	0.29	0.45	Lithuania	0.61	0.70	Tajikistan	1.00	1.00
2022	Congo, Rep.	0.24	0.27	Lithuania	0.64	0.72	Tajikistan	1.00	1.00
2023	Congo, Rep.	0.24	0.27	Lithuania	0.65	0.73	Tajikistan	1.00	1.00
2015	Costa Rica	0.74	0.67	Luxembourg	0.35	0.36	Tanzania	0.39	0.88
2016	Costa Rica	0.65	0.63	Luxembourg	0.35	0.36	Tanzania	0.39	1.00
2017	Costa Rica	0.68	0.68	Luxembourg	0.36	0.38	Tanzania	0.39	1.00
2018	Costa Rica	0.67	0.64	Luxembourg	0.39	0.41	Tanzania	0.42	1.00
2019	Costa Rica	0.71	0.65	Luxembourg	0.39	0.40	Tanzania	0.43	0.74
2020	Costa Rica	1.00	0.63	Luxembourg	0.42	0.42	Tanzania	0.43	0.69
2021	Costa Rica	1.00	0.67	Luxembourg	0.39	0.39	Tanzania	0.45	0.70
2022	Costa Rica	1.00	0.63	Luxembourg	0.39	0.41	Tanzania	0.48	0.78
2023	Costa Rica	1.00	0.60	Luxembourg	0.40	0.40	Tanzania	0.50	0.77
2015	Cote d'Ivoire	0.19	0.46	Madagascar	0.82	1.00	Thailand	0.57	0.81
2016	Cote d'Ivoire	0.26	0.73	Madagascar	0.95	1.00	Thailand	0.58	0.83
2017	Cote d'Ivoire	0.23	0.45	Madagascar	1.00	0.90	Thailand	0.55	0.78
2018	Cote d'Ivoire	0.36	0.52	Madagascar	1.00	1.00	Thailand	0.55	0.83
2019	Cote d'Ivoire	0.37	0.65	Madagascar	1.00	1.00	Thailand	0.55	0.74
2020	Cote d'Ivoire	0.38	0.69	Madagascar	1.00	0.97	Thailand	0.58	0.76
2021	Cote d'Ivoire	0.38	0.60	Madagascar	0.99	0.85	Thailand	0.60	0.79
2022	Cote d'Ivoire	0.37	0.55	Madagascar	0.86	0.65	Thailand	0.58	0.81
2023	Cote d'Ivoire	0.38	0.56	Madagascar	0.88	0.66	Thailand	0.63	0.84
2015	Croatia	1.00	1.00	Malawi	0.92	1.00	Togo	0.60	1.00
2016	Croatia	1.00	1.00	Malawi	0.92	0.87	Togo	0.39	0.91
2017	Croatia	1.00	1.00	Malawi	0.86	1.00	Togo	0.68	1.00
2018	Croatia	1.00	1.00	Malawi	0.82	1.00	Togo	0.57	1.00
2019	Croatia	1.00	1.00	Malawi	0.77	1.00	Togo	0.62	1.00
2020	Croatia	1.00	1.00	Malawi	0.75	1.00	Togo	0.57	1.00
2021	Croatia	1.00	1.00	Malawi	0.76	1.00	Togo	0.64	1.00
2022	Croatia	1.00	1.00	Malawi	0.80	1.00	Togo	0.61	1.00
2023	Croatia	1.00	1.00	Malawi	0.82	1.00	Togo	0.60	1.00

Year	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis	Country	Main Analysis	Robustness Analysis
2015	Cyprus	0.58	0.60	Malaysia	0.29	0.35	Trinidad and Tobago	0.28	0.31
2016	Cyprus	0.54	0.55	Malaysia	0.27	0.33	Trinidad and Tobago	0.31	0.37
2017	Cyprus	0.55	0.55	Malaysia	0.28	0.34	Trinidad and Tobago	0.33	0.40
2018	Cyprus	0.56	0.57	Malaysia	0.25	0.32	Trinidad and Tobago	0.32	0.41
2019	Cyprus	0.54	0.53	Malaysia	0.29	0.35	Trinidad and Tobago	0.32	0.39
2020	Cyprus	0.54	0.53	Malaysia	0.30	0.37	Trinidad and Tobago	0.36	0.43
2021	Cyprus	0.52	0.50	Malaysia	0.29	0.35	Trinidad and Tobago	0.30	0.38
2022	Cyprus	0.46	0.47	Malaysia	0.26	0.32	Trinidad and Tobago	0.28	0.35
2023	Cyprus	0.46	0.47	Malaysia	0.25	0.32	Trinidad and Tobago	0.29	0.37
2015	Czechia	0.90	1.00	Maldives	0.45	0.42	Tunisia	0.57	0.59
2016	Czechia	0.89	1.00	Maldives	0.42	0.41	Tunisia	0.57	0.60
2017	Czechia	0.86	1.00	Maldives	0.38	0.37	Tunisia	0.54	0.57
2018	Czechia	0.89	1.00	Maldives	0.34	0.33	Tunisia	0.58	0.53
2019	Czechia	0.86	1.00	Maldives	0.40	0.37	Tunisia	0.63	0.58
2020	Czechia	0.90	1.00	Maldives	0.67	0.62	Tunisia	0.60	0.53
2021	Czechia	0.92	1.00	Maldives	0.48	0.45	Tunisia	0.61	0.59
2022	Czechia	0.96	1.00	Maldives	0.41	0.39	Tunisia	0.63	0.59
2023	Czechia	0.93	1.00	Maldives	0.38	0.37	Tunisia	0.67	0.61
2015	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.47	0.45
2016	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.41	0.40
2017	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.39	0.40
2018	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.41	0.40
2019	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.43	0.41
2020	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.37	0.39
2021	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.30	0.37
2022	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.27	0.38
2023	Denmark	1.00	1.00	Mali	1.00	1.00	Türkiye	0.27	0.38
2015	Djibouti	0.49	0.23	Malta	0.52	0.55	Turkmenistan	0.39	0.52
2016	Djibouti	0.47	0.20	Malta	0.53	0.56	Turkmenistan	0.37	0.51
2017	Djibouti	0.38	0.18	Malta	0.48	0.52	Turkmenistan	0.33	0.52
2018	Djibouti	0.39	0.17	Malta	0.48	0.55	Turkmenistan	0.32	0.44
2019	Djibouti	0.41	0.20	Malta	0.50	0.55	Turkmenistan	0.34	0.51
2020	Djibouti	0.42	0.21	Malta	0.47	0.56	Turkmenistan	0.30	0.47
2021	Djibouti	0.41	0.19	Malta	0.44	0.53	Turkmenistan	0.31	0.47
2022	Djibouti	0.39	0.19	Malta	0.41	0.53	Turkmenistan	0.31	0.44
2023	Djibouti	0.38	0.18	Malta	0.44	0.54	Turkmenistan	0.31	0.45
2015	Dominican Republic	1.00	1.00	Mauritania	0.39	0.30	Uganda	0.48	0.62
2016	Dominican Republic	1.00	1.00	Mauritania	0.42	0.28	Uganda	0.48	0.58
2017	Dominican Republic	1.00	1.00	Mauritania	0.41	0.31	Uganda	0.41	0.64
2018	Dominican Republic	1.00	1.00	Mauritania	0.43	0.37	Uganda	0.48	0.80
2019	Dominican Republic	0.82	1.00	Mauritania	0.41	0.35	Uganda	0.48	0.93
2020	Dominican Republic	0.97	1.00	Mauritania	0.41	0.38	Uganda	0.47	0.88
2021	Dominican Republic	0.56	1.00	Mauritania	0.45	0.47	Uganda	0.54	1.00
2022	Dominican Republic	0.79	1.00	Mauritania	0.48	0.35	Uganda	0.49	0.70
2023	Dominican Republic	0.78	1.00	Mauritania	0.48	0.35	Uganda	0.49	0.71
2015	Ecuador	0.92	0.67	Mauritius	0.41	0.53	United Arab Emirates	0.20	0.24
2016	Ecuador	0.90	0.64	Mauritius	0.42	0.49	United Arab Emirates	0.21	0.24
2017	Ecuador	0.86	0.63	Mauritius	1.00	0.53	United Arab Emirates	0.21	0.25
2018	Ecuador	0.91	0.75	Mauritius	1.00	0.52	United Arab Emirates	0.23	0.25
2019	Ecuador	0.84	0.62	Mauritius	1.00	0.58	United Arab Emirates	0.28	0.30
2020	Ecuador	0.92	0.61	Mauritius	1.00	0.65	United Arab Emirates	0.33	0.34
2021	Ecuador	0.86	0.69	Mauritius	1.00	0.65	United Arab Emirates	0.32	0.35
2022	Ecuador	0.84	0.66	Mauritius	1.00	1.00	United Arab Emirates	0.29	0.34
2023	Ecuador	0.85	0.69	Mauritius	1.00	1.00	United Arab Emirates	0.31	0.35
2015	Egypt, Arab Rep.	0.63	1.00	Mexico	0.43	0.40	United Kingdom	0.82	1.00
2016	Egypt, Arab Rep.	0.52	0.33	Mexico	0.45	0.41	United Kingdom	0.85	1.00
2017	Egypt, Arab Rep.	0.51	0.31	Mexico	0.42	0.36	United Kingdom	0.87	1.00
2018	Egypt, Arab Rep.	0.47	0.29	Mexico	0.40	0.31	United Kingdom	1.00	1.00
2019	Egypt, Arab Rep.	0.49	0.28	Mexico	0.42	0.31	United Kingdom	1.00	1.00
2020	Egypt, Arab Rep.	0.48	0.29	Mexico	0.45	0.31	United Kingdom	1.00	1.00
2021	Egypt, Arab Rep.	0.45	0.31	Mexico	0.41	0.33	United Kingdom	0.93	1.00
2022	Egypt, Arab Rep.	0.39	0.31	Mexico	0.43	0.34	United Kingdom	0.90	1.00
2023	Egypt, Arab Rep.	0.39	0.32	Mexico	0.42	0.35	United Kingdom	0.92	1.00
2015	El Salvador	1.00	0.55	Moldova	1.00	1.00	United States	0.46	0.48
2016	El Salvador	1.00	0.56	Moldova	1.00	1.00	United States	0.48	0.49
2017	El Salvador	1.00	0.52	Moldova	1.00	1.00	United States	0.47	0.48
2018	El Salvador	1.00	0.52	Moldova	1.00	1.00	United States	0.47	0.48
2019	El Salvador	1.00	0.51	Moldova	1.00	1.00	United States	0.45	0.45
2020	El Salvador	1.00	0.52	Moldova	1.00	1.00	United States	0.45	0.45
2021	El Salvador	1.00	0.51	Moldova	1.00	1.00	United States	0.43	0.45
2022	El Salvador	1.00	0.52	Moldova	1.00	1.00	United States	0.42	0.45
2023	El Salvador	1.00	0.52	Moldova	1.00	1.00	United States	0.40	0.42

Year	Country	Robustness		Country	Robustness		Country	Main	
		Main Analysis	Analysis		Main Analysis	Analysis		Analysis	Analysis
2015	Estonia	1.00	1.00	Mongolia	0.38	0.76	Uruguay	0.91	0.85
2016	Estonia	0.98	1.00	Mongolia	0.37	0.76	Uruguay	1.00	0.87
2017	Estonia	1.00	1.00	Mongolia	0.36	0.82	Uruguay	1.00	0.92
2018	Estonia	1.00	1.00	Mongolia	0.36	0.84	Uruguay	1.00	0.88
2019	Estonia	1.00	1.00	Mongolia	0.36	0.81	Uruguay	1.00	0.88
2020	Estonia	0.99	1.00	Mongolia	0.36	0.85	Uruguay	1.00	0.92
2021	Estonia	0.95	1.00	Mongolia	0.38	0.82	Uruguay	1.00	1.00
2022	Estonia	1.00	1.00	Mongolia	0.39	0.77	Uruguay	1.00	0.89
2023	Estonia	1.00	1.00	Mongolia	0.38	0.77	Uruguay	1.00	0.89
2015	Eswatini	1.00	0.21	Montenegro	1.00	0.47	Uzbekistan	0.43	0.71
2016	Eswatini	1.00	0.18	Montenegro	1.00	0.45	Uzbekistan	0.39	0.63
2017	Eswatini	1.00	0.20	Montenegro	1.00	0.48	Uzbekistan	0.36	0.45
2018	Eswatini	1.00	0.22	Montenegro	1.00	0.48	Uzbekistan	0.38	0.39
2019	Eswatini	1.00	0.22	Montenegro	0.58	0.48	Uzbekistan	0.40	0.42
2020	Eswatini	1.00	0.23	Montenegro	0.77	0.56	Uzbekistan	0.45	0.46
2021	Eswatini	1.00	0.23	Montenegro	0.77	0.51	Uzbekistan	0.47	0.58
2022	Eswatini	1.00	0.24	Montenegro	0.73	0.48	Uzbekistan	0.49	0.58
2023	Eswatini	1.00	0.27	Montenegro	0.66	0.48	Uzbekistan	0.50	0.58
2015	Ethiopia	0.93	0.70	Morocco	0.59	1.00	Vietnam	1.00	1.00
2016	Ethiopia	0.77	0.63	Morocco	0.56	0.74	Vietnam	1.00	1.00
2017	Ethiopia	0.80	0.59	Morocco	0.52	0.67	Vietnam	1.00	1.00
2018	Ethiopia	0.62	0.61	Morocco	0.73	1.00	Vietnam	1.00	1.00
2019	Ethiopia	0.63	0.63	Morocco	0.72	1.00	Vietnam	1.00	1.00
2020	Ethiopia	0.59	0.74	Morocco	0.78	1.00	Vietnam	1.00	1.00
2021	Ethiopia	0.70	0.80	Morocco	0.80	1.00	Vietnam	1.00	1.00
2022	Ethiopia	0.74	0.83	Morocco	0.68	0.86	Vietnam	1.00	1.00
2023	Ethiopia	0.82	0.90	Morocco	0.71	0.87	Vietnam	1.00	1.00
2015	Fiji	0.59	1.00	Mozambique	1.00	1.00	Zambia	0.44	0.31
2016	Fiji	0.58	1.00	Mozambique	1.00	0.58	Zambia	0.47	0.29
2017	Fiji	0.60	1.00	Mozambique	1.00	0.82	Zambia	0.47	0.29
2018	Fiji	0.53	1.00	Mozambique	1.00	1.00	Zambia	0.75	0.36
2019	Fiji	0.69	1.00	Mozambique	1.00	1.00	Zambia	0.51	0.35
2020	Fiji	0.77	1.00	Mozambique	1.00	1.00	Zambia	0.47	0.39
2021	Fiji	0.80	1.00	Mozambique	1.00	1.00	Zambia	0.42	0.37
2022	Fiji	0.63	1.00	Mozambique	1.00	1.00	Zambia	0.41	0.34
2023	Fiji	0.64	1.00	Mozambique	1.00	1.00	Zambia	0.39	0.34
2015	Finland	1.00	1.00	Myanmar	0.88	0.56	Zimbabwe	0.77	0.57
2016	Finland	1.00	1.00	Myanmar	0.86	0.52	Zimbabwe	0.75	0.52
2017	Finland	1.00	1.00	Myanmar	0.94	0.47	Zimbabwe	0.75	0.52
2018	Finland	1.00	1.00	Myanmar	1.00	0.51	Zimbabwe	0.60	0.45
2019	Finland	1.00	1.00	Myanmar	1.00	0.47	Zimbabwe	0.60	0.45
2020	Finland	1.00	1.00	Myanmar	1.00	0.74	Zimbabwe	0.65	0.51
2021	Finland	1.00	1.00	Myanmar	1.00	1.00	Zimbabwe	0.64	0.49
2022	Finland	1.00	1.00	Myanmar	1.00	0.92	Zimbabwe	0.63	0.45
2023	Finland	1.00	1.00	Myanmar	1.00	0.89	Zimbabwe	0.63	0.48
2015	France	1.00	1.00	Namibia	1.00	1.00			
2016	France	0.83	0.85	Namibia	1.00	1.00			
2017	France	0.89	1.00	Namibia	1.00	1.00			
2018	France	1.00	1.00	Namibia	1.00	1.00			
2019	France	1.00	1.00	Namibia	1.00	1.00			
2020	France	1.00	1.00	Namibia	1.00	1.00			
2021	France	1.00	1.00	Namibia	1.00	1.00			
2022	France	1.00	1.00	Namibia	1.00	1.00			
2023	France	1.00	1.00	Namibia	1.00	1.00			
2015	Gabon	0.21	0.54	Nepal	1.00	1.00			
2016	Gabon	0.20	0.27	Nepal	1.00	1.00			
2017	Gabon	0.24	0.24	Nepal	0.97	0.72			
2018	Gabon	0.25	0.28	Nepal	1.00	1.00			
2019	Gabon	0.25	0.26	Nepal	0.93	1.00			
2020	Gabon	0.23	0.28	Nepal	0.91	0.83			
2021	Gabon	0.23	0.35	Nepal	0.89	1.00			
2022	Gabon	0.27	0.58	Nepal	1.00	1.00			
2023	Gabon	0.28	0.34	Nepal	1.00	1.00			

APPENDIX D

TOP TREND ANALYSIS

Ranking	Country	Declining Trend	Ranking	Country	Increasing Trend
1	Burkina Faso	-5.78%	1	Afghanistan	6.90%
2	Montenegro	-4.76%	2	Mauritius	6.85%
3	Israel	-4.16%	3	Costa Rica	5.13%
4	Dominican Republic	-3.98%	4	Senegal	4.24%
5	Nigeria	-3.38%	5	Ukraine	3.65%
6	India	-3.13%	6	Iceland	3.34%
7	Cambodia	-2.63%	7	Bosnia and Herzegovina	2.55%
8	Barbados	-2.56%	8	Morocco	2.46%
9	Egypt, Arab Rep.	-2.40%	9	Suriname	2.43%
10	Türkiye	-2.38%	10	Sudan	2.37%
11	Lao PDR	-2.32%	11	Cote d'Ivoire	2.29%
12	Ireland	-2.20%	12	Nicaragua	2.14%
13	Bulgaria	-2.05%	13	Serbia	2.03%
14	Romania	-1.99%	14	Myanmar	1.70%
15	Congo, Dem. Rep.	-1.87%	15	United Arab Emirates	1.67%

APPENDIX E

CLUSTER ANALYSIS – TÜRKİYE

Table E1. Cluster Analysis Limits

Cluster Rank	Year	Minimum Efficiency Limit	Maximum Efficiency Limit	Mean Efficiency
1	2015	0.91	1.00	0.99
2	2015	0.70	0.90	0.81
3	2015	0.42	0.67	0.54
4	2015	0.13	0.41	0.29
1	2016	0.92	1.00	0.99
2	2016	0.72	0.90	0.83
3	2016	0.44	0.69	0.56
4	2016	0.14	0.42	0.31
1	2017	0.92	1.00	1.00
2	2017	0.70	0.90	0.82
3	2017	0.44	0.68	0.56
4	2017	0.12	0.43	0.31
1	2018	0.92	1.00	1.00
2	2018	0.72	0.91	0.82
3	2018	0.46	0.69	0.57
4	2018	0.11	0.43	0.32
1	2019	0.90	1.00	0.99
2	2019	0.69	0.89	0.80
3	2019	0.45	0.68	0.57
4	2019	0.15	0.43	0.33
1	2020	0.88	1.00	0.98
2	2020	0.61	0.84	0.71
3	2020	0.41	0.60	0.50
4	2020	0.16	0.39	0.31
1	2021	0.86	1.00	0.98
2	2021	0.59	0.83	0.68
3	2021	0.38	0.57	0.46
4	2021	0.18	0.36	0.28
1	2022	0.82	1.00	0.97
2	2022	0.55	0.80	0.65
3	2022	0.36	0.53	0.44
4	2022	0.17	0.35	0.26
1	2023	0.91	1.00	0.99
2	2023	0.70	0.89	0.81
3	2023	0.44	0.67	0.55
4	2023	0.17	0.42	0.32

1: Excellent Performers

2: Good Performers

3: Least Performers

4: Worse Performers

Table E2. Türkiye's Clusters Over Years

Country	Year	Efficiency	Cluster	Cluster Definition
Türkiye	2015	0.47	3	Least Performers
Türkiye	2016	0.41	4	Worse Performers
Türkiye	2017	0.39	4	Worse Performers
Türkiye	2018	0.41	4	Worse Performers
Türkiye	2019	0.43	4	Worse Performers
Türkiye	2020	0.37	4	Worse Performers
Türkiye	2021	0.30	4	Worse Performers
Türkiye	2022	0.27	4	Worse Performers
Türkiye	2023	0.27	4	Worse Performers

Table E3. 2023 Worse Performer Group Country List

2023 Worse Performer Group Country List			
1	Angola	25	Maldives
2	United Arab Emirates	26	Mexico
3	Armenia	27	Mongolia
4	Azerbaijan	28	Malaysia
5	Bahrain	29	Oman
6	Bahamas, The	30	Pakistan
7	Brunei Darussalam	31	Panama
8	Botswana	32	Papua New Guinea
9	Cote d'Ivoire	33	Qatar
10	Cameroon	34	Romania
11	Congo, Rep.	35	Russian Federation
12	Djibouti	36	Saudi Arabia
13	Algeria	37	Singapore
14	Egypt, Arab Rep.	38	Sierra Leone
15	Gabon	39	Turkmenistan
16	Guinea-Bissau	40	Trinidad and Tobago
17	Indonesia	41	Türkiye
18	Ireland	42	United States
19	Iran, Islamic Rep.	43	Zambia
20	Iraq		
21	Kazakhstan		
22	Kuwait		
23	Sri Lanka		
24	Luxembourg		

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