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Research Paper

Performance Analysis and Sustainability Assessment of International Markets: Iran Versus Some Other Countries

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Abstract

Evaluating the performance of countries in international markets and measuring their efficient utilization of allocated resources provides a clear understanding of the state of business management within these countries. Additionally, assessing the sustainability of performance in international markets is a crucial factor in predicting international trade outcomes. Knowledge of countries' performance in international markets helps identify their economic and non-economic management statuses. Furthermore, it aids in the allocation of financial support from global organizations. This article presents an innovative approach to designing a model that examines the performance of nations in international markets across both economic and non-economic dimensions, while considering the presence of undesirable factors. The model encompasses two stages: preparation and exploitation of existing platforms. It also assesses the sustainability of countries' performance during the studied period. To test the model, data from 21 countries between 2010 and 2017 were evaluated. The results indicated that the model effectively examines countries' performance and assesses its sustainability over time. Based on these findings, an evaluation of Iran's performance status among comparable countries was conducted, and a roadmap for enhancing Iran's performance was provided.

1 Introduction

Country performance evaluation involves assessing and classifying the performance demonstrated in input, output, interim results, and final public sector management outcomes. Rotberg [39] emphasizes the importance of result-oriented performance measurement, as the ultimate goal of public policies is to achieve tangible results. However, there is no universally applicable standard to assess all crucial indicators in performance evaluation. Relying on a one-dimensional performance system often leads to inaccurate or unreasonable outcomes. The relationship between trade, growth, and poverty reduction is unequivocal. From 1990 to 2017, developing countries increased their share of global exports from 16 percent to 30 percent, while extreme poverty declined from 36 percent to 9 percent (World Bank, [46]). International

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transfers play a significant role in the global economy, with foreign direct investment becoming a major source of private capital in many developing countries. The investment strategy employed directly impacts portfolio performance, emphasizing the importance of implementing the right investment strategy effectively (Juddoo et al., [23]; Huang et al., [14]). Under certain circumstances, appropriate investment strategies yield substantial excess returns, coupled with the adoption of recent technology for relevant purposes (Hutabarat et al., [15]; Van der Hart et al., [45]). Interactions between domestic and foreign companies are expected to enhance productivity, technology transfer, new processes, improved management skills, employee training, and access to international production networks. Through combining domestic savings and foreign direct investment, employment can be improved, exports diversified, production structures transformed, production technology processes strengthened, and growth and development promoted (Alfaro et al., [3]).

Policies related to basic services, infrastructure, asset building, and entrepreneurship are crucial foundations for both present and future human and economic development. These policies aim to reduce inequality, create economic opportunities through the establishment of small and medium-sized businesses, and expand ownership of assets such as homes. Collectively, these policies contribute to increased broad-based economic opportunities, equality, and long-term economic competitiveness (Tsapko-Piddubna, [44]). The evaluation system measures the effectiveness of management decisions concerning resource utilization and facility usage, with economic efficiency or effectiveness of activities serving as the primary indicator. Performance evaluation is central to all activities and determines survival (Abdalkarim, [1]; Bani Hani et al., [5]; Choudhary et al., [6]). The outcomes of performance evaluation projects in developing countries encourage donors and committed partner countries to prioritize and manage results as a key principle of development cooperation, influencing the impact of World Bank assistance and affiliated organizations (Holzapfel S, [13]). Therefore, it is crucial for countries to continue recognizing trade as a pathway to development. Developing countries can utilize these tools to gain a better understanding of potential distributional impacts before implementing policies, monitor their implementation, and coordinate responses across government entities.

2 Theoretical Foundations and Research Background

2.1 Economic and Non-Economic Performance Indicators

In assessing the competitiveness of countries, both the World Economic Forum (WEF) and the International Institute for Management Development (IMD) evaluate the effectiveness of government management. The developed countries, such as the 7G member states, have actively evaluated performance to improve countries' competitiveness; this trend is expected to spread to developing countries. Therefore, evaluating the country's operational efficiency is a valuable subject of study, Wu et al., [49]. Gross domestic product is considered as an essential economic indicator because it shows the performance of an economy based on the result of factors of production located in the national territory. On the other hand, it has been the dominant indicator of research for several decades aimed at the critique of GDP as well as the construction of alternative indicators, which better reflect the performance of the entire economic and social system. Ivanova and Masarova, [16]. Vojtovic and Krajnaakova [46] stated that GDP for the final evaluation of production could not include measurement and evaluation in all aspects of life. For a more accurate assessment, it should involve community performance and well-being by employing a combination of several other indicators of community performance. In the professional literature, there are alternative indicators about the way of measuring economic performance such as net economic welfare,

real economic development, human development index, economic freedom index (HDI), economic welfare index (IEF), and global competitiveness index (GCI). Limited attention has been paid to the selection of specific indicators. It is not clear at first because the decision depends on the main characteristics of the studied countries, e.g., whether they are developed or developing. Numerous studies had the limitation of not paying much attention to this problem. For instance, the indicators presented by Hobijn et al. [12] for analyzing developed and developing countries can simultaneously distinguish between two groups of countries, but they cannot calculate the different levels of well-being in developed countries. These indicators are measured (e.g., daily protein, calorie intake, infant mortality, life expectancy) when they are quite homogeneous in developing countries. Neumayer [35] criticized previous authors for converging with various well-being indicators, namely life expectancy, infant survival, education, literacy, and access to TV. The extensive range of indicators compensates for the bias caused by the analysis of developed and developing countries at the same time. Neumayer [35] obtained different results compared to Hobjin et al. [12], which showed strong evidence of convergence for most indicators. Giles and Feng [10] surveyed 14 OECD countries regarding five criteria for living in well-being: life expectancy, Gini coefficient of income inequality, poverty rate, education participation rate, and carbon dioxide emissions. McGillivari [32] also examined several indicators for some developing countries, such as poverty, inequality, health status, education status, gender bias, empowerment, governance, and mental well-being, and found out that most of the applied indicators are strongly related to income, and as a result, they are not capable of providing more information compared to income.
According to the literature, it can be argued that the choice of indicators should be based on the main characteristics of countries (e.g., low, medium, or high development, etc.). Certainly, in order to make important comparisons between countries, there must be a broad agreement on the selected indicators. In particular, as the analysis relates to developing countries, it can be argued that the main dimensions of non-economic well-being should be the prospects of health (e.g., life expectancy and expenditure on health) and education (e.g., literacy rate and scientific and technical journal articles).

2.2 Economic Situation of Iran in Comparison with the Economic Situation of the World

One of the most important indicators for estimating the progress and development of a country in the economic sector is always the comparison and evaluation of the country's position among other countries, especially countries in the region. Ranking countries in terms of various indicators to find a clear picture of their position in the world is an issue that is interesting for international organizations. Inter-country comparison of economic indicators, in addition to determining the country's position among different economies, also makes it possible to review the adopted policies and the resultant developments. Farhadi Kia et al., [9]. The position of countries in the global and regional economies has a close relationship with their growth. It means that the higher a country's economic growth, the more foreign capital it attracts, and this factor contributes to the further growth of that country's economy. Hence, the 20-year vision document of Iran up to 2025, as an upstream document of the system, aims to obtain the first economic rank amongst the 16 countries in the region. However, half a year after the implementation of this document, Iran is still far away from the projected objectives in the region [38].
In order to measure the economy, GDP is usually applied in terms of the parity of purchasing power and GDP in dollars (fixed price). In terms of purchasing power parity as one of the important indicators to measure the economy, GDP reveals that Iran was in third place in 2014 after Turkey and Saudi Arabia. According to the mentioned index, it is noteworthy that Iran's position in the year of implementation of the

Vision Document in 2005 was second amongst the countries in the Vision Document. However, Saudi Arabia achieved the second position in the region, and Iran was in the third position since 2008. GDP at a fixed price in 2005 as one of the other important indicators for measuring the economy, shows that Iran had a GDP of $277 billion, after Turkey ($673 billion) and Saudi Arabia ($523 billion), in third place in the year 2014. Rezaei [38]. Since all countries' statistics in the field of vision document in 2014 are not available in terms of economic growth position (speed of changes in GDP) and Iran's position in the Southwest Asia region is different in terms of the volume of GDP and is in the lower ranks. In recent years, some countries in the Persian Gulf, including Qatar, and in Central Asia, such as Azerbaijan, Turkmenistan, Uzbekistan, and Kazakhstan, have sought to accelerate their economic growth due to economic reforms and also a foreign investment. Iran's economic growth performance indicates that economic growth has been volatile and has not followed a stable trend. Calculating the standard deviation of economic growth as an indicator of fluctuation shows that Azerbaijan, Armenia, and Qatar have experienced the most fluctuations in economic growth. The standard deviation of Iran's economic growth in the first eight years of implementing the vision document is also high compared to Saudi Arabia, Egypt, and Pakistan. However, the vision document regarding the economic growth index has emphasized the feature of "its acceleration and continuity."

2.3 Review of Research Literature

In the present study, the research literature is divided into three sections.

- Evaluating the performance of countries.

- Performance evaluation using the DEA method.

- Reviewing and evaluating performance sustainability.

2.3.1 Evaluating the Performance of Countries

Ivanova and Masarova [16] investigated countries' performance and stated that GDP is yet an important indicator of the country's economic growth while measuring and expressing GDP requires a broader understanding of the development of society. However, it may be argued that there are other dimensions that can be considered essential, such as law and order, peace, security, and freedom. Zanella et al. [50] evaluated countries' performance using indicators such as greenhouse gas emissions, water quality, green space, and waste generation. Cracolici et al. [7] in a study entitled "The Measurement of Economic, Social and Environmental Performance of Countries: A Novel Approach," applied the novel approach to assess the performance of countries in three different approaches. This study provides a new analytical framework for assessing the diversity between countries and declares that the country's performance analysis should not be limited to economic or social factors.

2.3.2 Performance Evaluation Using DEA Method

Giokas and Pentzaropoulos [11], in a study entitled "Efficiency ranking of the OECD member states in the area of telecommunications: A composite AHP/DEA study," ranked the performance of all 30 OECD member countries in the field of telecommunications productivity using a combined method AHP/DEA. The data used in this study were extracted from the OECD database in 2005, reflecting the productivity

and profitability rates of network technology, employment, and infrastructure communications. Marchante and Ortega [30] used an Alternative Combined Index (AHDI) in the field of HDI to measure the quality of life and economic integration in the Spanish regions. Particularly, they considered three different per capita income and six quality of life indicators alternately. Ramanathan [35] in a study entitled "Evaluating the comparative performance of countries of the Middle East and North Africa: A DEA application," examined the economic and social performance of 18 countries in the MENA region, including Algeria, Bahrain, Comoros, Egypt, Iran, Jordan, Kuwait, Lebanon, Sudan, Mauritania, Morocco, Oman, Saudi Arabia, Syria, Tunisia, Turkey, the United Arab Emirates, and Yemen. Lovell et al. [29] in a study entitled "Measuring macroeconomic performance in the OECD: A comparison of European and non-European countries," assessed the macroeconomic performance of 19 countries in the period 1970-1990. According to the results of this model, Switzerland, Sweden, Germany, Norway, the USA, New Zealand, Denmark, and Japan were the eight countries with the highest efficiencies; the efficiency of European countries was 0.718 on average, while the average efficiency of non-European countries was equal to 0.768.
Additionally, Moghaddas et al. [34] proposed a Developed Data Envelopment Analysis Model for Efficient Sustainable Supply Chain Network Design to choose an efficient strategy for each stage of an SSC network. This approach seeks to provide a sustainable design with DMs to avoid imposing additional costs on SCs that result from noncompliance with environmental and social issues. In this study, the environmental performance variable has been considered in the next step so that the environmental waste of each country, including carbon and nitrogen emissions, was added to the list of indicators, and the model was implemented repeatedly to observe variations in the performance rank of countries. The results revealed that with the addition of the new variable, the performance rankings of the countries changed and the relative performance of the European countries decreased when the environmental discharge was added to the list. Accordingly, a crucial feature of the presented model is considering the issue of competition to choose the efficient strategy. Furthermore, undesirable outputs and feedbacks and independent inputs and outputs for intermediate stages in the network system are considered to create a structure compatible with the real world. The output of the proposed approach enables DMs to select the appropriate strategy for each stage of the network to maximize the aggregate efficiency of the network.

2.3.3 Assessing and Evaluating the Performance Sustainability

Sustainability is an essential ingredient for long-term success of firms, and its assessment has a significant impact on decision making and sustainability management. In the current paper, a network data envelopment analysis is proposed to assess the sustainability of systems over several periods when undesirable outputs are present in the process. Indeed, sustainability is assessed in each period and, as a whole, simultaneously. Furthermore, the current study concerns economic, social, cultural and environmental aspects; Amirteimoori et al. [4].
Amirteimoori et al. [4] designed a network data envelopment analysis model capable of evaluating the performance over time in the presence of undesirable indicators. In this study, researchers applied the model to evaluate the performance sustainability of gas companies for over three years. Martín-Gamboa et al. [31] studied the concept of life cycle approaches and DEA as a multi-criteria method for assessing the sustainability of energy systems. They investigated the potentials and limitations of the subject. Zhou et al. [52] provided a literature review on DEA application. They conducted sustainability studies in four groups: corporate sustainability assessment, regional sustainability assessment, sustainability composite indicator construction, and sustainability performance analysis. Moreover, some authors have applied supply chain

sustainability using the DEA technique. Tajbakhsh and Hassini [43] introduced a DEA-based approach for assessing the sustainability of supply chains. They developed non-cooperative and centralized approaches to assess the effectiveness of a sustainable supply chain in the presence of intermediary measures.

2.4 Network Data Envelopment Analysis Models

Data envelopment analysis was first introduced by Charnes et al. Izadikhah and Farzipoor, [19] and used in various applications of industries and organizations Izadikhah and Farzipoor, [18]. The conventional DEA models make no assumptions regarding the internal operations of a DMU and consider each DMU as a 'black-box', Kao [24] and neglect internal structure of units and relationships between them, Niknafs et al, [36] This structure reveals no insight related to the sources of inefficiency and cannot provide process-specific guidance to DMUs' managers to improve the DMU's efficiency. Lewis and Sexton, [28]. On the other hand, many real-world problems, have a network structure such that the production process (DMU) is divided into multiple stages (sub-DMUs) so that an intermediate product plays the role of an output for one stage meanwhile it plays the role of an input for another stage. Mirhedayatian et all, [33], Lee, [27]; Izadikhah, [17]. There are structures in which the entire operation is divided into more than two processes. These structures may be series, parallel, or a combination of these. These structures are generally called network structures, Akbari et al, [2]. Network DEA model is based on the traditional data envelopment analysis model to decompose the whole process including the decision-making unit into several subprocesses or stages. Each stage is distinguished by its own input and output process, and all stages are related by intermediate elements. W. Chen [47], L. Liang [26], J. Ma [20]; Zhao, [51].
In the black-box approach the efficiency score of a DMU is a function of its inputs and outputs, meanwhile in the network DEA approach opens the black-box of efficiency and evaluates the performance a DMU with taking its inputs, outputs, and intermediate factors into consideration. Izadikhah, [17]

3 Research Method

The effects of countries performance evaluation are highly uncertain if the prior knowledge of performance evaluation is limited. It is also complicated for the evaluation model to manage both quantitative and qualitative measurements and positive and negative values. This study proposes an innovative way to assess the sustainability performance of countries. It is a two simultaneous steps research procedure. Qualitative steps are to establish evaluation criteria based on literature reviews, and Sustainability dimension determination and Indicators classification and an attempt was made to determine the data required to design and implement the model after conducting interviews with experts and extracting qualitative results. The results include the approval of important indicators, the classification of indicators in three sectors of input, intermediate, and output, and a suitable model to evaluate the performance of countries in international markets.
At the Quantitative steps, statistical data related to indicators from 2010 to 2017 were required, which were collected by studying the yearbooks and statistical information of the World Bank website. Due to the network nature of countries' performance in international markets and the importance of performance measurement over time, an attempt was made to design a network data analysis model capable of measuring performance in different indicators and determining the importance of indicators in both economic and non-economic dimensions. Moreover, it can assess the sustainability of countries' performance for a long time. Since evaluating a country's performance in a year or a short period of time does not yield the right

results, a country cannot turn input sources into output in the short term. Therefore, in the present study, performance sustainability was also evaluated to design the model and assess the performance in different dimensions. Therefore, this study is completely innovative in using two quantitative and qualitative aspects together and considering different indicators and designing a two-dimensional model. In general, the implementation steps of the present study are divided into two parts: quantitative and qualitative. As can be seen in Figure 1, the research method is summarized.

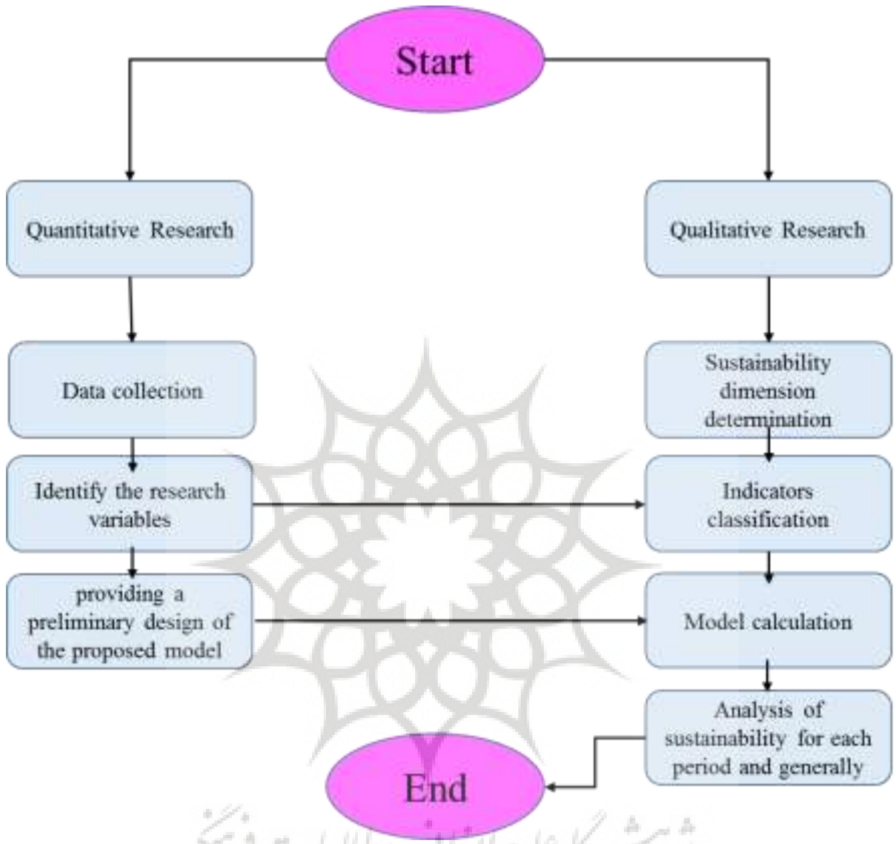

Fig.1: A summary of the procedure

3.1 Qualitative Research

Step 1: Identify the research variables to provide a preliminary design of the proposed model

At this step, by reviewing the literature and theoretical foundations of the research background and also reviewing the methods and models in scientific sources in the field of performance evaluation based on the Mendeley software report, an attempt has been made to present a preliminary and comprehensive model to evaluate countries' performance in global markets, which includes all the studied indicators. By summarizing previous theoretical studies, 25 variables were applied to evaluate the performance of countries. However, the possibility of access to data on variables at the level of international markets is another important point in determining the variables used in the model.

The possibility of accessing statistical data related to variables has been investigated by studying the statistical reports in the statistical yearbook of the World Bank and also by examining the statistical reports of the World Trade Organization for evaluating the possibility of access to the data required for the present study (for determining the input, intermediate, and output variables). Researches have revealed that statistics on the following indicators (Table 1) are available in most countries.

Table 1: Available Variables at the Level of International Markets

1. Gross Domestic Product (GDP)
2. Gross National Income (GNI)
3. Imports of goods and services (annual % of growth)
4. Exports of goods and services (annual % of growth)
5. Inflation, GDP deflator (annual %)
6. Life expectancy (LE),
7. Pollution index
8. Unemployment, total (% of the total labor force)
9. Current health expenditure (% of GDP)
10. Current account balance (% of GDP)
11. Population
12. Literacy rate, adults total (% of people aged 15 and over)
13. Foreign direct investment
14. Scientific and technical journal articles
15. Use of IMF credit (DOD, current US$)
16. Labor force, total
17. Total natural resources rents (% of GDP)

In order to evaluate the performance of countries, different criteria have been used, which are summarized in the table 2.

Table 2. Literature review of evaluating the performance of countries

	Authors	Publication	Description of Used Indicators
1	McGillivary, M. [32]	World Development	Poverty, inequality, health status, educational status, gender, empowerment, governance, and mental well-being
2	Lovell, C., et al [29]	European journal of operational research	GDP per capita, inflation, unemployment and trade balance, environmental dis-amenities (carbon and nitrogen emissions)
3	Neumayer, E. [35]	Structural Change and Economic Dynamics	Life expectancy, infant survival, education, literacy, and access to TV
4	Giles, D. E. , Feng, H. [10]	Structural Change and Economic Dynamics	Life expectancy, Gini coefficient of income inequality, poverty rate, education participation rate, and carbon dioxide emissions
5	Ramanathan [37]	Socio-Economic Planning Sciences	Labor, life expectancy, primary education, age dependency, illiteracy, and infant mortality
6	Marchante, A. J., Ortega, B. [30]	Regional Studies	Life expectancy, the survival rate of babies, the probability of surviving to age 60, adult literacy rate, mean years of schooling (years) and the long-term unemployment rate
7	Giokas, D. I., Pentzaropoulos, G. C. [11]	Telecommunications Policy	Communications, number of available lines, the total number of employees in telecommunications, number of internet hosts, the total number of subscribers, and total tel. income
8	Cracolici, M. F. et al.[7]	Social indicators research	GDP per capita, health conditions, life expectancy, higher education, work-life balance, and leisure time
9	Zanella, A., et al [50]	In Livro de Actas do 15º Congresso da	Greenhouse gas emissions, water quality, amount of green space and waste
10	Ivanová, E., Masárová, J. [16]	Economic research-ekonomska istraživanja	Economic development and economic performance, GDP, net economic welfare, human development index, competitiveness index, economic freedom index, welfare index, perceived corruption index

Furthermore, in the qualitative section, experts were asked to comment on how the variables are divided into input, intermediate, and output indicators. Finally, after extracting and analyzing the interview results, the indicators were classified according to the nature of input, intermediate or output, presented in Table 3.

Table 3: Indicators classifications

Type of Variable	Type of Indicator	Indicator
Input	Economic	Foreign direct investment, net (BoP, current US$)
Input	Economic	Use of IMF credit (DOD, current US$)
Input	Non-economic	Population, total
Input	Non-economic	Literacy rate, adult total (% of people ages 15 and over)
Input	Non-economic	Scientific and technical journal articles
Intermediate	Economic	Current account balance (% of GDP)
Intermediate	Economic	GDP (current US$)
Undesirable intermediate	Economic	Inflation, GDP deflator (annual %)
Undesirable intermediate	Non-economic	Unemployment, total (% of the total labor force) (national estimate)
Undesirable intermediate	Non-economic	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)
Intermediate	Non-economic	Total natural resources rents (% of GDP)
Intermediate	Non-economic	Labor force, total
Output	Economic	GNI (current US$)
Output	Economic	Exports of goods and services (annual % growth)
Output	Economic	Imports of goods and services (annual % growth)
Output	Non-economic	Life expectancy at birth, total (years)
Output	Non-economic	Current health expenditure (% of GDP)

Table4: The countries under investigation.

DMU No.	Country
DMU1	Azerbaijan
DMU2	Bangladesh
DMU3	Brazil
DMU4	Chile
DMU5	Colombia
DMU6	Georgia
DMU7	Honduras
DMU8	Indonesia
DMU9	Iran, Islamic Rep.
DMU10	Kazakhstan
DMU11	Kyrgyz Republic
DMU12	Mauritania
DMU13	Mexico
DMU14	Pakistan
DMU15	Paraguay
DMU16	Peru
DMU17	Russian Federation
DMU18	Philippines
DMU19	Senegal
DMU20	Tajikistan
DMU21	Turkey

3.2 Quantitative Research

Since the analysis of the present study is at the international level, its statistical population is all low developed or developing countries in which the share of development indicators is low and homogeneous data is statistically reported; 21 countries whose global statistical information access was possible based on the indicators set in the period 2010 to 2017, have been investigated in the form of a statistical sample by applying judgmental sampling method. At this level, the data related to the specified indicators for each country were applied in the Network Data Envelopment Analysis (NDEA) model written by the authors of the present paper. As can be seen in the model 1, it is a network model consisting of two stages.

•First Stage: Preparing

In this stage, efforts are being made to assess the impact of available data on developing a suitable platform for the successful performance of countries in international markets and creating the desired outputs. At this stage, the input indicators extracted from the interview results are categorized into two general economic and non-economic dimensions. The non-economic dimension includes various social, cultural, and environmental dimensions. The desired outputs are also categorized into two general economic and non-economic dimensions, the non-economic dimensions of which include different social and environmental dimensions.

•Second Stage: Exploitation

In the exploitation stage, the output indicators of the previous stage, called intermediate indicators, are considered inputs. The output indicators of the second stage are classified into two general economic and non-economic dimensions, the non-economic dimension of which includes the indicators of the social dimension. In the current section, a DEA-based approach is proposed to assess systems' sustainability with undesirable outputs over time. The authors consider n production systems, DMUj (j =1,…, n), to measure sustainability in P (p = 1, …, P) periods. The mathematical model of network data analysis envelopment designed in the present study is as follows.

3.4 Multiperiod efficiency analysis and Modeling undesirable outputs

This part of the model, which we have divided the model into two dimensions and attributed different input and output variables to each dimension using experts, is innovative compared to previous models and research.

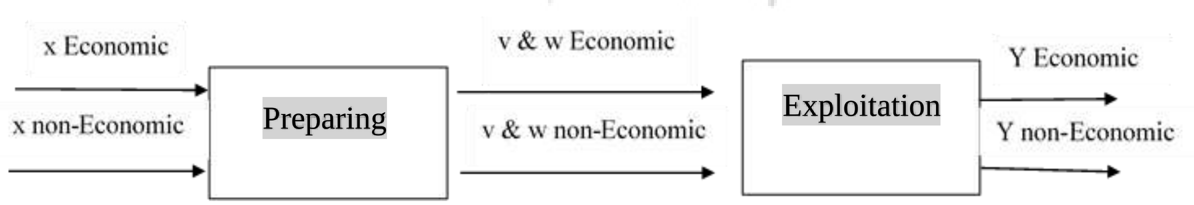

Fig. 2: The conceptual model for analyzing the performance of countries

As can be seen in the figure 1, the output of the first stage is the input of the second stage, which is why NDEA is used.

Assume that there are n DMUs, DMU_j; (j = 1..., n), where each DMU uses inputs $X_{ij}^t(i = 1, \dots, m, t = 1, \dots, T)$ and produces outputs $y_{rj}^t(r = 1, \dots, s, t = 1, \dots, T)$ in period t (t = 1, ..., T). Jablonsky [21], amirteimoori, et. al. [4] has presented the average efficiency score e_0 of the unit under evaluation, DMU_0, over all periods as follows:

$$
\begin{aligned}
& e_0^* = Min \frac{\sum_{t=1}^{T} \theta_0^t}{T} \\
& s.t. \sum_{j=1}^{n} \lambda_j^t x_{ij}^t \le \theta_0^t x_{io}^t, \quad i = 1,2, \dots, m, \\
& \qquad\qquad t = 1, \dots, T, \\
& \sum_{j=1}^{n} \lambda_j^t y_{rj}^t \ge y_{ro}^t, \quad r = 1,2, \dots, s, \quad t = 1, \dots, T, \\
& \lambda_j^t \ge 0, \quad j = 1, \dots, n, \quad t = 1, \dots, T
\end{aligned} \tag{1}
$$

$\lambda_j^t(j = 1, \dots, n,\ t = 1, \dots, T)$ is intensity variables. θ_0^t indicates the efficiency score of DMU_0, for each period t. Model (1) is under the assumption of constant returns to scale. However, it can be rewritten under variable returns to scale by adding the following constraint to model (1):

$$
\sum_{j=1}^{n} \lambda_j^t = 1, t = 1, \dots, T. \tag{2}
$$

Note that we have considered the multiperiod efficiency in an input orientation as can be seen in model (1) although Jablonsky [21], amirteimoori, et, al. [4] took into account an output orientation. The results of model (1) interpreted as follows:

- DMU_0, is globally efficient if and only if the optimal value of model (1), e_0^* equals to one, that is, e_0^* = 1. It means that it is efficient in all periods under consideration.
- DMU_0, is said to be inefficient if and only if the optimal value of model (1), e_0^* is obtained less than one, that is, e_0^* <1. It means that it is inefficient at least in one period from periods under consideration.

Assume that we have a sample of n DMUs, and each $DMU_j(j = 1, \dots, n)$ uses inputs $X_j = (X_{1j}, \dots, X_{mj}) \ge 0$, to produce desirable outputs $y_j = (y_{1j}, \dots, y_{rj}) \ge 0$ and to emit undesirable outputs $b_j = (b_{1j}, \dots, b_{kj}) \ge 0$.

The production possibility set is defined as

$$
T = \{(x, y, b) | (y, b)\ can\ be\ produced\ by\ x\} \tag{3}
$$

The weak disposability assumption of Shephard [41], amirteimoori, et al. [4] is given as follows:

Definition 1. Outputs (y, b) are weakly disposable if and only if:

(x, y, b) ∈ T and $\theta \in [0, 1]$ implies $(x, \theta\, y, \theta\, b) \in T$.

Taking the foregoing weak disposability assumption of Shephard [41] into consideration, the following technology set has been proposed by Färe and Grosskopf [8]:

$$T = \left\{ \begin{array}{ll} (x,y,b)| & \sum_{j=1}^{n} \lambda_j x_j \leq x, \\ & \sum_{j=1}^{n} \theta \lambda_j y_j \geq y, \\ & \sum_{j=1}^{n} \theta \lambda_j b_j = b, \\ & \sum_{j=1}^{n} \lambda_j = 1\,, \\ & \lambda_i \geq 0, 0 \leq \theta \leq 1, j = 1, \dots, n \end{array} \right\} \tag{4}$$

Färe and Grosskopf [8], amirteimoori, et, al. [4] have used a single abatement factor, and Kuosmanen [24] claimed that using a single abatement factor cannot provide the complete and correct technology set, and then, Kuosmanen [25] has used an individual abatement factors θ_j to each observed DMU_j; j = 1, ..., n, and he proposed the following technology set in linear format:

$$T = \left\{ \begin{array}{ll} (x,y,b)| & \sum_{j=1}^{n} (z_j + \mu_j) x_j \leq x, \\ & \sum_{j=1}^{n} z_j y_j \geq y, \\ & \sum_{j=1}^{n} z_j b_j = b, \\ & \sum_{j=1}^{n} (z_j + \mu_j) = 1\,, \\ & z_j, \mu_j \geq 0, j = 1, \dots, n \end{array} \right\} \tag{5}$$

$\bar{T}$ is the correct and complete technology set when we take the weak disposability assumption into consideration. The assumption of weak disposability, as discussed, is utilized to handle undesirable outputs. Thus, the technology set under the weak disposability assumption with multiple abatement factors for period p can be shown as follows as (6).

$$e_o^* = Min \frac{\sum_{p=1}^{P} \alpha^p}{P}$$

s.t. Stage 1:

(*Economic*)

$$\begin{aligned} &\sum_{j=1}^{n} \varphi_j^p x_{ij}^p \leq \theta_o^{1p} x_{io}^p\,, \quad i \in I^{Economic}, p = 1, \dots, P, \\ &\sum_{j=1}^{n} \delta_j^{1p} \varphi_j^p v_{rj}^p \geq v_{ro}^p\,, \quad r \in DO^{Economic}, p = 1, \dots, P, \\ &\sum_{j=1}^{n} \delta_j^{1p} \varphi_j^p w_{cj}^p = w_{co}^p, \quad c \in UDO^{Economic}, p = 1, \dots, P, \end{aligned} \tag{6}$$

$$\sum_{j=1}^{n} \varphi_j^p = 1\ ,\ \ p = 1, \dots, P\ ,$$

(*NonEconomic*)

$$\sum_{j=1}^{n} \xi_j^p x_{ij}^p \leq \theta_o^{2p} x_{io}^p\ ,\ \ i \in I^{noneconomic}, p = 1, \dots, P,$$

$$\sum_{j=1}^{n} \delta_j^{2p} \xi_j^p v_{rj}^p \geq v_{ro}^p\ ,\ \ r \in DO^{noneconomic}, p = 1, \dots, P,$$

$$\sum_{j=1}^{n} \delta_j^{2p} \xi_j^p w_{cj}^p = w_{co}^p\ ,\ \ c \in UDO^{noneconomic},$$

$$p = 1, \dots, P,$$

$$\sum_{j=1}^{n} \xi_j^p = 1\ ,\ \ p = 1, \dots, P,$$

Stage 2:

(*Economic*)

$$\sum_{j=1}^{n} \varphi_j'^{\,p} v_{rj}^p \leq \theta_o^{3p} v_{ro}^p\ ,\ \ r \in DO^{Economic}, p = 1, \dots, P,$$

$$\sum_{j=1}^{n} \delta_j^{3p} \varphi_j'^{\,p} w_{cj}^p = w_{co}^p,\ \ c \in UDO^{Economic}, p = 1, \dots, P,$$

$$\sum_{j=1}^{n} \delta_j^{3p} \varphi_j'^{\,p} y_{mj}^p \geq y_{mo}^p\ ,\ \ m \in O^{Economic}, p = 1, \dots, P,$$

$$\textstyle\sum_{j=1}^{n} \varphi_j'^{\,p} = 1\ ,\ \ p = 1, \dots, P,$$

(*NonEconomic*)

$$\sum_{j=1}^{n} \xi_j'^{\,p} v_{rj}^p \leq \theta_o^{4p} v_{ro}^p\ ,\ \ r \in DO^{noneconomic}, p = 1, \dots, P,$$

$$\sum_{j=1}^{n} \delta_j^{4p} \xi_j'^{\,p} w_{cj}^p = w_{co}^p\ ,\ \ c \in UDO^{noneconomic}, p$$

$$= 1, \dots, P\ ,$$

$$\sum_{j=1}^{n} \delta_j^{4p} \xi_j'^{\,p} y_{mj}^p \geq y_{mo}^p\ ,\ \ m \in O^{noneconomic}, p$$

$$= 1, \dots, P,$$

$$\sum_{j=1}^{n} \xi_j'^{\,p} = 1\ ,\ \ p = 1, \dots, P,$$

Generic:

$$\varphi_j^p, {\varphi'}_j^p, \xi_j^p, {\xi'}_j^p \geq 0\,, 0 \leq \delta_j^{1p}, \delta_j^{2p}, \delta_j^{3p}, \delta_j^{4p} \leq 1\,, \forall j, p.$$

As can be seen, model (6) is non-linear. In order to linearize this non-linear model, we will use the similar procedure to Kuosmanen [25]. To do this, make the following changes of variables, according to the definition of the use of weakness that Shephard [39] has for desirable and undesirable outputs.

$$\begin{aligned}
&\lambda_j^p = \delta_j^{1p}\varphi_j^p,\ \ \lambda_j^p + \mu_j^p = \varphi_j^p \\
&{\lambda'}_j^p = \delta_j^{3p}{\varphi'}_j^p\,,\ \ {\lambda'}_j^p + {\mu'}_j^p = {\varphi'}_j^p \\
&\gamma_j^p = \delta_j^{2p}\xi_j^p\,,\ \ \gamma_j^p + \eta_j^p = \xi_j^p \\
&{\gamma'}_j^p = \delta_j^{4p}{\xi'}_j^p\,,\ \ {\gamma'}_j^p + {\eta'}_j^p = {\xi'}_j^p
\end{aligned} \tag{7}$$

Now, to evaluate the sustainability of multiperiod systems with undesirable outputs, the following linear programming problem is suggested:

$$\begin{aligned}
&e_o^* = Min \frac{\sum_{p=1}^{P} \alpha^p}{P} \\
&s.t. \\
&Stage\ 1: \\
&(Economic) \\
&\sum_{j=1}^{n} (\lambda_j^p + \mu_j^p) x_{ij}^p \leq \theta_o^{1p} x_{io}^p\,,\ \ i \in I^{Economic}, p = 1, \dots, P, \\
&\sum_{j=1}^{n} \lambda_j^p v_{rj}^p \geq v_{ro}^p\,,\ \ r \in DO^{Economic}, p = 1, \dots, P\,, \\
&\sum_{j=1}^{n} \lambda_j^p w_{cj}^p = w_{co}^p\,,\ \ c \in UDO^{Economic}, p = 1, \dots, P\,, \\
&\sum_{j=1}^{n} (\lambda_j^p + \mu_j^p) = 1\,,\ \ p = 1, \dots, P\,, \\
&(NonEconomic) \\
&\sum_{j=1}^{n} \left(\gamma_j^p + \eta_j^p\right) x_{ij}^p \leq \theta_o^{2p} x_{io}^p\,,\ \ i \in I^{noneconomic}, \\
&\qquad p = 1, \dots, P\,, \\
&\sum_{j=1}^{n} \gamma_j^p v_{rj}^p \geq v_{ro}^p\,,\ \ r \in DO^{noneconomic}, p = 1, \dots, P\,,
\end{aligned} \tag{8}$$

$$\sum_{j=1}^{n} \gamma_j^p w_{cj}^p = w_{co}^p\,, \;\; c \in UDO^{noneconomic},$$
$$p = 1, \dots, P\,,$$
$$\sum_{j=1}^{n} (\gamma_j^p + \eta_j^p) = 1\,, \;\; p = 1, \dots, P\,,$$

Stage 2:
(*Economic*)

$$\sum_{j=1}^{n} \left(\lambda_j'^{\,p} + \mu_j'^{\,p}\right) v_{rj}^p \le \theta_o^{3p} v_{ro}^p\,, \;\; r \in DO^{Economic},$$
$$p = 1, \dots, P,$$
$$\sum_{j=1}^{n} \lambda_j'^{\,p} w_{cj}^p = w_{co}^p\,, \;\; c \in UDO^{Economic}, p = 1, \dots, P\,,$$
$$\sum_{j=1}^{n} \lambda_j'^{\,p} y_{mj}^p \ge y_{mo}^p\,, \;\; m \in O^{Economic}, p = 1, \dots, P\,,$$
$$\sum_{j=1}^{n} (\lambda_j'^{\,p} + \mu_j'^{\,p}) = 1, \;\; p = 1, \dots, P\,,$$

(*NonEconomic*)

$$\sum_{j=1}^{n} \left(\gamma_j'^{\,p} + \eta_j'^{\,p}\right) v_{rj}^p \le \theta_o^{4p} v_{ro}^p, \;\; r \in DO^{noneconomic},$$
$$p = 1, \dots, P\,,$$
$$\sum_{j=1}^{n} \gamma_j'^{\,p} w_{cj}^p = w_{co}^p\,, \;\; c \in UDO^{noneconomic},$$
$$p = 1, \dots, P\,,$$
$$\sum_{j=1}^{n} \gamma_j'^{\,p} y_{mj}^p \ge y_{mo}^p\,, \;\; m \in O^{noneconomic}, p = 1, \dots, P\,,$$
$$\sum_{j=1}^{n} (\gamma_j'^{\,p} + \eta_j'^{\,p}) = 1, \;\; p = 1, \dots, P\,,$$

Generic:

$$\alpha_o^p = \frac{\sum_{t=1}^{4} w_t^p \theta_o^{tp}}{\sum_{t=1}^{4} w_t^p},$$
$$\lambda_j^p, \lambda_j'^{\,p}, \mu_j^p, \mu_j'^{\,p}, \gamma_j^p, \gamma_j'^{\,p}, \eta_j^p, \eta_j'^{\,p} \ge 0\,, j = 1, \dots, n\,,$$
$$p = 1, \dots, P.$$

Model 8 is a Network Data Envelopment Analysis Model and can evaluate the performance of indicators in economic and non-economic dimensions and assess the sustainability of performance in any period. The following notations are applied for modeling:

e_o^*: The objective function
p: Periods of time
α^p: The performance of each country during the period
$x_{ij}^{(p)}$: ith input of *DMUj* (j = 1, …, n) for stage 1 *in* period *p*
W^p_{cj}: cth undesirable output of *DMUj* (j = 1, …, n) for stage 1 in period *p*
V^p_{rj}: rth output of *DMUj* (j = 1, …, n*) for the first stage in period p*
y^p_{mj}: mth output of *DMUj* (j = 1, …, n) for stage 2 in period *p*
λ_j^p, μ_j^p: Intensity variables for input variable in economic aspect in stage 1 (for country *j* at time *p*)
γ_j^p, η_j^p: Intensity variables for input variable in non-economic aspect in stage 1 (for country *j* at time *p*)
λ'^p_j, μ'^p_j: Intensity variables for input variable in economic aspect in stage 2 (for country *j* at time *p*)
γ'^p_j, η'^p_j: Intensity variables for input variable in non-economic aspect in stage 2 (for country *j* at time *p*)

Definition 1. (Overall sustainable) The *o*th system is said to be overall sustainable if and only if e_o^* =1.

This means that in the sustainability of the *o*th system, it is efficient in each period and each dimension. Therefore, the system is said to be overall unsustainable if it is inefficient in some period or some dimension. In this case, we have $e_o^* < 1$.

Definition 2. (Economic sustainable) A system DMU*o* is called to be economic sustainable if and only if $\theta_o{*}^{p1} = \theta_o{*}^{p3} = 1$, p=1, ..., P. It means that the system *o* is efficient in social and economic dimensions for each period.

Definition 3. (Non-Economic sustainable) A system DMU*o* is called to be Non-Economic sustainable if and only if $\theta_o{*}^{p2} = \theta_o{*}^{p4} = 1$, p=1, ..., P. It means that the system *o* is efficient in social and environmental dimensions for each period.

Theorem 1. The linear model (1) is always feasible.

Proof. Consider

$$
\begin{aligned}
&\lambda_o^p = 1, \lambda_j^p = 0,\ \ j = 1, \dots, n,\ \ p = 1, \dots, P, \\
&\mu_o^p = 0,\ \ j = 1, \dots, n,\ \ p = 1, \dots, P\ , \\
&\lambda'^{\,p}_o = 1,\ \ \lambda'^{\,p}_j = 0,\ \ j = 1, \dots, n,\ \ j \neq o, p = 1, \dots, P\ , \\
&\mu'^{\,p}_o = 0,\ \ j = 1, \dots, n,\ \ p = 1, \dots, P\ , \\
&\gamma_o^p = 1, \gamma_j^p = 0,\ \ j = 1, \dots, n,\ \ j \neq o,\ \ p = 1, \dots, P\ , \\
&\eta_o^p = 0,\ \ j = 1, \dots, n,\ \ p = 1, \dots, P\ , \\
&\gamma'^{\,p}_o = 1, \gamma'^{\,p}_j = 0,\ \ j = 1, \dots, n,\ \ j \neq o,\ \ p = 1, \dots, P\ , \\
&\eta'^{\,p}_o = 0, j = 1, \dots, n,\ \ p = 1, \dots, P\ ,
\end{aligned}
\tag{9}
$$

$$\theta_o^{1p} = \theta_o^{2p} = \theta_o^{3p} = \theta_o^{4p} = 1,\ \ p = 1, \dots, P,\ \ e_o = 1.$$

It is clear that it is a feasible solution to this problem.

Theorem 2. $0 < e_o^* \le 1$.

Proof. According to Theorem 1, a feasible solution of the model (1) is $e_o = 1$. Given that the objective function of the model (1) is the minimization, the optimal value of the model (1) is less than or equal to one ($e_o^* \le 1$). Now, we assume that $e_o^* = 0$ *(i.e.* $\theta_o^{tp} = 0\ \ \forall t, p$). Due to semi-positive inputs and outputs, all $\lambda_j^p, \mu_j^p, \lambda_j^{'p}, \mu_j^{'p}, \eta_j^p, \gamma_j^p, \eta_j^{'p}, \gamma_j^{'p},\ j = 1, \dots, n,\ p = 1, \dots, P$ are not zero in model (1). Therefore, $\theta_o^{tp}\ \forall t, p$ could not be equal to zero. As a result, $0 < e_o^* \le 1$.

The first four constraints are related to economic indicators and the second four constraints are related to non-economic indicators and all these eight constraints are related to the first stage (preparing). The third four constraints are related to economic indicators and the fourth four constraints are related to non-economic indicators and all these eight constraints are related to the second stage (Exploitation).

The generic constraint is $\alpha_0^p \ = \frac{\sum_{i=1}^4 \ w_i^p \theta_0^\varphi}{\sum_{i=1}^4 \ w_i^p}$ which is used for normalization.

The first constraint in the economic dimension in the first stage is related to inputs, which has appeared with the principle of poor accessibility. The second constraint is related to desirable outputs, the third constraint is related to undesirable outputs and the fourth constraint represents the convexity. In Model 1, the issue of sustainability in both economic and non-economic dimensions was created in a two-stage network data envelopment analysis for the international market case. The model was case based which is completely innovative.

4 Results

4.1 Results of the Sustainability of Countries' Performance from 2010 to 2017

In the present study, for designing the network data envelopment analysis model, an attempt was made to provide a model to evaluate the sustainability of countries' performance in different periods. Certainly, the nature of countries' performances is not effective in the short term, and the success or failure of performance management in countries can be seen in the long term. Especially considering that creating a sustainable performance in non-economic indicators such as social life expectancy index or environmental pollution index does not have much effect in the short term and countries require a long time to express the ability to improve performance in many indicators and even need to pass a generation of people in the community, it is extremely important to examine the sustainability of performance. For this purpose, in the above model, the performance sustainability of countries was calculated according to all dimensions and indicators presented in Table 1 and Table 2. The total sustainability of each country in each period and the total sustainability of performance in all periods e_o^* are shown in Table 5.

Table 5: Results of the sustainability of the country's total performance in all periods

Units	Country	α^{2010}	α^{2011}	α^{2012}	α^{2013}	α^{2014}	α^{2015}	α^{2016}	α^{2017}	e_o^*
1	Azerbaijan	0.8694	0.8277	0.7829	0.8899	0.9087	0.9153	1.0000	1.0000	**0.8992**
2	Bangladesh	0.8380	0.9674	0.9763	0.9646	0.9059	0.9201	0.8739	0.8619	**0.9135**
3	Brazil	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	**1.0000**
4	Colombia	0.8908	0.9757	0.9264	0.9728	0.9456	0.9532	0.9111	0.8948	**0.9338**
5	Georgia	0.9665	0.9690	1.0000	0.9708	0.9660	0.9884	0.9800	0.9655	**0.9758**
6	Chile	0.9314	1.0000	0.9745	0.9513	0.9360	0.9271	0.9067	0.9120	**0.9424**
7	Honduras	0.9355	0.9554	0.9602	0.9558	0.9794	1.0000	0.9042	0.8843	**0.9469**
8	Kazakhstan	0.8019	0.7187	0.8210	0.8351	0.8857	0.9338	1.0000	0.9579	**0.8693**
9	Kyrgyz Rep.	0.8780	0.9835	0.9803	0.9736	0.9497	0.9833	0.9789	0.9536	**0.9601**
10	Iran, I.R.	1.0000	0.8535	1.0000	1.0000	0.9466	0.9354	0.9579	1.0000	**0.9617**
11	Indonesia	0.7365	0.7514	0.7537	0.9434	0.9430	0.9491	0.9909	0.8032	**0.8589**
12	Mauritius	1.0000	0.9892	0.9927	0.9588	1.0000	0.9989	1.0000	1.0000	**0.9924**
13	Mexico	0.9715	0.8070	0.8967	0.8575	0.9219	0.9293	0.9505	0.9273	**0.9077**
14	Pakistan	0.7987	0.9111	0.8268	0.9081	0.8362	0.8530	0.9894	0.8846	**0.8760**
15	Paraguay	1.0000	0.9106	0.9237	1.0000	0.8950	0.9247	1.0000	1.0000	**0.9568**
16	Peru	0.8490	0.7770	0.8151	0.8440	0.8154	0.8376	0.8870	0.7473	**0.8216**
17	Philippines	0.9149	0.6872	0.8932	0.9167	0.9604	1.0000	1.0000	0.9315	**0.9130**
18	Russian Fed.	0.6667	0.7616	0.7652	0.7717	0.7875	0.7809	0.7881	0.7854	**0.7634**
19	Senegal	0.6875	0.8150	0.8296	0.8670	0.8786	0.8796	1.0000	0.9349	**0.8615**
20	Tajikistan	0.9844	0.9929	1.0000	0.9752	0.9698	0.9868	0.9811	0.9890	**0.9849**
21	Turkey	0.8324	0.8734	0.9047	0.9362	0.9342	0.9896	1.0000	1.0000	**0.9338**
	Average	0.9472	.09594	0,9693	0,9722	0,9566	0,9716	0,9654	0,9636	**0,9626**

According to the results of this section and the way of implementing the network data envelopment analysis model, each unit's efficiency or inefficiency can be reviewed and analyzed independently, and countries can also be compared with each other.

4.2 Studying the Sustainability

It can be interpreted from the results of the sustainability of each country's performance in each period that Iran had been fully efficient in both economic and non-economic dimensions and both preparation and exploitation stages in the years 2010, 2012, 2013, and 2017; however, Iran had not been efficient in 2011, 2014, 2015, and 2016. Moreover, it can be understood from the results of the sustainability of each country's performance that Iran's performance in all periods and all dimensions and stages of assets was less than one and approximately equal to 0.9617. According to the results in Table 4, Brazil was the only efficient country in terms of overall sustainability in all periods.

Moreover, Table 4 indicates that Russia, in contrast to Brazil, was not in a good situation in terms of performance sustainability during 2010-2017. The average efficiency of countries for each year is presented in the last row of the table. The surveyed countries performed better on average in 2015 and 2013, which can be attributed to the global economy's growth. Table 5 can be an excellent reference for better conclusions and finding the reason for the difference between Iran's efficiency with other countries' efficiency. For example, Brazil, Mexico, and Russia were compared with Iran, but the same comparison can be made for all countries under investigation.

Table 6: Comparison of the average indicators of the four countries of the study population (2010-2017)

Indicator	**Type of Variable**	**Average for Brazil 2010-2017**	**Average for Iran 2010-2017**	**Average for Mexico 2010-2017**	**Average for Russia 2010-2017**
Foreign direct investment	Input	-65987084642	2865962	-21009462509	10624512500
Use of IMF credit	Input	4242281020	1881342151	4189554769	8334164178
Population, total	Input	201847970	75195583	119526729	143659322
Literacy rate, (adult)	Input	91/78	63/84	94/21	99/63
Scientific and technical articles	Input	50278/71	33802/63	13445/76	45328/54
Current account balance	Intermediate	-2/79	5/50	-1/75	3/20
GDP	Intermediate	2233893324010	435719457532	1179324045600	1796111335780
Inflation, GDP deflator	Undesirable intermediate	7/40	17/12	4/40	9/61
Unemployment, total	Undesirable intermediate	9/33	11/87	4/58	5/79
PM2.5 air pollution	Undesirable intermediate	14/34	38/54	24/05	17/59
Total natural resources rents	Intermediate	4/11	22/25	4/75	13/38
Labor force	Intermediate	99471951	25176836	52753760	75375599
GNI	Output	3/63	-6/12	6/41	5/08
Exports of goods and services	Output	3/80	5/87	7/64	3/21
Imports of goods and services	Output	2186622152364	437093345071	1153273937846	1741357600780
Life expectancy	Output	74/58	74/46	74/96	70/61
Current health expenditure	Output	10/05	6/69	5/48	5/06
Total efficiency		1	0,9617	0,9077	0,7634

According to Table 5, it can be seen that the country has the highest degree of efficiency that possesses the least amount of input, could provide the highest amount of desirable output, and experiences a significant reduction in the amount of undesirable output. For example, Brazil, with its negative direct investment flow (outflow) and negative current account balance during the studied period, was able to increase its GNI and spend significantly on public health. Russia was the most inefficient country in the studied period under review since it was not capable of utilizing suitable resources and also applying the appropriate indicators for preparing, such as high foreign direct investment flows, positive current account balances, high literacy rates, and the highest average of scientific production. In addition, for the best results, the country should extend more bilateral and multilateral agreements with various potential states in terms of trade and financial integrations, Samargandi, et al, [40].

According to the statistics of Iran and its comparison with Brazil, which was the only efficient country in the present study, it can be concluded that Iran, with high inflation, high unemployment, and low GDP, has not been able to make a successful preparation. Therefore, Iran, with high income from natural resources and high labor force and scientific production, has not only failed to achieve high gross national income but also had an unfavorable situation in creating environmental pollution, so that the average environmental pollution index of Iran in 2010-2017 was about ten units higher than the average rate for all countries. Accordingly, due to the high scientific output in Iran, the high level of pollution index can be considered due to weak management or poor implementation. Hence, according to the results of this study, legislators and key decision-makers are advised to design long-term management plans to reduce inflation and unemployment and increase the proper use of natural resources, labor, and educated people. Performance management is a strategic and integrated process that provides sustainable success to countries by improving performance in both economic and non-economic dimensions and also through developing the planning capabilities.

Consequently, according to the results of the present study, performance improvement programs can be applied to enhance the performance of countries in international markets. By comparing the status of inputs and outputs of each country (in economic and non-economic dimensions and preparation and exploitation stages) with the status of inputs and outputs of an efficient country, it is possible to identify the strengths and weaknesses of each country and represent a roadmap to improve that country's situation. For instance, according to the information in Table 5, a performance improvement program for Iran can be planned as the following, according to the research results for all studied countries.

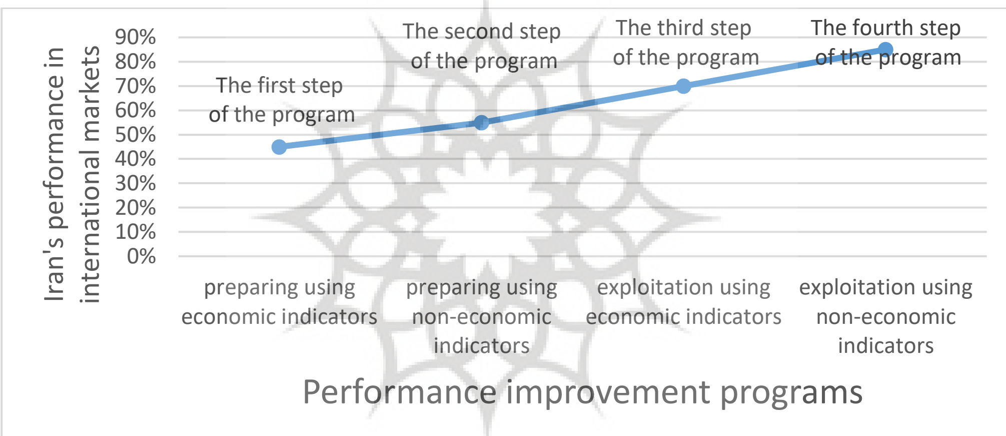

Chart 1: Iran roadmap to improve performance in international markets

In Iran, the following programs can be used to improve performance in international markets.

- The first step of planning: The programs should be prepared to increase GDP and reduce inflation in Iran using economic policies. With the increase of GDP and a decrease in the inflation rate and the economic dimension of the preparation stage, there is a slight improvement in Iran's performance.
- The second step of planning: By reducing the unemployment rate and pollution, a positive step can be taken in social and environmental dimensions, enhancing Iran's performance in the non-economic dimension and the preparation stage.
- The third step of planning: The programs should be set to enhance the value of imports and exports and increase gross domestic product. By implementing these performance improvement programs, Iran increases efficiency in the economic dimension in the exploitation stage.
- The fourth step of planning: The efforts should be made to make the best application of the appropriate data and opportunities created in the preparation stage. Accordingly, at this step, efforts

are being made to increase the life expectancy of people in the community and enhance the government's decisions to spend more money for improving the people's health in the community.

5 Conclusion

An overview of the research results indicates that in the years 2010 to 2017, most of the studied countries performed better in the non-economic dimension compared to the economic dimension, which can be attributed to a change in the community health culture. In terms of evaluating the performance, the country with the highest degree of efficiency is the country with the lowest level of input capable of providing the highest desirable output and experiences a significant reduction in undesirable outputs. For instance, Brazil has been effective in significantly increasing its national income and spending most on community health with negative flow direct investment (outflow) and negative current account balance during the studied period. Nowadays, most countries have made progress on public health, the importance of the environment, increasing community education, and scientific communities. However, due to the global economic problems and crises in 2011 and 2014, few countries among the underdeveloped and developing countries have achieved the desired economic performance.

5.1 Results and Discussion

As mentioned, the present study aimed to design a comprehensive and systematic model for performance evaluation so that it can evaluate the performance of countries in export markets and examine the level of their efficiency, inefficiency and sustainability of performance. Then, Iranian performance and its stability of performance is compared with other studied countries. To discuss and compare this research with other similar studies, a separate analysis can be made on the similarities and dissimilarities, selection and implementation of the NDEA model, how to select and categorize the indicators, considering the stability of performance over time, and the results of efficiency or inefficiency of Iran. Regarding the comparison of this article with the study conducted by Cracolici et al. [7] the performance stability has also been considered in their studies, and the sustainability of countries' performance was examined over 10 years, which is similar to the present research in terms of performance over time. Similarly, in the study conducted by Cracolici et al. [7] both economic factors and non-economic indicators have been considered (such as social indicators). It was found that only a limited number of countries in the study period could improve economic and environmental performances.

Also, by comparing the results of this article with research Tsapko-Piddubna [44] we find that, considering that the regression model has been used and human development indicators, labor force and policy structures have been used, the results of the study, like the results of the qualitative part of our research, emphasize the importance of indicators of skilled and educated labour training and human well-being in creating appropriate performance in the future. Finally, the paper states that altogether these policies would increase broad-based human economic opportunities and consequently both equality, economic well-being, and CEE economies' competitiveness in the long run. The counter-intuitive effect observed in the regression model between education and skills development policy and country's inclusive growth and development needs further investigations, as education is important for social mobility and decrease in income and wealth inequality. In addition, comparing the results of this study with the one conducted by Lovel et al. [29] indicated that they are consistent with each other in considering economic and non-economic factors. In Lovel et al. [29] study, the model was first implemented without considering the environmental indicators and then the environmental factors were added. When environmental indicators were added in the study mentioned above, the state countries significantly decreased, indicating the importance of considering non-economic indicators. In the study mentioned above, the DEA model has been used, although the model designed in the present study was NDEA-based. The innovative method of this study is an enhanced DEA method because it has features that solve all DEA deficiencies, it is called Global Performance Measurement (GEM). This model is derived from the output model of the Chanker, Charness and Cooper. According to the results of this model, Switzerland, Sweden, Germany, Norway, USA, New Zealand, Denmark and Japan were the eight countries with the highest efficiency, respectively, and the efficiency of European countries was 0.718 on average, while the average efficiency of non-European countries was 0.768. Taherinezhad, et al [42] studied about Nations performance evaluation during SARS-CoV-2 outbreak handling via data envelopment analysis. They used two-stage model with desirable-undesirable variables to measure the efficiency of 50 nations by 5 December 2020. Then, a multi-layer perceptron (MLP) network with a Limited memory BFGS (L-BFGS) optimization algorithm was proposed to predict the efficiency of nations at any time of the epidemic. In the study conducted by Ramanathan [37], the labor force, GNP, life expectancy, literacy level, etc. indicators have been used. In addition, the DEA method has been used; however, it is different from the present study in terms of classification of indicators because this study has two preparation and exploitation stages of existing platforms, which the indicators are divided into economic and non-economic dimensions. At each stage, both dimensions have been examined, which is different from the present study.

Giokas, D. I., & Pentzaropoulos [11] in a study ranked the performance of all 30 member countries of the Organization for Economic Cooperation and Development (OCED) in the field of telecommunications productivity using the combined method AHP / DEA paid. The study is based on five performance variables from 2005 for all 30 OECD countries. The five variables of these countries' performance in the field of communication were the number of accessible lines, the total number of employees in telecommunications, the number of host Internet, the total number of subscribers and the total telecommunication revenue. The DEA model used in this research is a two-dimensional output-oriented model that is used to evaluate the productivity, profitability and ranking of countries in telecommunications. This study discusses the policy implications of the results obtained and concludes by emphasizing the requirements for improving the productivity of backward countries in one or two dimensions. In this study, 8 out of 30 member countries of the Organization for Economic Cooperation and Development have had 100% asset efficiency.

Zanella et al. [50] in a study entitled "Environmental Performance Assessment of countries" has examined and fully assessed the environmental performance of countries based on data from the World Bank. In this study, it is stated that environmental performance evaluation is often done using environmental indicators. In this study, the environmental performance of 163 countries has been studied. The results showed that only Costa Rica had an efficiency of 100% and the other 23 countries had an efficiency of over 90%. Wu et al. [49] examined country performance evaluation: the DEA model approach. This study uses data envelopment analysis to evaluate the performance of 21 OECD countries and assesses whether the undesirable outputs produced are more than the desired outputs.The results show that R&D costs, a proxy variable for knowledge capital, can actually improve countries' efficiency scores. Regarding the results and analyzing the efficiency or inefficiency of Iran compared to other countries, Iran could not make a successful platform due to high inflation and unemployment and low GDP. Therefore, in the second stage, i.e. exploiting the existing platforms, it has not been successful. Considering the results analysis and its comparison with other similar research, it is worth noting that a study with these features has not compared Iran with other countries. However, in the study by Ramanathan [37] Iran has been considered. According to the research results, Iran was not an efficient country. Iran's efficiency in 1997 and 1998 was 0.600 and 0.623, respectively, which is much lower than Iran's efficiency in the present research (0.9617). This study has some limitations which should be considered in future research. First, data were collected from Homogeneous Nations. Hence, future research should consider other countries. Second, this study focused on in International Markets, thus, other sectors could be of interest for future research. Third, some limited factors were employed as input and output, therefore, other factors could be an interesting choice for future studies. Fourth, this study particularly focused on data from 2010 to 2017. Thus, newer period of time and different sample characteristics could be an interesting object for future research.

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