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Application of Multi-Criteria Decision-Making Model and GM (1,1) Theory for Evaluating Efficiency of FDI on Economic Growth: A Case Study in Developing Countries

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Abstract: Foreign direct investment (FDI) and corporate social responsibility (CSR) spending are one of the major factors in improving sustainable economic development of a country. Therefore, this study focuses on the multi criteria application of FDI and sustainability factors (CSR spending) in various developing countries to explore its impact and decision making for sustainable economic growth. The study uses a case study methodology whereby FDI, exchange rate, and CSR expenditure data from 20 countries were used to assess the efficiency in sustainable economic growth. Data were collected from the World Bank for 20 Asian and African developing countries during 2012–2017 and analyzed using GM (1,1), mean absolute percentage error (MAPE), Malmquist productivity index (MPI)-data envelopment analysis (DEA), and the slacks-based measure of efficiency (SBM) model. Correlation analysis is used to find the relationship for FDI, CSR, exchange rate, gross domestic product (GDP), and GDP per capita (GDPPC). The results of the Malmquist productivity index and the frontier effect clearly highlight that a few countries have witnessed a great improvement in terms of productivity and technological progression. Therefore, the decision makers must adopt the model of those countries with respect to sustainable development of the nation. This study helps developing nations as well as researchers to benchmark efficient countries and follow their strategies to develop a new one for utilizing FDI and CSR spending in sustainable economic development. The study also helps policy makers in multi criterion application of FDI and CSR for decision making in economic development.

Keywords: FDI; CSR spending; sustainable economic development; GM (1,1); DEA; MCDM

1. Introduction

Foreign direct investment (FDI) provides capital, foreign exchange, technology, competition, and increases reach to the foreign market. Therefore, it is considered as a very fruitful factor for the development of the economy [1]. The market measure, framework accessibility, and exchange transparency assume the biggest jobs in pulling in FDI to nations, while characteristic assets accessibility and institutional quality assume inconsequential jobs [2]. Gross domestic product per capita, farming quality included as a level of gross domestic product (GDP), and swelling impact FDI inflows adversely in created nations, while GDP per capita, exchange transparency, horticulture esteem included as a level of GDP, and framework have positive and factually critical effects on FDI inflows in creating nations. Exchange receptiveness as a level of GDP and foundation emphatically influence FDI in created nations. Institutional quality is a progressively vital determinant of FDI in created nations more than in creating nations [3]. In the recent years, it is also been seen that there is increasing competition between developing countries to attract a substantial amount of FDI by

offering incentives to the foreign investors and liberalizing trade policies [1]. Developing countries face inadequate savings and liquidity constraints, which result in the important role of FDI inflow to gain more capital in order to achieve sustainable development. However, foreign corporations and investments provide technological benefits and additional direct capital inflow, which indicates that FDI plays a crucial part in modernizing host economies and promoting sustainable growth [4]. Hence, FDI is expected to affect sustainable economic growth through directly increasing the stock of capital, encourage integration of new technologies, and knowledge transformation. FDI also enhances the existing knowledge level in the host country by introducing alternative management strategies and organization practices, which directly impact the labor productivity. Labor productivity improves performance and economics of the organization, which indirectly impacts the economy of the country [5]. However, the most obvious impact of FDI inflows is GDP growth. The transfer of advanced technology from developed countries to developing nations creates spillovers, which is an important aspect in the GDP growth of the country. It is also important that FDI have a positive and direct effect on the rate of GDP growth per capita [4,5]. FDI brings in development of the financial system, trade openness, and institutions for technological adoptions, which helps in development of GDP per capita growth rate. However, apart from FDI, CSR (corporate social responsibility) is also responsible for sustainable economic growth of a country [6].

CSR, or corporate social responsibility, implies the activities of an enterprise or organizations whereby the primary objective is aligned between financial developments and societal and environmental concerns. In a contemporary financial situation, the idea of CSR has turned out to be broadly coordinated with business ethic in all parts of the world. Organizations' voluntary CSR activities comprises of economic, environmental, and social responsibility [7]. The need for CSR is progressively more critical in developing nations where monetary incongruities are increasingly articulated and both the environment and societies are significantly and progressively powerless against human-instigated ecological dangers [6]. CSR and business ethics center principally on the strengthening of networks and social aspects, improvement of finances, development of the environment, improvement of society and cultures, and upliftment of the employees of the organization [8]. The essential elements needed to achieve high rates of sustainable economic growth include accountable governments, open and effective markets, infrastructure, capable human capital, equality of opportunity, sound environmental management, growing businesses, environmental activities, and investing in people [8]. Sustainable long-term economic growth increases revenue generation, creation of employment, environmental development, and leads to poverty reduction in developing countries [6]. CSR spending therefore plays a major role in covering these aspects for sustainable economic development.

The main aim of the study is to explore and benchmark the most efficient developing countries utilizing its FDI and CSR spending for sustainable economic development in terms of GDP and GDP per capita. The efficiency of the usage of FDI and CSR spending implicates the effective and efficient sustainable growth of the country. In order to address the research aim, it is important to address the research questions of the study. The first is what is the role of CSR spending and FDI in impacting GDP and GDP per capita (GDPPC)? The second research question is which of the chosen developing countries indicate efficient use of CSR spending and FDI? Lastly, the study needs to answer the question of how does the efficient use of multi criteria FDI and CSR spending help in sustainable economic development of the country? In this regard, the main goals and objectives of the study include identifying and benchmarking the most efficient developing country that has been using FDI and CSR spending for sustainable economic growth. Another goal of the study is to use multi criteria aspects of economic development FDI and CSR spending and monitor the efficiency of decision making for sustainable development. One last goal of the study is to indicate the use of FDI and CSR spending based on the multiple-criteria decision-making (MCDM) model with respect to policy making and sustainable development of the nation.

Efficiency is the measure of performance of either a country or a company. In other words, it is the level of performance in maximizing either its inputs or its output value. Usually, the efficiency is based on increased performance of the output either by efficiently reducing or increasing its inputs.

Since the main aim of the study is to assess the efficiency of FDI and CSR spending on economic development of the developing countries, efficiency of FDI and CSR spending indicates the efficient increase or decrease of FDI and CSR spending on increased sustainable economic development shown by rise in GDP of the country.

However, the impact of FDI on GDP may not be focused on the total, but rather the sectored distribution. The sectored distribution of GDP includes agriculture, manufacturing, industry, and services. FDI is based on these factors, such that a foreign company in the field of electronics will either invest to improve the industrial GDP or the manufacturing GDP [9]. An FDI investment in the field of agriculture will impact the overall GDP as well as the sectored GDP.

The study uses a unique method of multi criteria for the sustainable development of a developing nation. The multi criterion focuses on equivalent importance of FDI and CSR spending. These are the most important aspects in sustainable development of a nation. However, previous literature lacks the usage of multi criteria financial and sustainable aspects in decision making for sustainable economic growth. The study also uses this MCDM model in order to help policy makers identify the importance and effective strategies for sustainable economic development. Use of MCDM in data envelopment analysis is very rare but helps in identifying and benchmarking the most efficient DMUs, so that their models of efficiency can be adopted by other decision-making units (DMUs). Moreover, this study is the first to use MCDM, data envelopment analysis (DEA) analysis, and GM (1,1) whereby efficiency of multiple criteria of FDI, exchange rate, and CSR spending were shown for decision making in sustainable economic development from cases of 20 developing nations.

In this study, literature will review the concepts of MCDM, FDI, and CSR spending in economic development, and the use of DEA in similar studies. The methodology section will show the complete flow of processes used for analyzing and conducting the study. This will also present the formula and data used for the research. The analyzed data were interpreted and presented graphically, and lastly, the research questions and the research limitations have been presented.

2. Literature Review

MCDM, or multiple-criteria decision-making, is concerned with structuring and solving decision and planning problems involving multiple criteria. MCDM uses different models and theories for analyzing a decision model. MCDM is a sub-discipline of operations research and management science that explicitly considers multiple criteria in a decision-making environment [9]. It is mainly used to support decision-makers facing decision and planning problems where a unique optimal solution does not exist, and decision-makers' preferences are involved. MCDM uses a series of steps for the decision-making process that includes identifying the goal of the decision-making process, selection of the parameters and factors, and weighing methods to represent importance, inference, and decision making based on the results. Therefore, it is important in this study to use an MCDM whereby the strategies of efficient and benchmarked components can be adopted for two criteria, FDI usage and CSR spending, and decide on a plan for sustainable growth. However, according to Nakayama, Arakawa, and Yun, if decision makers can make their decisions by seeing efficiencies of components and factors, the idea of DEA (data envelopment analysis) can be applied to MCDM problems [10,11]. Since MCDM can be used with the help of DEA analysis, the current study can use multiple criteria of finances and sustainability for decision making in strategies for sustainable economic development. Therefore, the decision makers can efficiently use and adopt the multiple criteria and strategize for economic growth.

According to Lee and others, foreign investment can be driven by corporate social responsibility (CSR) [12]. FDI brings in added industrial value and productivity spillovers; technology transfer and R&D activities; and investment in human resources. FDI benefits economic growth and competitiveness through embodied technology, managerial skills, and higher productivity growth. Some works concur that the FDI commitment to development is certain yet relies upon certain variables in the host nation. Alfaro reasoned that the commitment of FDI to development relies upon the area of the economy where the FDI works. The study guaranteed that FDI inflow to the

assembling segment positively affects development while FDI inflow to the essential segment will in general negatively affect development. For the administration area, the impact of FDI inflow isn't so clear [13]. According to the 2030 Agenda for Sustainable Development, foreign investments are important for sustainable development of developing nations [14]. Therefore, CSR is a very important aspect in sustainable economic growth of developing nations. FDI is, however, driven by market liberalization that enables organizations to seek globally new outlets for their products and services and to exploit competitive advantages relating to production cost differentials, access to labor, technologies, and natural resources. On the other hand, CSR activities can help increase social welfare and sustainability by contributing to various social issues such as human capital development, environment protection, and social cohesion. Therefore, CSR spending and FDI are interrelated and have significant impact on sustainable economic development.

Deena Saleh analyzed the connection between Foreign Direct Investment and Economic Growth in Developing Countries; the principle center is around Turkey and Egypt because of likenesses between two nations as far as monetary, political and verifiable terms. A diagram of FDI; types, inspirations, and local nation factors is exhibited. Systems drawing in FDI are analyzed: Fiscal and Financial Incentives, Location Strategic and Marketing Strategies. The effect of FDI on host nations is examined. At last, the examination hole talks about variables identified with both the Egyptian and Turkish economy [15]. The researcher used the slacks-based measure (SMB) model with unexpected output and global Malmquist productivity index to solve the green technology progress index in the case of China. Statistical findings found that China's investment in developed countries can bring reverse green technology spillovers and promote China's green technology progress. However, it was therefore implied that FDI has positive impact on the outward foreign direct investment (OFDI) flows, thereby helping efficiently in sustainable growth with respect to green technology progress. Another similar study by Sun and colleagues asserted that there is a positive relationship between outward FDI and the competitiveness of Taiwanese industries [16]. The researcher used data of 15 industries in Taiwan to explore the relationship between competitiveness and expansionary and defensive outward FDI. The findings indicated that outward FDI has an impact on innovation of domestic industries and were also responsible for efficiency of the industries. These industries decrease the international market share, by allowing cost improvements channeled through reallocations that resulted in scale changes. Thus, FDI is responsible for improving the performance of industries. It is indicative from the literature that FDI has a positive impact on the economic growth of a nation and, hence, can also be used to find the efficiency of FDI in sustainable economic growth of developing nations.

However, the study by Malik and Imran contradicts the previous findings that FDI causes positive and significant impact on economic growth [17]. Malik analyzed the impact of FDI and trade openness on economic growth of Pakistan during the period of 2008 to 2013. The researcher used the variables FDI, trade openness, and domestic capital to address the negative impact on economic growth. It was interpreted that policy reformulation and government-related factors were responsible for the poor economic growth in Pakistan. Malik's study was supported by the study of Zahid Awan, who conducted a study to find the impact of FDI on GDP during the period 1971–2008 [18]. The study indicated a negative impact of gross fixed capital formation, degree of trade openness, inflation rate, and current account balance on the economic growth of Pakistan. Similarly, the study by Sakib found that FDI, nation's debt, trade, and inflation showed a negative impact on GDP for the years 1981 to 2010 [19]. Thus, FDI may either have a positive or negative impact.

The study focuses on Schumpeterian growth theory as the operational zed FDI and CSR notion models and focuses on the sustainable growth process [20]. In addition, the relationship between CSR and FDI towards economic growth and development with the notion of appropriate growth institutions has been focused on. This theory not only focuses on macroeconomic structure of economic growth of a country, but also the microeconomic issues regarding incentives, policies, and organizations. Similarly, this study includes the macroeconomic factors of FDI and exchange rate as well as corporate social responsibility as macroeconomic policy and macroeconomic incentive. It is

also evident from the Schumpeterian growth models focusing on firm dynamics, which are CSR responsibilities and economical reallocation of resources.

According to a study by Hoque and colleagues, CSR spending is motivated towards social and economic development of the nations as well as the community [21]. Corporate social responsibility (CSR), its goals, and practices have always shown an impact on business, society, and the economy. However, the use of CSR by corporations is mainly to show the philanthropic nature of the corporations and is not motivated towards economic growth of the company as well as the country. The study also found that the corporations involved in CSR spending have inadvertently helped in the sustainable financial development of the company as well as the nations. Similarly, Hopkins investigated the impact of CSR on sustainable economic growth of the developing nations India, Bangladesh, Sri Lanka, and Kenya [22]. It was found that investments by foreign nations as a part of their CSR strategy has helped these countries in improving their economic conditions. The CSR spending by the corporation of India and Sri Lanka has also helped them in environment, education, health and hygiene, and socio-economic development. Thus, these findings have helped in improving the financial as well as the economic conditions of the country. Lastly, another study by Aaijaz and bin Ibrahim on the CSR in Malaysia found that CSR stands to be of vital importance for a mutual and symbiotic growth [23]. The study found that CSR was very important for adoption of economic and financial strategies both by the private corporations as well as FDIs. The study indicated that CSR spending has led towards globalization of increased FDI, which, in turn, has helped in the sustainable economic development of Malaysia.

On the other hand, This paper intends to explore observationally the effect of FDI on financial development for Azerbaijan, Kyrgyz Republic, Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan over the period 1997-2010. The Johansen cointegration and Granger causality tests are utilized so as to break down the causal connection among FDI and monetary development. It is essential to see the headings of causality between two factors for the arrangement creators to energize private segments. The cointegration test results demonstrated that FDI and Economic Growth factors are cointegrated for Azerbaijan and Turkmenistan. By utilizing Granger Causality test we found that FDI causes GDP for Azerbaijan and bidirectional causality is watched for Turkmenistan [24]. Another study by Argiro et al, this research endeavors to address the causal-request between internal FDI and monetary development utilizing a board informational index for two distinctive Economic Associations that is EU (European Union) and ASEAN (Association of South Eastern Asian Nations) over the period 1970-2003. The inflows of FDI to created have nations bring up the issue of how these inflows influence their economies and what is the communication among FDI and development [25]. Supporting the findings of FDI impact, Sharmiladevi pointed out that FDI is a critical factor in the globalization procedure as it gives openings and budgetary difficulties around the globe advances steady and enduring monetary connections between nations through direct access to speculators in home economies to generation units of the host economies. Understanding the impact/effect of internal FDI on monetary development is a dynamic region to think about for analysts, as the observational proof on effect of FDI inflow on and financial development are blended, which merits crisp enquiry [26].

Thus, the literature indicates that sustainability variables and financial variables have direct and positive impacts on the sustainable development of developing nations. Thus, the use of FDI, exchange rate, and CSR spending in the current study will help the decision makers for planning efficient sustainable economic development. However, the literature also found certain gaps in knowledge, whereby very few studies have studied and included MCDM and DEA for efficiency measurement and decision making. There is also a lack of studies using FDI and CSR spending to find efficiency measures and their impact on sustainable growth of developing nations. Lastly, no studies combine DEA, Grey forecasting, and MCDM for exploring the efficiency of FDI and CSR spending on sustainable economic growth of developing nations.

3. Materials and Methods

3.1. Research Development Flow

The study applies the GM (1,1) model to forecast the FDI inflows impacting the economic growth of DMUs represented by the set of developing countries. The study also uses Malmquist data envelopment analysis (MPI) and slack-based measure of efficiency (super SBM) to find the efficiency of the decision-making units (DMUs). The process of conducting the study is defined in the figure 1 as follows:

Step 1: Identification of the objectives

The objectives of the study have been identified on the basis of current FDI inflows and CSR spending of the developing countries and their impact on sustainable economic growth. These multiple criteria will also help decision makers model efficient methods for CSR spending and FDI for sustainable development of the nation.

Step 2: Literature review

Following the investigation and background about the topic, the present study identified previous literature to understand the current knowledge of the study. This chapter also includes a review of MCDM and literature on the use of FDI and CSR spending for sustainable development in the developing nations.

Step 3: Research methodology

An exploratory study was conducted whereby data envelopment analysis and prediction was done to assess the impact and efficiency of FDI and CSR spending on sustainable economic growth of the nations. Prediction model used GM (1,1) to predict the data available for DMUs from 2012 to 2017. This method of prediction is highly reliable and suitable with the data of DMUs. On the other hand, DEA models were used for estimating the efficiency and performance of the DMUs. Malmquist DEA was conducted whereby the slacks of the variables and SBM model helped in ranking of the DMUs. Finally, the multi-criteria factors FDI and CSR spending were used for decision making of sustainable economic growth of the nations.

Step 4: Research planning

Following this, the researcher defines the major process and tasks that are planned to manage the time and work in an efficient manner. The research planning also comprises all the methods and techniques used in conduction of the study.

Step 5: DMUs collection

The information in regard to the economic and CSR spending parameters in the developing countries has been collected from the World Bank database. Data were collected for 20 developing countries.

Step 6: Input and output collection

FDI inflows, exchange rate, and CSR spending are taken as input variables and the output variables include GDP growth and GDP growth per capita for the period 2012 to 2017. The data was collected from the World Bank database.

Step 7: Pearson correlation method

Then, the researcher records the coefficients are recorded in order to check the correlation between inputs and outputs. The correlation will show the degree of relationship between all the variables.

Step 8: Malmquist DEA analysis and super-SBM model

Analysis of the DMUs for efficiency of the FDI and CSR on GDP and GDPPC using Malmquist DEA from 2012 to 2017 for 20 developing nations was done. The sequence of DEA analysis was then arranged according to the super-SBM model.

Step 9: Grey model prediction

We used the data of economic and sustainability parameters of 20 DMUs 2012–2017 and applying grey GM (1,1) model to predict the economic growth in 2018 and 2019. Mean absolute percentage error (MAPE) was applied to verify the accuracy of the model and to calculate the predicted errors.

Step 10: Conclusion

The last step is to analyze results from the findings and then conclude to address the aim of the study. The findings will help in attributing the multi criteria towards decision making for sustainable economic development.

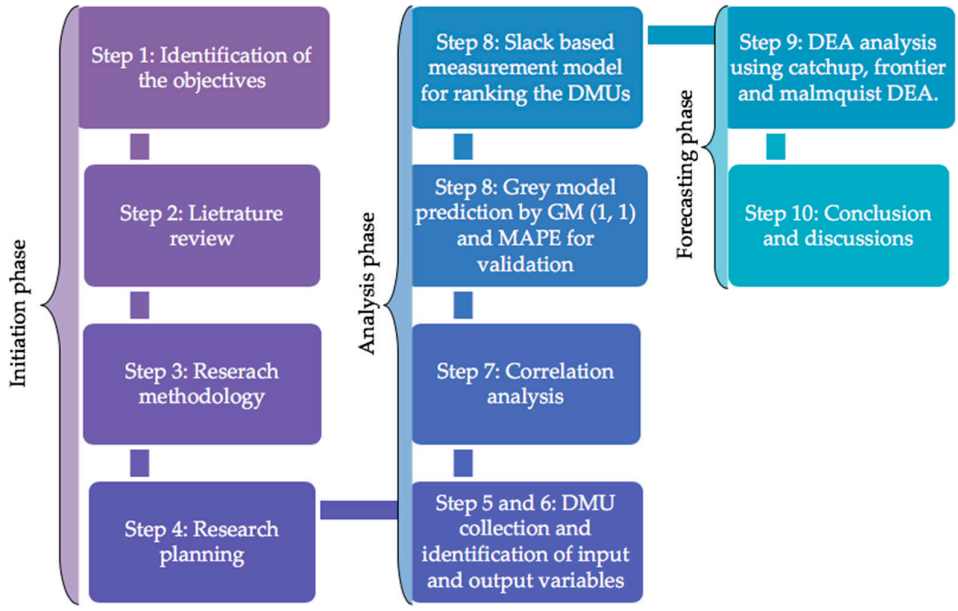

Figure 1. Research framework.

3.2. DMU Collection

After researching and studying the economic growth in developing countries, data for the decision making units (DMUs) denotes the countries i.e., Argentina, Bangladesh, Cambodia, Chad, China, Costa Rica, Ghana, Guatemala, Guyana, Indonesia, Iraq, Kazakhstan, Kenya, Libya, Maldives, Myanmar, Nigeria, Thailand, and Vietnam from the World Bank database [27]. Table 1 show the 20 selected countries. The choice of countries comes from the fact that the majority of developing countries are also the largest markets for developed nations to invest in for the growth and development of the host nation as well as the investing nation. According to the World Bank, developing nations are usually found in Asian, African, and South American continents, and these continents also produce the largest economies and markets. The study collected data from majority of the African and Asian countries and few from the South American countries, as they are the largest market for developed nations. In addition, the data for CSR spending was also found for these countries, but only for the period 2012–2017. Therefore, the study gathered data for FDI and CSR spending from the chosen 20 countries spread over the major continents.

GDP and GDP per capita are used as output variables and FDI, exchange rate, and CSR spending were used as input variables for the analysis of the super SBM model. For the GM (1,1) forecasting model, the data of all these economic parameters were used to predict the economic growth of developing countries.

Table 1. List of 20 developing countries as 20 decision-making units (DMUs).

No	DMU	Countries	No	DMU	Countries
1	DMU1	Argentina	11	DMU11	Iraq
2	DMU2	Bangladesh	12	DMU12	Kazakhstan
3	DMU3	Cambodia	13	DMU13	Kenya
4	DMU4	Chad	14	DMU 14	Libya
5	DMU5	China	15	DMU15	Maldives
6	DMU6	Costa Rica	16	DMU16	Myanmar
7	DMU7	Ghana	17	DMU17	Nigeria
8	DMU8	Guatemala	18	DMU18	Pakistan
9	DMU9	Guyana	19	DMU19	Thailand
10	DMU10	Indonesia	20	DMU20	Vietnam

GDP growth and GDP growth per capita of the 20 developing countries were taken as output variable, whereas FDI, exchange rate, and CSR defined in terms of USD are considered as input variables in the data envelopment analysis (DEA) approach. The inputs/outputs element will directly impact the results of the analysis and evaluation. The values for inputs and outputs have been provided in the Appendix A Figure A1. The description for inputs and outputs have been presented underneath.

1. Input variables:
    a. FDI: Foreign direct investments in the developing nations shown in percentage (%); the data were collected from the World Bank database. The FDI considered here are both Greenfield and Brownfield types of investment, and the FDI for no particular sector, but an overall FDI in the chosen countries.
    b. Exchange rate: Exchange rate shown in USD; the data were collected from the World Bank database. It is considered as one of the important factors reflecting the level of economic development of each country.
    c. CSR spending: Corporate social responsibility spending by the countries in total from their profits as vales in USD, and the data were collected from World Bank.
2. Output variables:
    a. Gross domestic product (GDP): The total economic growth of the nation's output value of production shown as % value; the data were collected from the World Bank database.
    b. GDP per capita (GDPPC): The total economic growth of nation's output value of production on the basis of per person shown as a percentage (%) value; data were collected from World Bank database.

3.3. GM (1,1) Model

The Grey forecasting model is a method of prediction under the common technique based on modeling and controlling partial information. The objective of this technique is to assist the policy makers for making critical decisions and future predictions [28]. It includes analysis, modeling, forecasting, and controlling on the basis of theory even when the partial information is not known [29]. According to the definition of Zhou, "The grey model (GM) is a theory of analysis, modeling, forecasting and controlling for studying grey system that partial information is known, partial information is unknown" (p. 363). The formula for the GM (1,1) forecasting is presented underneath.

- As an initial step, it is necessary to check the feasibility of the GM (1,1) model. The judgment criteria are whether the original sequence compares to the ratio.
- Following this, generate a new set of data series X(i)

$$X(i) = x'_1, x'_2, x'_3, x'_4, \ldots x'_n. \quad (1)$$

- Calculate x_i using

$$x_i' = \sum_{j=1}^{j=i} x_j'. \quad (2)$$

- Then, construct a matrix:

$$\begin{bmatrix} -\frac{1}{2}(x_1' + x_2') & 1 \\ -\frac{1}{2}(x_2' + x_3') & 1 \\ -\frac{1}{2}(x_{t-1}' + x_t') & 1 \end{bmatrix}. \quad (3)$$

- Then, to construct vectors:

$$Y = (\, x_2 + x_3 + x_4 + \ldots + x_t\,)^{T}. \quad (4)$$

- To create GM (1,1) model, use the formula:

$$dx'/dt + \alpha x' = \beta. \quad (5)$$

- To solve the forecasting model, use the formula:

$$x_{t+1}' = (x_1 - \beta/\alpha)e^{-\alpha} + \beta/\alpha, \quad (6)$$

$$x_{t+1}' = x_{t+1}' - x_t', \quad (7)$$

$$\begin{bmatrix} \alpha \\ \beta \end{bmatrix} = (B^T B)^{-1} (B^T Y). \quad (8)$$

After following the above steps, the researcher comes to the calculation in Ms excel. This models some sort of complex calculation including matrix inverse operation, matrix transposition, matrix multiplication, etc., in excel.

Mean absolute percent error (MAPE) was used to verify the accuracy of the forecast. If MAPE has a lower percentage, the forecast value is typically close to the actual value. It offers multiple advantages in terms of scale independency and interpretability. If Ai and Fi denote the actual and forecasts the values of the data point I, respectively, then the value of MAPE can be calculated using the formula:

$$\text{MAPE} = \frac{1}{n}\left[\sum_{i=0}^{n} \left|\frac{A_i - F_i}{A_i}\right| * 100\right].$$

The interpretation of the value of MAPE defined [30] is that,

- <10% is excellent forecasting ability;
- 10%–20% is good Forecasting ability;
- 20%–50% is reasonable forecasting ability;
- 50% is poor forecasting.

3.4. DEA Models

For the creation of DEA methodology for economic parameters, DMUs represent the set of 20 developing countries developing countries. DEA will assist the researcher in identifying the developing countries impacted by the FDI inflows. The input variables are indicated in terms of percentage of GDP and the output variable are in terms of GDP growth.

3.4.1. Malmquist Productivity Index (MPI)

The Malmquist productivity index concept was originally developed for analyzing the consumption of inputs by S Malmquist [31]. Later it was used as a productivity index—directly from input and output data by using DEA [32], it was defined as DEA-MI and was also applied in various fields as a tool to measure the productivity change of DMUs over time. According to the definition of Fare, "Malmquist productivity index is a binary comparison of two entities, in empirical applications usually the same unit at different points in time, but we may also compare different units at the same point in time" (p. 80), the formula for which is presented underneath.

Suppose there are 'n' DMUs, where each country is consuming 'm' different inputs for the production of 's' different outputs. x_{rj}, y_{rj} represent the i^{th} input and r^{th} output, respectively, of the jth DMU at time t [33].

$$D^t_o (x^t_o, y^t_o) = \text{Minimize } \theta, \quad (9)$$

Subject to

$$\sum_{j=1}^{n} \lambda_j x^t_{ij} \leq \theta x^t_{io}, \; i = 1, 2, \ldots, m,$$

$$\sum_{j=1}^{n} \lambda_j y^t_{rj} \leq \theta y^t_{ro}, \; r = 1, 2, \ldots, s,$$

$$\lambda_j \geq 0, \; j = 1, 2, \ldots, n.$$

If the value of $\theta = 1$, then DMU will be efficient and its input–output combination lies on the efficiency frontier. If the value of $\theta < 1$, then DMU will be inefficient and its input–output combination lies inside the efficiency frontier.

$D_o^{t+1}\left(x_{o,}^t y_o^t\right)$ can be obtained and it compares $(x_o^t, \; y_o^t)$ to the frontier at time t+1. Therefore, MPI measures the productivity change of a particular DMU_0 at time t+1 and t, can be shown by the following equation:

$$MI0 = \left[\frac{D_o^t (x_0^{t+1}, y_0^{t+1})}{D_o^t (x_{o,}^t y_o^t)} \frac{D_o^{t+1} (x_0^{t+1}, y_0^{t+1})}{D_o^t (x_{o,}^t y_o^t)}\right]^{1/2}, \quad (10)$$

where MI_0 shows progress in the total factor productivity of the DMU_0 from the period t to t+1, while $MI_0 = 1$ and $MI < 1$ indicates the status quo and decay in productivity, respectively [31].

MPI can be decomposed into efficiency change and technical change. MPI > 1 represents productivity improvement. If MPI = 1, there is no productivity change and if MPI < 1, there is productivity reduction.

$$MPI = \frac{D_o^{t+1} (x_0^{t+1}, y_0^{t+1})}{D_o^t (x_{o,}^t y_o^t)} \left[\frac{D_o^t (x_0^{t+1}, y_0^{t+1})}{D_o^{t+1} (x_{o,}^{t+1} y_o^{t+1})} \frac{D_o^t (x_o^t, \; y_0^t)}{D_o^{t+1} (x_{o,}^t y_o^t)}\right]^{1/2}, = \text{Efficiency change} \times \text{Technological change} \quad (11)$$

3.4.2. Super SBM (Slack-Based Measure of Efficiency)

The super SBM model is used to measure the overall efficiency of the model of the DMUs. The analyses are generated using the DEA software [34,35]. According to the definition of Morita [36], "The optimal solution reveals the existence, if any, of a surplus in inputs and a shortage in outputs called slacks and slack-based measure helped to evaluate the efficiency based on the slack values of input and output variables" (p. 358).

Input and output matrix is (X, Y), where $X = (x_{ij}) \in R^{mxn}$ and $Y = (y_{ij}) \in R^{sxn}$. λ is a nonnegative vector in R^n. The vector $S^- \in R^m$ and $S^+ \in R^s$ shows an excess input and a short falling output, respectively [37]. The SBM model is given by following equation [38]:

$$\min \varrho_0 = \frac{1 - (1/m) \sum_{i=1}^{m} s_i^- \; / \; x_{i0}}{1 - (1/s) \sum_{i=1}^{m} s_i^- \; / \; y_{i0}}, \quad (12)$$

Subject to:

$$x_0 = X \lambda + S,$$

$$y_0 = Y \lambda + S^+$$

$$(\lambda \geq 0, X \geq 0, Y \geq 0).$$

Suppose (ϱ^*, λ^*, s-*, s+*) is the optimal condition of SBM and (x_0, y_0) is SBM efficient of DMU. When $\varrho^* = 1$, s-* = 0 and s+* = 0. Hence, a super-efficiency model was developed for ranking DMUs, and it was shown by the following formula [39].

$$\min \delta = \frac{1/m \sum_{i=1}^{m} \bar{x}_i / x_{io}}{1/s \sum_{r=1}^{s} \bar{y}_i / y_{io}}, \quad (13)$$

Subject to:

$$\bar{x} \geq \sum_{j=1, j\neq 0}^{n} \lambda_j x_j,$$

$$\bar{y} \leq \sum_{j=1, j\neq 0}^{n} \lambda_j x_j,$$

$$\bar{x} \geq x_o$$

$$\bar{y} \geq y_o,$$

$$\bar{y} \geq 0,$$

$$\lambda \geq 0.$$

The super SBM model gives a value of the objective function which is greater or equal to one. The higher the value, the more efficient the unit [40].

4. Empirical Results

In order to evaluate the efficiency of FDI on the economic growth, the researcher provides the results of the data analysis in this chapter. For this purpose, this chapter presents the descriptive statistics, MAPE and correlation, DEA Malmquist efficiency, super SBM, and GM (1,1) forecasting.

4.1. Descriptive Analysis

Table 2. Descriptive analysis of inputs/outputs for 20 developing countries.

	2012	2013	2014	2015	2016	2017
Mean values						
(I) FDI	4.300222	4.1337	3.241317	3.777846	3.81397	3.613895
(I) Exchange rate	1895.341	1968.24	2055.931	2179.402	2201.425	2235.44
(I) CSR	8.26×10^{13}	9.04×10^{13}	1.06×10^{14}	1.09×10^{14}	1.72×10^{14}	1.46×10^{14}
(O) GDP	11.72395	4.627784	3.247418	3.740674	3.631044	5.528482
(O) GDPPC	9.998527	2.915393	1.569377	2.101911	2.028486	3.934829
Median Values						
(I) FDI	2.812205	3.38	2.297729	2.388213	1.544243	2.113612
(I) Exchange rate	121.2538	126.88	129.8264	147.6048	155.6346	155.9776
(I) CSR	1.70×10^{12}	1.7×10^{12}	1.85×10^{12}	1.87×10^{12}	1.90×10^{12}	1.32×10^{12}
(O) GDP	5.653178	5.63	4.840688	3.988543	4.594821	4.976562
(O) GDPPC	4.697757	4.15	2.900515	2.511485	3.144485	3.648149
Standard deviation values						
(I) FDI	3.212752174	3.085967241	3.549387923	2.659336604	3.951083016	2.674947
(I) Exchange rate	4841.12459	4945.831676	5112.599642	5362.453706	5392.712858	56935436.77
(I) CSR	231780205431866	2.4951×10^{14}	2.90871×10^{14}	3.04179×10^{14}	3.99725×10^{14}	3.3488×10^{13}
(O) GDP	25.73247311	4.532824874	6.73945103	3.368720558	3.994174652	4.016798263
(O) GDPPC	26.07415055	4.154884321	6.409869073	3.342767573	4.070637734	4.975242728

Table 2 indicates the mean and median values of the input and output variables. The mean values of the FDI inflows and GDP growth and GDP per capita growth fall over time. On the other hand, the mean and median values of the exchange rate increase over time. This is evident from the fact that the FDI of few countries like Argentina, Kenya, Nigeria, Kzakasthan, and others had decreased FDI between 2012 and 2017. On the other hand, FDI of countries like Vietnam, Iraq, China, Guatemala, and few others have increased rates of FDI. Similarly, the exchange rates of these countries decreased with the increased FDI. On the other hand, the exchange rate increased for the countries with poorer FDI. However, CSR of the countries indicated a steady growth over the years of 2012 to 2017, except for a few that were modulated by the rate of FDI and exchange rate. Countries with lower FDI for a year also indicated decreased CSR spending. Therefore, it may indicate that the growth of FDI and CSR spending are congruent to each other, as increased FDI will improve the economy of the country and this will improve the financial position of the corporations. In this case, the CSR will also rise, and vice versa. This is indicated by the descriptive findings of the data chosen.

4.2. Pearson Correlation

Pearson correlation analysis was utilized to analyze the relationship between inputs and outputs factors. The Pearson relationship coefficient in the analysis was determined throughout the years. Pearson connection coefficient to decide the information was utilized in this analysis, which is inappropriate for the DEA necessities. Connection coefficients are dependable from the dimension of (−1) to (1); if this factor is close to (1), it is an ideal straight connection. After effects of the Pearson connection coefficient from Table 3 and Appendix A Figure A2 demonstrate that the elements utilized in this analysis have a solid straight relationship, which is steady with the states of DEA and can be utilized for analysis. In this regard, the study conducted by Tintin [41] revealed that the relationship between FDI, economic growth, and productivity in developing countries can only be established in the long run. Some of the developing economies, like Nepal and Iraq, face several political and legal barriers in the context of foreign direct investment. In addition to this, the positive impact of FDI on economic growth and productivity is partly verified in developing countries. This is because there is a key element of technology rather than FDI and international trade that play a major role in the economic growth of the developing countries.

The correlation findings indicated that FDI and GDP are positively correlated. This is from the fact that FDI is invested in by a foreign nation, usually a developed nation, to improve the economic conditions of the host nation as well as improve resource utilization. One of the most important facts is that the profit needs to be higher than the costs of communications, transportation, and other barriers due to language, policies, and culture. In this respect, the receiving country remains as the financial inflow and use to improve its resources and financial outflow for the investing country/firm to influence its presence in the receiving country. This helps the receiving country to better utilize its economy and its resources to stabilize the country. Similarly, FDI is also impacted by the CSR policies and activities. CSR activities lead to sustainable utilization of its resources, causing economic and social benefits. This, in turn, helps the receiving country better implement strategies of social, economic, and environmental responsibilities.

Table 3. Correlation results in 2012.

2012	FDI	Exchange rate	NFA	GDP	GDPPC
FDI	1	0.114452231	0.101948393	0.178335512	0.175836882
Exchange rate	0.114452231	1	0.750814682	0.087061726	0.080994309
NFA	0.101948393	0.750814682	1	0.075397665	0.070300221
GDP	0.178335512	0.087061726	0.075397665	1	0.999313151
GDPPC	0.175836882	0.080994309	0.070300221	0.999313151	1

4.3. MAPE

Table 4 compares the productivity across different countries in order to rank countries that are generated by optimally utilizing the input variables are presented in the table below [42]. The best productivity is shown by Libya, however this DEA does not show benchmarking values and it is suggested that, to benchmark the countries for the same time period, multistage DEA can be performed. The forecast is calculated by the actual data, and if the errors are in the allowable range, then it will be a reliable and usable model for the study [43]. The forecasted results of this study have a high level of accuracy, as average MAPE of 20 DMUs is 8.21% as in Table 5. If MAPE is smaller, the volatility in forecasts will be less, so the slacks-based measure of efficiency can be predicted.

Table 4. Comparing the productivity among DMUs.

DMU	Score	Rank
Argentina	6.691818	5
Bangladesh	3.183123	9
Cambodia	0.942166	17
Chad	3.583169	8
China	5.957026	6
Costa Rica	1.241669	14
Ghana	19.00478	2
Guatemala	2.341989	10
Guyana	1.453401	12
Indonesia	0.962719	16
Iraq	14.77137	3
Kazakhstan	0.292901	20
Kenya	11.07297	4
Libya	890.5083	1
Maldives	5.361731	7
Myanmar	1.443307	13
Nigeria	1.703518	11
Pakistan	1	15
Thailand	0.847998	18
Vietnam	0.308264	19

Table 5. Average mean absolute percentage error (MAPE) value of 20 DMUs comparing the productivity among DMUs.

DMU	Country	Average MAPE %
DMU1	Argentina	28.41%
DMU2	Bangladesh	4.36%
DMU3	Cambodia	9.45%
DMU4	Chad	3.66%
DMU5	China	3.13%
DMU6	Costa Rica	1.69%
DMU7	Ghana	7.31%
DMU8	Guatemala	4.41%
DMU9	Guyana	10.87%
DMU10	Indonesia	4.82%
DMU11	Iraq	19.97%
DMU12	Kazakhstan	5.56%
DMU13	Kenya	7.75%
DMU14	Libya	4.09%
DMU15	Maldives	21.2%
DMU16	Myanmar	1.91%
DMU17	Nigeria	2.67%
DMU18	Pakistan	4.13%
DMU19	Thailand	11.01%
DMU20	Vietnam	7.83%
	Average of 15 DMUs	8.21%

4.4. GM (1,1)

The Grey forecasting mode has been used by the researcher to evaluate the efficiency of FDI on economic growth in 20 developing countries 2012–2017, which are shown in Tables 6–8. It was assessed that forecasting values of 2015 for the 20 countries worked out because MAPE (mean absolute percentage error) is small with 8.21%. Average MAPE of the 20 DMUs is less than the 10%

limit. Therefore, based on the rules, the forecasted results in this study have a high level of accuracy. Here, the MAPE is small, therefore there will be less volatility in forecasts; it is also called the slacks-based measure of efficiency (SBM) [40]. The forecasted values using the Grey method indicate the rate of rise of both Greenfield and Brownfield FDIs in the chosen developing nations. Moreover, the forecasted values show the rise in CSR spending and FDI, and their impact will also raise the GDP of the chosen nations for the years 2018, 2019, and 2020. However, a few countries may have a negative impact on their GDP due to poor growth of FDI and CSR spending and increased exchange rates. This collaborated how current structure of FDI and CSR spending has an impact on the economy of the nations and how they cause rises in the exchange rate.

Forecasted values of the data indicate the expected amount of FDI the chosen developing nation may expect during the years 2018 to 2020. However, this must help the governments and the authorities of the developing nation to plan for effective and sustainable expenditure of the FDI for economic growth. In addition, the data also shows the needed amount of CSR expenditure to meet the needs of efficient resource utilization. Effective resource utilization will help the country in efficient economic growth and attract more FDI. Furthermore, it indicates that the FDI may increase in any of the following sectors of GDP: Agriculture, industry, manufacturing, and services.

Table 6. Predicted values of 2018 by Grey forecasting.

DMUs	Inputs			Outputs	
	FDI	**Exchange Rate**	**CSR**	**GPD**	**GDPPC**
Argentina	1.622597	6.826187	4.224391859	5.525289	4.874841
Bangladesh	1.378895	78.88855	40.13372367	59.51114	49.82243
Cambodia	11.2997	4041.375	2026.337349	3033.856	2530.097
Chad	4.993812	522.6079	263.8008603	393.2044	328.5026
China	2.43133	6.219753	4.325541697	5.272648	4.799095
Costa Rica	5.848197	518.8878	262.3680064	390.6279	326.498
Ghana	7.980594	2.579417	5.280005571	3.929711	4.604858
Guatemala	2.111944	7.769367	4.940655429	6.355011	5.647833
Guyana	5.881685	205.6754	105.7785508	155.727	130.7528
Indonesia	2.09318	11275.62	5638.858265	8457.241	7048.05
Iraq	1.543156	1166.375	583.9590779	875.167	729.5631
Kazakhstan	5.947617	175.5404	90.74401663	133.1422	111.9431
Kenya	1.526369	89.18827	45.35732184	67.2728	56.31506
Libya	1.3879	1.296741	1.342320323	1.319531	1.330925
Maldives	9.223382	15.36957	12.29647497	13.83302	13.06475
Myanmar	4.263292	930.2962	467.2797648	698.788	583.0339
Nigeria	1.036572	166.4509	83.74373935	125.0973	104.4205
Pakistan	0.643156	99.72336	50.18325988	74.95331	62.56829
Thailand	2.245069	32.13415	17.18961058	24.66188	20.92575
Vietnam	5.550692	21151.75	10578.64837	15865.2	13221.92

Table 7. Predicted values of 2019 by Grey forecasting.

DMUs	Inputs			Outputs	
	FDI	Exchange rate	CSR	GPD	GDPPC
Argentina	1.175702	8.044883	7.06×10^{11}	2.343233	2.558359
Bangladesh	1.323651	78.15896	1.87×10^{12}	7.198837	6.013214
Cambodia	10.38307	4048.875	2.34×10^{13}	6.883909	5.267612
Chad	5.4214	536.1575	1.30×10^{12}	4.604649	8.314397
China	2.103562	6.196892	8.99×10^{12}	6.8	6.168845
Costa Rica	5.665175	530.5903	8.12×10^{11}	3.674083	2.865371
Ghana	8.432425	3.049072	9.94×10^{10}	6.11453	2.60775
Guatemala	1.846392	7.718805	1.03×10^{15}	2.926409	0.967754
Guyana	4.329658	206.2082	1.58×10^{11}	3.1204	2.587685
Indonesia	1.868254	12176.75	3.38×10^{14}	5.05048	3.864745
Iraq	1.323102	1166.569	3.40×10^{13}	5.890044	6.707532
Kazakhstan	6.315246	192.1535	2.77×10^{13}	2.55	0.894517
Kenya	0.953066	91.76296	1.92×10^{11}	5.377319	2.962332
Libya	1.375768	1.316784	5.90×10^{10}	14.73567	9.036705
Maldives	9.089197	15.3721	6.25×10^{12}	7.495807	4.553891
Myanmar	5.116735	1025.752	9.85×10^{12}	6.120411	5.031326
Nigeria	0.856286	172.4813	3.36×10^{12}	1.215706	3.562975
Pakistan	0.752147	101.1976	-2.70×10^{10}	5.613679	3.492789
Thailand	1.396504	32.9539	5.90×10^{12}	3.592829	3.140663
Vietnam	5.728411	21332.44	1.03×10^{15}	6.511529	5.249353

Table 8. Predicted values of 2020 by Grey forecasting.

DMUs	Inputs			Outputs	
	FDI	Exchange Rate	CSR	GPD	GDPPC
Argentina	1.237697	8.7611	7.06×10^{10}	2.3479	2.559
Bangladesh	1.598821	78.4522	1.85×10^{14}	7.199	6.01356
Cambodia	11.16702	4049.212	2.34×10^{12}	6.887901	5.2689
Chad	5.378105	538.129	1.30×10^{10}	4.60721	8.3191
China	1.987762	6.10086	7.19×10^{12}	6.9134	6.16972
Costa Rica	5.436101	530.9877	8.89×10^{13}	3.67519	2.8695
Ghana	7.229053	3.04679	9.21×10^{10}	6.11514	2.6021
Guatemala	1.127996	7.9857	1.27×10^{14}	2.92793	0.9645
Guyana	4.447296	206.3491	1.65×10^{10}	3.1238	2.5878
Indonesia	1.673427	12177.79	3.76×10^{12}	5.05121	3.8656
Iraq	1.591105	1166.969	3.90×10^{10}	5.890061	6.70219
Kazakhstan	7.269014	193.072	2.17×10^{15}	2.59	0.89912
Kenya	1.552479	91.7926	1.19×10^{12}	5.379021	2.9976
Libya	1.976921	1.9028	5.61×10^{11}	14.73146	9.03678
Maldives	10.27819	16.0471	6.44×10^{12}	7.497809	4.554221
Myanmar	5.968945	1025.873	9.67×10^{11}	6.120921	5.0391

Nigeria	1.529017	172.4901	3.31×10^{11}	1.219901	3.5645
Pakistan	0.862964	102.017	-2.30×10^{11}	5.61189	3.49347
Thailand	1.988571	32.956	5.40×10^{13}	3.596779	3.1408
Vietnam	6.19792	21332.62	1.09×10^{14}	6.514292	5.24978

4.5. DEA Model

Super SBM Efficiency

The slack-based model has been used in order to improve the existing model that can generate efficiency in the existing model. In the present study, the model evaluates the technical efficiency of the 20 developing countries [41]. From DEA super SBM model, it is analyzed that Libya is the most efficient amongst the 20 DMUs in 2012–2017. This is from the fact that Libya has an important standing in the world economy and a different political and economic system. Moreover, in Libya, socialist and Islamic factors have impacted on the nature of corporate social responsibility disclosure (CSRD) [44]. As a result, the level of CSRD has increased in Libya since 2000 due to pressures from stakeholders for information which may influence organizational performance for Libyan companies. Libya has a unique economic, political, and social system. The Libyan economy is neither a classical political economy nor a bourgeois political economy. Studies have indicated that Libyan social environment have influenced CSR and CSRD [45]. It has also showed the importance of CSRD, and stakeholders' pressure in particular, after the establishment of a stock market in Libya. Figure 2 clearly highlights that Libya has shown consistent efficiency among the entire decision-making units. Since the slack-based measure deals directly with the input excesses and the output shortfalls of the decision making unit (DMU), it shows that the inputs are in excess for Libya, in comparison to the output received. Therefore, the country may reduce its inputs to increase its outputs. The measure also indicates that Libya is the only country that shows input excess and output shortfall. The measure of slacks also indicates that the measures of Libya are determined only by consulting the reference set of developing nations and is not affected by analysis for 2012 to 2017.

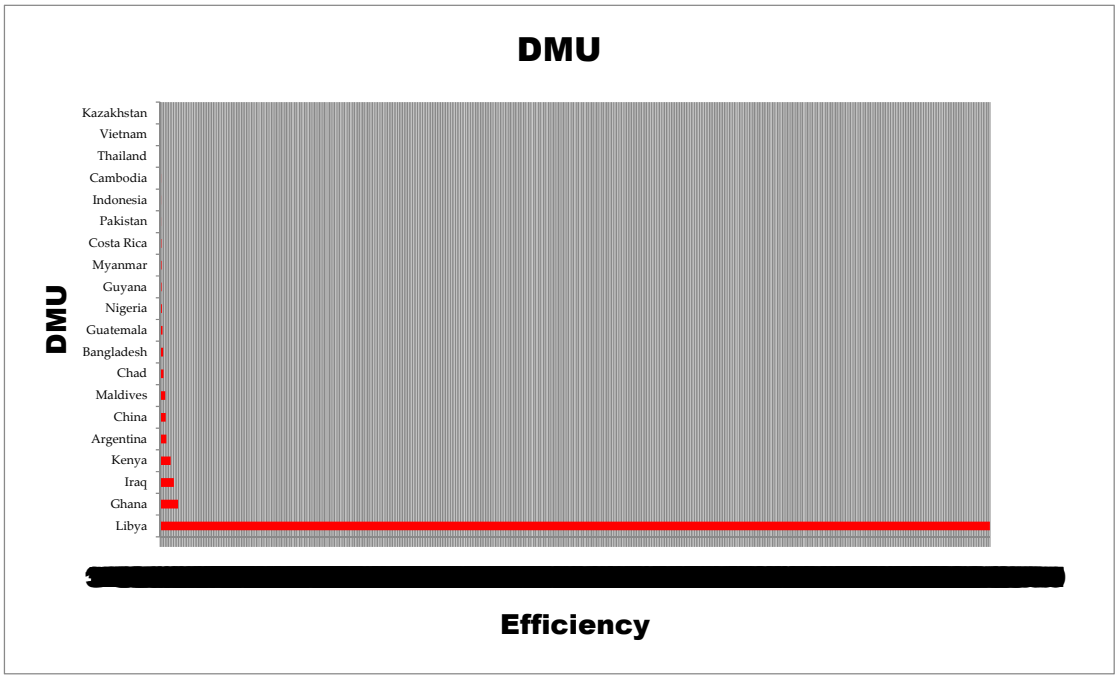

Figure 2. Efficiency of the DMUs.

Table 9 shows the efficiency scores and the ranking of the decision-making units under the super SBM model. The results clearly highlight that Libya has displayed consistently amongst 20 decision-making units 2012–2017 by scoring the score of 1.00. The country has ranked first among all the decision-making units. In addition to this, Ghana also showed consistent progress by achieving the score of 1.00 for 2012–2016 but its efficiency declined in 2017 by displaying a score of about 0.425. Also, Kenya achieved efficiency from the period of 2013 to 2017 by achieving an efficiency score of 1. Lastly, Iraq and China have achieved efficiency until 2016 followed by a decline in 2017. The efficiency score can be seen for only Argentina, Bangladesh, China, Ghana, Guatemala, Guyana, Iraq, Pakistan, Maldives, Libya, and Kenya. Only Libya showed a consistent efficiency value of 1.000. This indicates that the input variables of FDI and CSR spending in Libya have helped in the sustainable economic development. This is evident from the fact that the Greenfield and Brownfield FDI of Libya has increased with respect to the fall in the exchange rate of the country to USD. In addition, reduced exchange rate has caused the increased inflows of FDI and hence helped the corporations to spend more on CSR spending. Thus, this improved the GDP growth of the country, whereas, the FDI and CSR spending of other countries have fluctuated over time and, hence, do not have stable efficiency values.

Table 9. Efficiency score of 20 developing countries (super slacks-based measure of efficiency (SBM) model).

DMU	2012	2013	2014	2015	2016	2017	Rank
Argentina	0.013304	0.148764	0.078133	0.375468	1	0.090873	5
Bangladesh	0.077582	0.273066	0.021721	0.937506	1	0.126171	9
Cambodia	0.007916	0.047165	0.003511	0.129882	0.0804	0.471321	17
Chad	0.026782	0.119501	0.069774	0.297287	0.824502	0.127736	8
China	0.039408	0.201873	0.062978	0.866681	1	0.889667	6
Costa Rica	0.011686	0.027749	0.008649	0.137555	0.174718	0.52225	14
Ghana	1	1	1	1	1	0.425587	2
Guatemala	0.089321	0.605562	0.488747	1	1	0.000059	10
Guyana	0.036338	0.247845	0.112485	0.254094	1	0.265481	12
Indonesia	0.0369	0.171644	0.00899	0.36407	0.337604	0.016062	16
Iraq	0.1263	0.273863	0.006261	0.329268	1	0.278259	3
Kazakhstan	0.01034	0.111758	0.006518	0.066946	0.024628	0.003131	20
Kenya	0.023522	0.22813	0.059738	1	1	1	4
Libya	1	1	1	1	1	1	1
Maldives	0.359416	0.615609	1	0.634559	1	0.03179	7
Myanmar	0.046572	0.177496	0.012176	0.209937	0.164393	0.021411	13
Nigeria	0.039435	0.393516	0.03905	0.515101	0.653826	0.09114	11
Pakistan	0.129482	0.600943	0.030965	1	0.756063	0.268422	15
Thailand	0.031552	0.055858	0.004081	0.343757	0.793846	0.065809	18
Vietnam	0.013811	0.082197	0.006132	0.207033	0.122557	0.000217	19

Efficiency is measured by the examining the production units. In addition to this, it is also essential to identify the inefficient sources that need to be improved to achieve a position in the competitive environment. The DEA technique is widely used for benchmarking in a linear programming model. This technique is widely used by the researcher to measure technical efficiency. This technique uses the input–output variable to measure the amount of output that can be generated with the given level of inputs. This technique acts as a mathematical tool to evaluate the efficiency and deal with a certain set of uncertainties [46].

Malmquist Efficiency

The Malmquist index is commonly used for measuring the performance of the country in terms of technical efficiency, change in the technology, change in pure technical efficiency, and the change in the total factor productivity [38]. This index assists the researcher in comparing the productivity change within the groups. Malmquist productivity Index is used for assessing the

performance of 20 DMU's for further analysis. This index identifies the productivity change over time in the context of economic growth. In the present study, performance of the DMUs was measured through Malmquist Productivity Index, catch-up effect, and frontier shift. This helps the DMUs in assessing and improving their performance.

Catch-Up Effect

The catch effect is concerned with the amount of recovery that is obtained under the DMU to increase its efficiency. The catch-up effect represents the efficiency change indicating the extent to which a particular DMU improves or deteriorates its efficiency. If the change in efficiency is greater than 1, it represents the relative efficiency from an initial time period. In addition to this, if the change in efficiency is equal to 1, it represents no change. Further, if the change in efficiency is less than 1, it means that the DMUs have displayed an inefficient behavior [47]. In regard to the efficiency change displayed by different countries, the catch effect indicates the value needed by particular DMU to improve its productivity. The results in Table 10 indicate that Iraq and Cambodia have displayed a high level of improvement in efficiency as compared to 2012. However, few countries, like Pakistan, need to catch up with the other countries in terms of achieving efficiency.

Table 10. Catch-up effect of 20 developing countries.

Catch-up	2012–2013	2013–2014	2014–2015	2015–2016	2016-2017	Average
Argentina	1.480284016	0.471767	1.963734015	1.079406474	1.02	1.248798
Bangladesh	1.361188802	1	1	1	1.12	1.090297
Cambodia	6.584100297	0.777574	5.563699467	0.086327827	0.7834567	3.252925
Chad	1.628471196	1.740612	0.438333456	2.281368183	2.281368183	1.522196
China	1.65472205	1	1	1	1	1.163681
Costa Rica	0.656715233	1.548091	1.150521345	1.094745077	1.0168764	1.112518
Ghana	1	1	1	1	1	1
Guatemala	1.000009545	1	1	1	1	1.000002
Guyana	3.084279771	0.715698	1.777166107	1	1	1.644286
Indonesia	3.218566233	0.124762	5.47704508	1.331258518	1.1789867	2.537908
Iraq	3.111895485	0.0524	6.45967488	2.954325441	2.768747908	3.144574
Kazakhstan	2.240078826	0.701963	0.967615706	0.203086177	0.204679809	1.028186
Kenya	1.660006645	1	1	1	1	1.165002
Libya	0.99999	1	0.999999961	1.000000237	1.033457901	0.999998
Maldives	0.618267269	1.617438	0.999991252	1.000008749	1.879079873	1.058926
Myanmar	5.062967473	1	0.999999999	0.166274609	0.138796575	1.807311
Nigeria	2.191305897	1	0.91868677	0.548526384	0.567889935	1.16463
Pakistan	1.00000896	1	1	0.797371688	0.725790188	0.949345
Thailand	1.035113279	0.624179	2.417583431	1.347553929	1.357909236	1.356107
Vietnam	3.709386365	0.72662	1.358835928	0.438802031	0.445729203	1.558411
Average	2.164867867	0.905055	1.87464437	1.016452766	1.061308388	1.490255
Max	6.584100297	1.740612	6.45967488	2.954325441	2.768747908	3.252925
Min	0.618267269	0.0524	0.438333456	0.086327827	0.138796575	0.949345
SD	1.563748053	0.424758	1.768081666	0.665957276	0.645936127	0.695167

Figure 3 shows the efficiency change of the 20 DMUs from 2012 to 2016, indicating that the efficiency is improved and reached the highest point for Cambodia, Iraq, and Indonesia for the period of 2014–2015 and displayed a decreasing trend in the following year. These countries have been unstable due to the largest fluctuations and need to focus on their development. This might be from the fact that the multi-criteria FDI and CSR approach increased for Cambodia, Iraq, and Indonesia during the period of 2014–2015. In addition, the exchange rate of Cambodia, Iraq, and Indonesia also decreased in the year 2014–2015. Since the catch-up effect is the amount of recovery that is obtained under the DMU to increase its efficiency, countries like Cambodia, Iraq, and Indonesia indicates the rate of the particular DMU that may have improved or deteriorated its efficiency in the coming years.

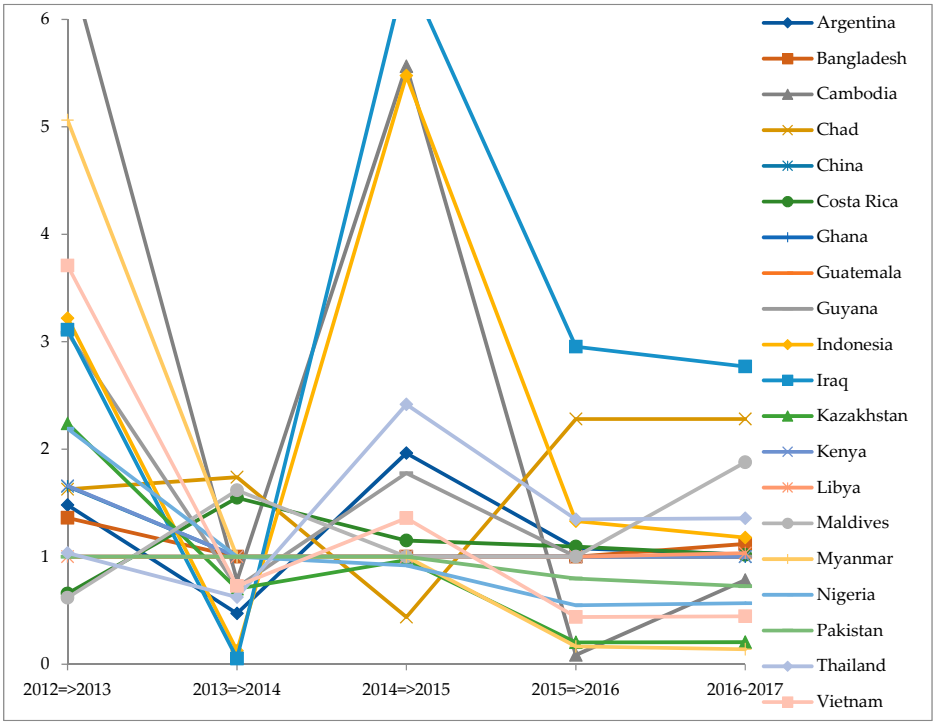

Figure 3. Graphical representation of catch-up effect.

Frontier Shift

The frontier effect measures the difference within the efficient frontiers within the two time periods. It is used for measuring the improvement in the technology of the decision-making units. The value of the technological frontier greater than 1 represents the technological progression and a value of less than 1 represents the technological recession [41]. In this regard, the present study measures the change in technological among the countries. Table 11 represents the technological changes within 20 DMUs during the period of 2012–2017. The results indicate that almost all the countries were enhancing their technology and achieved technological efficiency. Few developing countries, like Maldives and Cambodia, have achieved a frontier effect of greater than 2, indicating these countries have achieved technological progression. However, few countries, like China and Guyana, lacked in comparison to other countries to achieve overall technological efficiency.

Table 11. Frontier shift of 20 developing countries.

Frontier	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	Average
Argentina	1.033729	1.535975	0.477482	1.295642	1.345768	1.085707
Bangladesh	0.421819	1.052722	1.603703	1.01953	1.03575	1.024443
Cambodia	0.165562	1.205463	0.183773	7.31818	7.45769	2.218245
Chad	0.496304	1.114749	0.996217	0.969205	0.975454	0.894119
China	0.070136	1.063908	1.049862	0.220287	0.359056	0.601048
Costa Rica	1.001547	0.981916	1.0442	1.320923	1.494077	1.087146
Ghana	1.123062	0.064446	0.568473	0.868166	0.987556	0.656037
Guatemala	0.979101	1.270948	0.916375	0.689663	0.744734	0.964021
Guyana	0.428075	0.820161	0.318235	1.770453	1.876548	0.834231
Indonesia	0.260487	3.907661	0.181414	2.762586	1.235796	1.778037
Iraq	0.251157	2.353315	0.320109	1.070047	1.067435	0.998657
Kazakhstan	0.63686	1.101601	0.535642	1.850357	1.94639	1.031115
Kenya	0.802579	0.9252	1.251974	1.415366	1.563946	1.09878

Libya	1.270106	2.903408	0.271199	1.248931	1.403536	1.423411
Maldives	1.067161	1.783157	1.022214	11.79298	11.46744	3.916378
Myanmar	0.139591	1.005468	0.693692	1.212107	1.453784	0.762715
Nigeria	0.662873	1.70056	0.58735	1.082591	1.097456	1.008344
Pakistan	1.076915	0.830524	1.095916	1.191276	1.329976	1.048658
Thailand	0.320181	1.719647	0.47205	1.357139	1.463936	0.967254
Vietnam	0.285744	2.078699	0.862391	1.923062	1.676345	1.287474
Average	0.624649	1.470976	0.722614	2.118924	2.157638	1.234291
Max	1.270106	3.907661	1.603703	11.79298	11.46744	3.916378
Min	0.070136	0.064446	0.181414	0.220287	0.359056	0.601048
SD	0.38819	0.84709	0.393458	2.695143	2.68587	0.731341

The graph in Figure 4 clearly indicates that, though Cambodia was operating at a very low level of technical efficiency until 2014–2015, the country witnessed a great scale of improvement post-2015. Also, Guyana, which displayed one of the lowest technical efficiencies amongst all the decision-making units until 2014, also displayed a high level of improvement in 2015. However, countries like China, which was operating at a high level of technical efficiency until 2013, have recently witnessed a technological recession. Since this model indicates the difference within the efficient frontiers within the two time periods for Cambodia, Guyana, and China, the values indicate the required improvement in the technology of the decision-making units for multi-criteria FDI and CSR spending. These countries, along with a few others, need to improve their technological efficiency in the years 2015–2016 to become efficient for the years 2016–2017. It may also be indidcated that the difference within the efficient frontiers during 2015–2016 will help Cambodia, Guyana, and China to improve their input variables and exponential outputs.

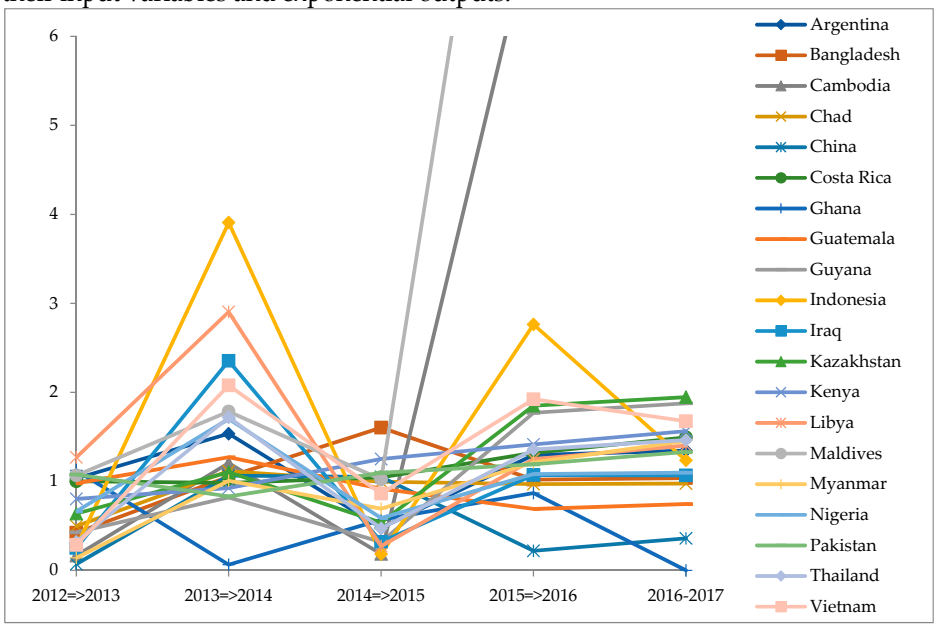

Figure 4. Graphical representation of frontier shift.

Malmquist Productivity Index

The Malmquist productivity index is used under the DEA model to measure the productivity in MPI. This measure is used to capture the relative overall performance of the decision-making units within different periods. This measure uses technology for the base period. This measure takes into account the efficiency and technological change in a geometric mean. It measures the overall change in productivity. If the value of the index is greater than 1, it means that there is an improvement in the overall productivity [42]. Table 12 shows the total productivity of the 20 DMUs from the period 2012–2017. The results clearly indicate that countries like Libya and Maldives have

witnessed a long-term upwards trend during the period of 2014–2017. These countries have displayed improvement in their efficiency. However, China's productivity has fallen since 2015, indicating poor performance in terms of total productivity.

Table 12. Catch-up effect of 20 developing countries.

Malmquist	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	Average
Argentina	1.530213	0.724623	0.937648	1.398524	1.356894	1.147752
Bangladesh	0.574175	1.052722	1.603703	1.01953	1.025387	1.062533
Cambodia	1.09008	0.937336	1.02246	0.631763	0.735383	0.92041
Chad	0.808217	1.940346	0.436675	2.211113	2.190765	1.349088
China	0.116056	1.063908	1.049862	0.220287	0.347639	0.612528
Costa Rica	0.657731	1.520096	1.201374	1.446073	1.957594	1.206319
Ghana	1.123062	0.064446	0.568473	0.868166	0.926286	0.656037
Guatemala	0.97911	1.270948	0.916375	0.689663	0.739265	0.964024
Guyana	1.320304	0.586987	0.565556	1.770453	1.793549	1.060825
Indonesia	0.838396	0.487526	0.993611	3.677716	3.057595	1.499312
Iraq	0.781574	0.123314	2.067798	3.161268	3.946744	1.533488
Kazakhstan	1.426617	0.773284	0.518296	0.375782	0.648744	0.773495
Kenya	1.332286	0.9252	1.251974	1.415366	1.879439	1.231206
Libya	1.270094	2.903408	0.271199	1.248931	1.653739	1.423408
Maldives	0.659791	2.884146	1.022205	11.79308	11.79303	4.089806
Myanmar	0.706744	1.005468	0.693692	0.201543	0.372926	0.651862
Nigeria	1.452557	1.70056	0.539591	0.59383	0.684735	1.071634
Pakistan	1.076925	0.830524	1.095916	0.94989	1.047435	0.988314
Thailand	0.331424	1.073367	1.141221	1.828818	1.943674	1.093707
Vietnam	1.059936	1.510425	1.171847	0.843843	0.901527	1.146513
Average	0.956764	1.168932	0.953474	1.817282	2.014051	1.224113
Max	1.530213	2.903408	2.067798	11.79308	11.79303	4.089806
Min	0.116056	0.064446	0.271199	0.201543	0.347639	0.612528
SD	0.383123	0.75521	0.423007	2.517195	2.540557	0.725004

The graph in Figure 5 reflects that there is a constant improvement in technical efficiency over time in almost all countries. Only Cambodia appears unstable with the largest fluctuations as the country was operating at a low level of efficiency but observed a great improvement in technological efficiency post-2015. Some countries, such as Costa Rica, require improvement in inputs like FDI inflows, CSR, and exchange rate to improve the economic countries. Since, Malmquist DEA indicates the productivity of the input and output variables, the multi-criteria measures of FDI and CSR for Cambodia are used to capture the relative overall performance of the decision-making units within different periods for the years 2014–2017. This also implicates that all other countries may follow the model of FDI usage and CSR expenditure for improved sustainable growth of the country.

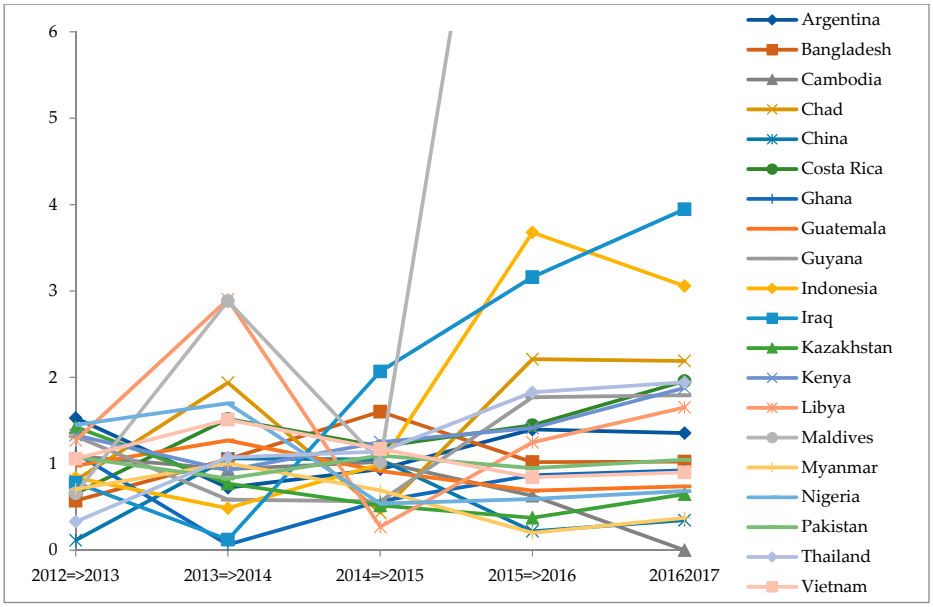

Figure 5. Graphical representation of Malmquist productivity index.

The results of the Malmquist productivity index and the frontier effect clearly highlight that Cambodia has witnessed a great improvement in terms of productivity and technological progression post-2015. In this regard, the study conducted by Richardson in 2014 [48] revealed that Cambodia has witnessed a technological progression in the recent years. In addition to this, the government is imparting training among the students in order to offer them exposure to computers and the internet. Further, the schools and educational institutes have started adopting the latest technological tools and e-learning courses to impart education among the students. The government has shown a favorable attitude in the context of the use of technology by providing the necessary infrastructure of electricity. The study conducted by the government of Cambodia, 2015 (Government of Cambodia, 2015) highlighted that the government has ensured internet availability, human capital, and cellphone coverage across long distances [49]. An improvement in technological equipment has led to increased productivity and output across all the sectors in the economy. Further, the government has also ensured a stable political system that focuses on the technological assistance and industrial development. Technological assistance has also helped the companies in higher proficiencies and financial performances. CSR spending in Cambodia in the recent years has also grown. However, in developing countries in East Asia, such as Cambodia, CSR is a relatively new concept, and the implications of developments in CSR for local companies are still being explored [50]. In Cambodia, the size of the industrial base and the extent to which the industrial structure offers potential for CSR activities are limited. However, the spending has increased over the years and is being efficiently used. This must help the decision makers in adopting the strategies of Cambodia so that multiple criteria FDI, exchange rate, and CSR spending can be used efficiently for sustainable development of the nations. In this regard, a conceptual framework may be used by the decision makers for efficient use of multiple criteria FDI and CSR (Figure 6).

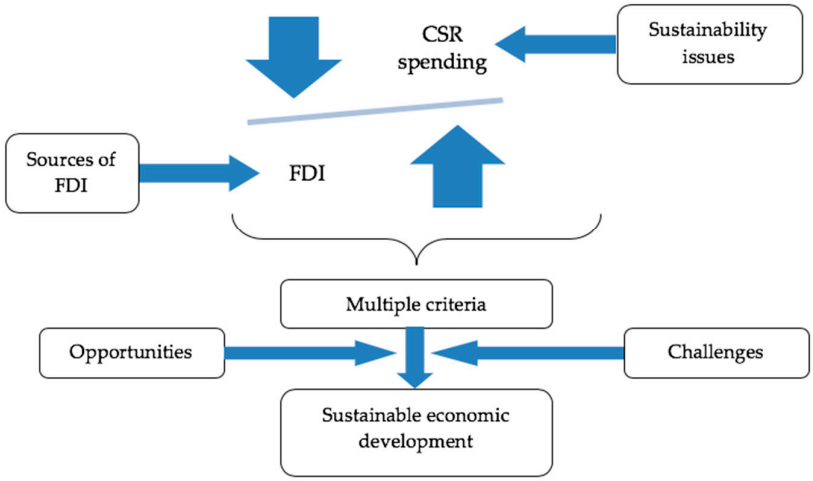

Figure 6. Conceptual framework for decision makers from the data envelopment analysis (DEA) analysis.

The decision makers are responsible for achieving sustainable economic growth of the nation. Therefore, it is very important the authorities efficiently evaluate the FDI inflows from organizations or international governments. This will help in the effective adoption of technologies and gather knowledge with respect to sustainable development and issues. CSR spending, as found from the literature, is an important method of solving sustainability issues. Therefore, CSR spending and FDI should be in conglomerate and function in a balanced way. The more FDI, the more CSR expenditure can be exerted to resolve the sustainability issues. Thus, these two multiple criteria can be used for the economic growth of the nation. However, during the line, the nation may face challenges and opportunities for sustainability, financial issues, technological changes, and human capital. Henceforth, policy makers must take note of the opportunities and challenges and come up with policies that will help in sustainable economic development.

The study, therefore, hypothesizes the theory of Schumpeterian growth theory. The findings from the study clearly indicated that developing nations have improved the economic conditions and improved growth generated by innovations. As a result, innovations result from FDI investments that are themselves motivated by the prospects. FDI investments, along with CSR spending, allows innovations to replace old policies; in other words, growth involves creative destruction. Therefore, using FDI and CSR will help in positive multi-criteria economic growth of developing nations. Therefore, the decision makers must follow the multi criteria of using FDI and sustainability values efficiently and benchmark the multi criteria models of Libya for sustainable economic development. Thus, for the forecasted years of 2018 to 2020, the decision makers of developing nations must suffice to attract larger inflows of FDI and increased CSR spending. This will have a direct positive impact on the GDP and GDPPC. In addition, the decision makers may view the forecasted values of their respective nations and contract it to the values of Libya for benchmarking and efficient implementation of multiple criteria (FDI and CSR) for sustainable economic developments in the years 2018–2020.

5. Conclusions

FDI and CSR spending are one of the most important aspects of sustainable economic development of nations. FDI helps the countries through increased development and implementation of different strategies for improving the finances and economics of a country. However, sustainable development focuses on the environmental, social, and economic aspects. Therefore, CSR expenditures are one of the best strategies of sustainable development, especially in developing nations. The results show that the average MPI of developing countries has improved over the years.

This implies that FDI has a significant impact on the economic growth of developing countries. Due to FDI, there is an improvement in the technical efficiency, which leads to improvement in total factor productivity. The Maldives stood in the top position in the Malmquist productivity index amongst developing countries. The reason behind this might be due to the rapid expansion of tourism in recent years. On the other hand, Iraq stood at the second highest position with an average value of 1.53 in MPI. Therefore, there is an improvement in total factor productivity (TFP) of countries which have values of MPI greater than 1. This further indicates that FDI is one of the major factors in enhancing the growth of the economy of developing countries. All developing nations still mainly focus on FDI to improve their economic conditions and therefore lack sustainable development. Apart from FDI, CSR spending is strategic for developed nations. Therefore, it is important that developing nations improve their CSR policies along with foreign investments. Larger foreign investments mean better usage of CSR. Improved CSR will help industries to flourish and henceforth help increase the GDP of the countries.

The findings, however, indicate that the decision makers of sustainable economic development will be now able to assess the economic growth models of Libya. This is on the fact that Libya was found to have the lowest slacks between the input variables and the output variables, and hence was also considered as rank 1 under SBM assessment. Although different nations were found to have MPI values of 1, Libya was the only one with the best SBM value. Therefore, the decision makers must follow the multi-criteria of using FDI and sustainability values efficiently and benchmark the multi-criteria models of Libya for sustainable economic development. Thus, for the forecasted years of 2018 to 2020, the decision makers of developing nations must suffice to attract larger inflows of FDI and increased CSR spending. This will have a direct positive impact on GDP and GDPPC. In addition, the decision makers may view the forecasted values of their respective nations and contract it to the values of Libya for benchmarking and efficient implementation of multiple criteria (FDI and CSR) for sustainable economic developments in the years 2018–2020. Thus, the study asserts the following conclusions: (i) CSR spending is an important activity that indicates the sustainable development of a country. Contributions of CSR to the economic development of the developing nations implicate sustainable economic development. (ii) The correlation findings indicated that larger foreign investments positively influence CSR spending capabilities. Improved CSR will help industries to flourish and henceforth help increase the GDP of the countries. (iii) In addition, the exchange rate plays a major role in allowing FDI inflows to developing countries. The higher the exchange rates, the better FDI inflows to the country, and vice versa. (iv) Forecasting indicates that the FDI and exchange rate of the chosen DMUs will constantly increase, except for a few countries (China, Guyana, Maldives, and a few other countries). This indicates that the countries with stable growth of FDI and exchange rate will become efficient in the future years with respect to GDP growth. Countries like Vietnam, Cambodia, Indonesia, Argentina, and a few others showed distinctive growth of FDI and CSR spending for the years 2018 to 2020. Henceforth, their GDP and GDPCC too seem to increase in a larger percentage. (v) Efficiency values indicate that increased inputs of FDI and CSR spending have made countries like Argentina, China, Vietnam, Thailand, Kenya, and others efficient in improving its economic status and on the way of fulfilling plans of sustainable economic development. (vi) Forecasted values CSR and FDI must be efficiently used by the developing nations for lowering the slack values and thereby focusing on outputs GDP and GDPPC. SBM values and MPI of the t+1 year (2017) must be used for benchmarking one or more than one DMU by the decision makers of the developing nations. The multiple criteria forecasted values can be used for developing a model of sustainable economic development.

However, there are certain limitations of the study, which are: (i) There is a lack of sustainability reports and data for the chosen countries. (ii) Moreover, the data collected as CSR spending is just one variable with respect to sustainable development. (iii) The study tried usage of MCDM but lacks usage of models due to lack of data availability. MCDM models need algorithm testing, which has been ignored in this study as it was outside the scope.

In order to overcome these issues, future studies must focus on: (i) A larger dataset of DMUs and output/input variable. (ii) Another important future scope is the exploration of other

sustainability variables for developing nations to see the impact on sustainable economic development. (iii) The future studies may also make comparative studies on developing and developed countries to find the efficient use of FDI and sustainability variables. (iv) In future research, we will also use the robustness analysis to enrich research methods. In addition, the study and research on the negative aspects of FDI will be our concern to have a more multidimensional perspective in assessing the effectiveness of FDI.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations and Acronyms

The following abbreviations and acronyms are used in this manuscript:

DEA	Data envelopment analysis
MPI	Malmquist productivity index
MCDM	Multiple criteria decision-making
SBM	Slack-based measurements
GM	Grey Model forecasting
MAPE	Mean absolute percent error
DMU	Decision-making units
CSR	Corporate social responsibility
FDI	Foreign direct investment
GDP	Gross domestic product
GDPPC	Gross domestic product per capita

Appendix A

DMU	2012					2013					2014				
	(I) FDI	I) Exchangerat	(I) NFA	(O) GDP	(O) GDPPC	(I) FDI	I) Exchangerat	(I) NFA	(O) GDP	(O) GDPPC	(I) FDI	I) Exchangerat	(I) NFA	(O) GDP	(O) GDPPC
Argentina	2.8066719	4.53693436	1.99568E+11	-1.026420454	-2.060574637	1.779205536	5.459352665	1.77027E+11	2.405323781	1.338452934	0.96240665	8.075275993	2.41758E+11	-2.512615321	-3.514195982
Bangladesh	1.18810285	81.86265833	9.27003E+11	6.521435078	5.279833222	1.73541854	78.103235	1.27257E+12	6.013596067	4.772796389	1.468712877	77.64140833	1.5119E+12	6.061093054	4.840840706
Cambodia	13.05795367	4033	2.06702E+13	7.313345505	5.577812185	12.29134433	4027.25	1.85446E+13	7.356665149	5.599918784	10.29992225	4037.5	2.23425E+13	7.142571101	5.40187153
Chad	4.687821048	510.5271359	5.58057E+11	8.882576072	5.313322316	4.017039751	494.0400374	5.3769E+11	5.700001363	2.251774958	-4.852284264	494.4149529	5.2269E+11	6.899985045	3.46636815
China	2.817738858	6.312332827	2.58175E+13	7.85626211	7.332030984	3.028225603	6.195758346	2.80329E+13	7.757635146	7.226936454	2.557600305	6.143434094	2.87771E+13	7.297665959	6.755778416
Costa Rica	5.801837126	502.901462	2.47309E+12	4.796919919	3.58892727	6.443621066	499.7668326	2.1368E+12	2.2690274	1.133016575	6.410226879	538.3172003	2.1893E+12	3.515338564	2.401894438
Ghana	7.855367882	1.795816667	6976474526	9.292789414	6.696690312	6.75033011	1.95405	5464121782	7.312525021	4.814854481	8.604962551	2.899775	8880081500	3.985865624	1.608950017
Guatemala	2.507793565	7.833605417	41497154575	2.970025412	0.797912686	2.512748931	7.85681375	43748526647	3.697177338	1.535244526	1.985216051	7.732233333	40404338163	4.174400627	2.032858704
Guyana	9.711827812	204.3583333	1.82009E+11	5.276306143	4.718395163	6.707623804	205.3941667	1.64601E+11	5.000564991	4.309408216	7.726466769	206.4491667	1.62458E+11	3.846923912	3.124314641
Indonesia	2.309780327	9386.629167	9.68208E+14	6.030050653	4.677119579	2.551356334	10461.24	1.01136E+15	5.557263689	4.23837264	2.819972605	11865.2113	1.10755E+15	5.006668426	3.731244892
Iraq	1.559625972	1166.166667	9.2454E+13	13.93643017	10.28814328	2.186846637	1166	1.09239E+14	7.6	4.085941243	2.037857749	1166	1.02457E+14	0.7	-2.530283268
Kazakhstan	6.561648211	149.1125	5.79534E+12	4.8	3.334055983	4.23069801	152.1291667	6.69695E+12	6	4.485116947	3.262927062	179.1916667	7.58348E+12	4.2	2.676714897
Kenya	2.741992463	84.52960176	3.28307E+11	4.563209131	1.78472733	2.0306559	86.1228789	3.90135E+11	5.878689477	3.091071126	1.335986481	87.92216381	4.83262E+11	5.357116778	2.61606794
Libya	1.740486447	1.261659638	1.58551E+11	123.139555	122.9683012	1.071708764	1.271691821	1.54233E+11	-13.6	-13.56809487	0.121528176	1.272402067	1.30049E+11	-24	-24.09969008
Maldives	7.898939479	15.36483532	5258259414	2.517383942	-0.421672655	10.95038209	15.36671003	8837788153	7.281073979	4.25914794	9.016594968	15.38039352	12542554917	7.329606386	4.477102315
Myanmar	2.225400651	640.6534167	5.53544E+12	7.332670447	6.420137223	3.740856005	933.5704564	5.59148E+12	8.426001025	7.45301583	3.323353455	984.3457476	7.46123E+12	7.991243344	7.001293806
Nigeria	1.533761875	157.4994258	8.69044E+12	4.279277314	1.524085569	1.080240347	157.311225	8.11757E+12	5.394416311	2.614625618	0.818201344	158.5526417	6.7305E+12	6.309718596	3.519624173
Pakistan	0.382826517	93.39519722	7.59129E+11	3.50703342	1.338548629	0.576510795	101.6288992	2.7659E+11	4.396456633	2.212692738	0.764443119	101.1000884	9.43984E+11	4.674707981	2.511972625
Thailand	3.244566328	31.08309167	4.94482E+12	7.242786605	6.746677123	3.791267406	30.72596667	5.00929E+12	2.687379919	2.236675835	1.221452216	32.47983333	5.04284E+12	0.984414064	0.580417497
Vietnam	5.370298997	20828	5.13327E+14	5.247367156	4.066064787	5.19792941	20933.41667	6.10318E+14	5.421882991	4.21688206	4.940800273	21148	8.23168E+14	5.983654637	4.784398867

DMU	2015					2016					2017				
	(I) FDI	I) Exchangerat	(I) NFA	(O) GDP	(O) GDPPC	(I) FDI	I) Exchangerat	(I) NFA	(O) GDP	(O) GDPPC	(I) FDI	I) Exchangerat	(I) NFA	(O) GDP	(O) GDPPC
Argentina	1.977134618	9.233185525	2.92E+11	2.731159828	1.698944824	0.587564212	14.75817509	6.02117E+11	-1.82254217	-2.784592111	0.256494019	16.56270693	9.6479E+11	2.863922897	1.879661216
Bangladesh	1.451287742	77.94690833	1.91E+12	6.552633316	5.365749925	1.050952188	78.46809167	2.19762E+12	7.113465228	5.96268914	0.861499755	80.43754167	2.25196E+12	7.284208377	6.164787475
Cambodia	9.42367263	4067.75	2.15E+13	7.036087179	5.333422892	11.4256005	4058.694579	2.63473E+13	6.953094396	5.292483361	1.374633936	6.758755086	2.52639E+13	6.814723618	5.19299957
Chad	5.463599758	591.4495075	88590967615	2.767675685	-0.459812013	5.948315995	593.0081704	-3.03711E+11	-6.255527085	-9.129830126	5.005499682	567.5130903	1.67327E+12	-2.953771549	-5.868097016
China	2.19156480 1	6.227488673	2.80E+13	6.900204817	6.358383356	1.56151998	6.644477829	2.63294E+13	6.7	6.123803825	6.877221374	4.350633333	20860278999	6.9	6.303967123
Costa Rica	5.395653458	534.56577	1.82E+12	3.631690989	2.547986556	5.189644861	544.7393672	1.61059E+12	4.156361507	3.096586889	1.368419324	7.34793875	65237082956	3.191803724	2.171721751
Ghana	8.549691232	3.668025	11389375764	3.837040864	1.50204564	8.142620601	3.9098	15495660278	3.721902905	1.42766937	5.771834176	206.5	1.46046E+11	8.507156219	6.147992732
Guatemala	1.843449419	7.654815	41734795472	4.140044358	2.03275711	1.710511953	7.599937083	49170987508	3.092487959	1.040643645	2.113611919	13380.87167	1.54179E+15	2.760329473	0.749086568
Guyana	4.349296787	206.5	1.46E+11	3.162407787	2.474984148	0.913209391	206.5	1.50016E+11	3.316131655	2.6763036	-2.545270347	1184	1.50016E+11	2.924668313	2.321827967
Indonesia	2.297616387	13389.41294	1.18E+15	4.8763223	3.645003674	0.487174266	13308.3268	1.2975E+15	5.033279592	3.845302036	2.849517699	326.0010227	1.14116E+13	5.067680274	3.9230726
Iraq	1.846078885	1167.333333	7.48E+13	4.8	1.580264666	0.085369906	1182	1.0975E+15	11	7.756986237	0.896056319	103.3738991	5.18557E+11	-0.780088428	-3.55917062
Kazakhstan	3.459782143	221.7283333	9.29E+12	1.2	-0.268267118	12.22302757	342.16	1.08568E+13	1.1	-0.327514633	12.56587323	4050.579986	3.84252E+13	4	2.595522719
Kenya	0.968209142	98.17845333	4.93E+11	5.718507131	3.005934527	0.555002206	101.5043695	4.96241E+11	5.869192849	3.192383638	0.555002206	1.393820011	1.08964E+11	4.88544448	2.272175223
Libya	2.478809734	1.38120986	1.14E+11	-8.862039401	-9.312938031	1.526965879	1.390368679	1.06479E+11	-2.795468829	-3.695929967	11.256862	15.38696851	10291808236	26.67587032	25.05903115
Maldives	7.437256304	15.36633122	12297384250	2.245924401	-0.235916332	10.81373925	15.36840768	7868670701	6.163158257	3.841872245	6.758146296	1360.358707	9.37664E+12	8.828456057	6.689948088
Myanmar	6.842048562	1162.615329	1.04E+13	6.992515574	6.013547473	5.184802496	1234.869517	9.46401E+12	5.871982226	4.907949674	0.930682809	305.7901092	1.19995E+13	6.368840526	5.401455162
Nigeria	0.652159517	192.4403333	5.30E+12	2.652693289	-0.022235191	1.098498181	253.492	7.64776E+12	-1.61686895	-4.160106639	0.923096643	105.4551621	8.34463E+11	0.81454403	-1.771579886
Pakistan	0.599136312	102.7692716	1.26E+12	4.731147475	2.610728514	0.892861508	104.769117	1.35637E+12	5.526735845	3.438653296	3.356246166	582.0945501	-2.99355E+11	5.700621241	3.655196043
Thailand	2.224113609	34.24771667	5.88E+12	3.020173993	2.658813525	0.743945817	35.29638333	6.13417E+12	3.282683075	2.973849715	1.745105465	33.93981106	6.36254E+12	3.902975042	3.641102721
Vietnam	6.106361156	21697.5675	8.33E+14	6.679288789	5.508820999	6.138072368	21935.00083	9.46391E+14	6.210811668	5.090510776	6.298467029	22370.08667	1.262E+15	6.81224566	5.725877848

Figure A1. List of variables for input and output variables.

2012	FDI	Exchangerate	NFA	GDP	GDPPC	2013	FDI	Exchangerate	NFA	GDP	GDPPC
FDI	1	0.114452231	0.101948393	0.178335512	0.175836882	**FDI**	1	0.119355515	0.069590687	0.311958233	0.317594185
Exchange rate	0.114452231	1	0.750814682	0.087061726	0.080994309	**Exchange rate**	0.119355515	1	0.81070485	0.098713935	0.138288302
NFA	0.101948393	0.750814682	1	0.075397665	0.070300221	**NFA**	0.069590687	0.81070485	1	0.084405188	0.118470205
GDP	0.178335512	0.087061726	0.075397665	1	0.999313151	**GDP**	0.311958233	0.098713935	0.084405188	1	0.976771721
GDPPC	0.175836882	0.080994309	0.070300221	0.999313151	1	**GDPPC**	0.317594185	0.138288302	0.118470205	0.976771721	1
2014	**FDI**	**Exchangerate**	**NFA**	**GDP**	**GDPPC**	**2015**	**FDI**	**Exchangerate**	**NFA**	**GDP**	**GDPPC**
FDI	1	0.153788594	0.044455	0.240789547	0.270217832	**FDI**	1	0.194516682	0.007869777	0.150767594	0.145108518
Exchange rate	0.153788594	1	0.888233875	0.144221736	0.171360102	**Exchange rate**	0.194516682	1	0.89807841	0.266616946	0.306590845
NFA	0.044455	0.888233875	1	0.107115678	0.131880139	**NFA**	0.007869777	0.89807841	1	0.196631432	0.237116116
GDP	0.240789547	0.144221736	0.107115678	1	0.990624833	**GDP**	0.150767594	0.266616946	0.196631432	1	0.964991838
GDPPC	0.270217832	0.171360102	0.131880139	0.990624833	1	**GDPPC**	0.145108518	0.306590845	0.237116116	0.964991838	1
2016	**FDI**	**Exchangerate**	**NFA**	**GDP**	**GDPPC**	**2017**	**FDI**	**Exchangerate**	**NFA**	**GDP**	**GDPPC**
FDI	1	0.088162524	0.190456485	0.003291392	0.027500276	**FDI**	1	0.196277669	0.058771412	0.52018354	0.494500502
Exchange rate	0.088162524	1	2016	0.215938947	0.24420951	**Exchange rate**	0.196277669	1	0.921628777	0.028800738	0.018526283
NFA	0.190456485	0.739676618	1	0.390814547	0.359803885	**NFA**	0.058771412	0.921628777	1	0.055890662	0.053751201
GDP	0.003291392	0.215938947	0.390814547	1	0.979142043	**GDP**	0.52018354	0.028800738	0.055890662	1	0.991494512
GDPPC	0.027500276	0.24420951	0.359803885	0.979142043	1	**GDPPC**	0.494500502	0.018526283	0.053751201	0.991494512	1

Figure A2. Correlation for inputs and outputs for the year 2012 to 2017.

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