

Article

Are Global Companies Better in Environmental Efficiency in India? Based on Metafrontier Malmquist CO₂ Performance

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Abstract: There is a rapid increase in inflows of foreign direct investment (FDI) into developing countries such as India. Some researchers argue that FDI has a positive impact on sustainable development in terms of environmental efficiency and brings innovative green technology to the host country. In contrast, others claim that FDI brings considerable pollution to the host country, and their motive is only to yield profit. To address this issue, this paper analyzes environmental efficiency between FDI and domestic firms in India for seven years between 2012 and 2018. The research aims to evaluate the performance of FDI firms in terms of environmental efficiency in India after implementing certain policy regulations, nationally and globally. In this analysis, we use the non-radial metafrontier Malmquist CO₂ performance index (NMMCPI) with three decomposition indices: efficiency change index, best practice gap index, and technological gap change index. Our empirical results indicate that domestic firms have performed well in terms of better catch-up and innovation performance. On the other hand, FDI firms only demonstrated higher technology leadership performance, indicating weaker catch-up performance and weaker innovation performance. From the results, we proposed that policymakers should harmonize between the FDI promotion and regulation in its sustainable performance because global companies are not sensitive to the local regulations, and not very proactive in implementing the global standard of eco-friendliness.

Keywords: foreign direct investment; environmental efficiency; non-radial metafrontier Malmquist index; partial-factor CO₂ emission performance; India

1. Introduction

At present, carbon dioxide (CO₂) emissions from human activities have increased rapidly due to the rapid industrialization, urbanization, population explosion, and exploitation of natural resources, etc. According to the Mauna Loa Atmospheric Reference Observatory in Hawaii in 2018, CO₂ levels reached 411 parts per million, the highest monthly average ever recorded in history [1]. A recent report indicates that countries like China, United States, and India are the major emitters of CO₂ in the world. In terms of CO₂ output, India has recorded more than half of the increase in global CO₂ since 2013 [2].

1.1. Socio-Managerial Contexts

Foreign direct investment (FDI): In recent decades, we have also witnessed a sharp increase in inflows of foreign direct investment (FDI) to developing countries. FDI in India began in 1991 under the Foreign Exchange Management Act (FEMA) with a baseline of USD 1 billion in 1990. Since then, India has been one of the most popular destinations preferred for FDI. India ranks the 9th to receive

FDI inflows as in 2019, against 12th in the previous year, among the largest recipients of FDI in the world reported by UNCTAD, 2020. Indian government proactively induced FDI due to its quantitative contribution in the local economy as well as the qualitative contribution for innovative technology transfer and advanced know-how for the sustainable development of India. Unfortunately, it does not always seem true in the performance of FDI firms. As shown in Figure 1, the trend in FDI inflows from 2001 to March 2016 corresponds to CO₂ emissions in India [3,4]. This means that there is a direct relationship between CO₂ emissions and FDI inflows into India. The Indian government may be concerned about this phenomenon as it expects qualitative contributions from FDI companies, including sustainable and environmentally friendly management of these global firms.

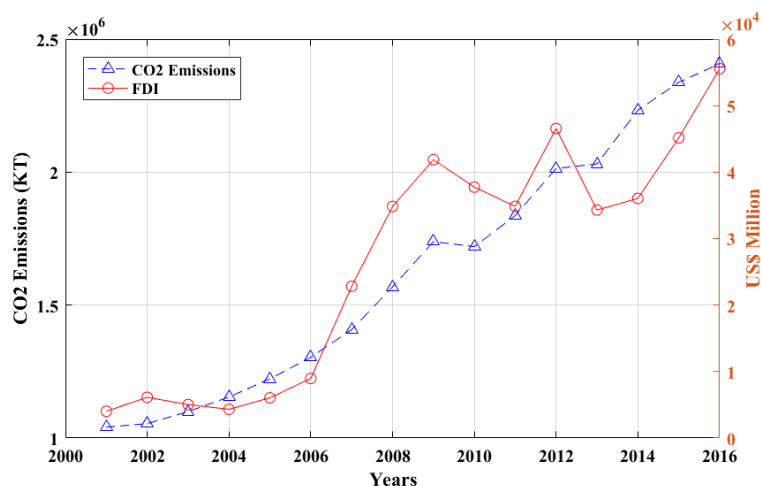


Figure 1. CO₂ emissions and foreign direct investment (FDI) inflows in India.

Gross Domestic Products (GDP): FDI is one of the important factors that promote economic growth in India. Thus, the Indian government has gradually relaxed restrictions on FDI to achieve rapid growth. For example, on 25 September 2014, the Prime Minister of India published an international marketing strategy called “Make in India” to encourage foreign firms to invest in India to strengthen the country’s manufacturing sector [5]. Figure 2 provides some details on FDI equity inflows by sector in India as of 2018 [4]. As shown in Figure 2, the main sectors of FDI inflows to India are services sectors, computer software and hardware, telecommunications, construction development, trading, automobile industry, chemicals, infrastructure, drugs and pharmaceuticals, etc.

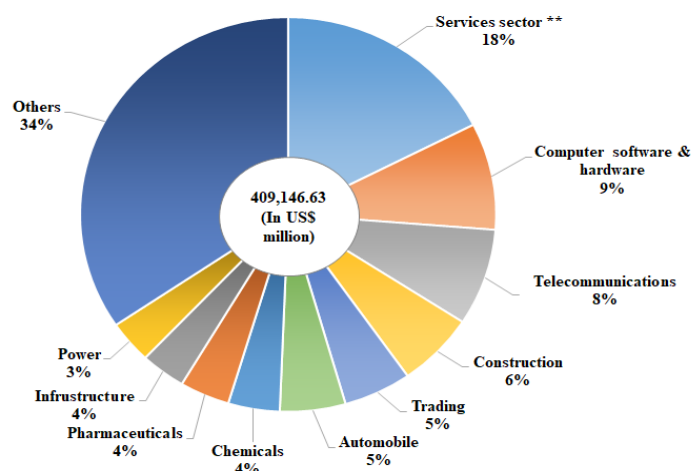


Figure 2. FDI inflows by sectors in India (as of 2018).

Corporate Social Responsibility (CSR): Due to strict environmental regulations in developed countries, investors have been discouraged from investing in pathways that produce much natural pollution and thus create a heavier response on its corporate social responsibility (CSR) for the community, resulting in overseas investments toward developing countries, where the environmental regulations are not very severe, and the global company has the invisible privileges on the local regulations. For these reasons, FDI investors still prefer countries where legal, environmental regulations have not yet been determined, ignoring the negative consequences of the investment they make, which in turn leads to environmental degradation. Due to the need for all kinds of industrial activities such as low-income level, insufficient property rights, and lack of development of environmental awareness, developing countries do not give much importance to environmental regulations [6]. As a result, the increased transfer from developed to developing countries by high CO₂-emitting industries such as energy-intensive industries has started to create an environmental hazard. Consequently, to avoid this type of negative impact situation and to increase its rigor, developing countries have also begun to improvise their environmental regulations. For example, the Reserve Bank of India has said that political action is needed to put in place an enabling environment for fostering green investment as well as advancing the net-zero carbon delivery program in India [7].

Energy-related policies in India: Some of the highlighted energy-related policy Acts and plans proposed and adopted by the Indian government are Energy and carbon taxes supported by the United Nations Framework Convention on Climate Change. A carbon tax is a step to help India reduce the amount of CO₂ released per unit of gross domestic product (GDP) and reach its voluntary target of 25% over 2005 levels by 2020. India has already introduced a national carbon tax, generally in the transport and energy sector of 50 rupees (Rs) per ton of coal consumed by any economic sector on July 1, 2010. The carbon tax has been further increased, and currently, the carbon tax amounts to Rs 400 per ton in India in all sectors emitting CO₂. Nationally Determined Contributions (NDCs) under the Paris Agreement, 2016. India is one of the few developing countries on the way to achieving the goals of the Paris Agreement by the “nationally determined contributions” or NDCs. On 2 October 2016, India ratified the Paris Agreement with a 4.1% reduction goal by 2030 in global CO₂ emissions. Based on NDCs, the three main objectives have been set by the Indian government. The first objective is to increase the share of non-fossil fuels to 40% of total electricity production capacity. The second objective is to reduce emission intensity in the economy from 33% to 35% by 2030 compared to the 2005 level. The third objective is to create an additional carbon sink of 2.5–3 billion tons of CO₂ equivalent for the period 2020–2030.

Now, the question is whether this rosy pathway does affect the sustainable management of FDI companies in India. The Indian government gave easier access on the market to the FDI firms with the expectation of these FDI firms’ leadership coming from the global standard on the qualitative contribution to the local economy, including the environmentally friendly economic activities in India.

1.2. Research Motivation and Objective

In the literature, however, many studies have argued on the potential impacts of FDI inflows and environmental sustainability, such as pollution from CO₂ emissions, energy consumption, etc. The influence of environmental regulations on FDI firm performance for decades has been an increasingly important subject for researchers around the world [8]. In one view, FDI can bring advanced technologies to the host country and improve the country’s sustainable growth because FDI raises its level of technical progress through “learning by doing” in sustainable ways [9,10]. Another extreme point of view is that developed countries are shifting polluting industries to developing countries. It has brought much pollution to developing countries by transferring energy-intensive and much pollution-oriented plants. Therefore, the increase in the inflow of FDI could have adverse effects on the host countries, causing severe environmental pollution and degradation of the environment [11–15]. It is a widely debated subject whether India benefits from FDI or not in environmental perspectives.

Based on the above argument, this research aims to evaluate the environmental efficiency between FDI and domestic firms in India and determine the performance of FDI in the period between 2012 and 2018. Since the evaluation should be based on the dynamic effect over time with multi-inputs/outputs model, we will use the non-radial metafrontier Malmquist index to analyze our data.

1.3. Research Contribution

There are two types of firms in India; FDI and domestic firms. The FDI firm implies that a company takes controlling ownership in a business entity in another country. To take advantage of cheaper wages, FDI firms invest directly in the fast-growing Indian market and change the business environment in India. A domestic firm is defined as a local investor who can conduct business in his home country. Since this research aims to compare all FDI firms with domestic ones, it will be essential to also focus on the average variation in the productivity of each firm over time.

This study contributes to understanding how vital FDI is to build a sustainable ecosystem in India, taking into account the environmental impact. How will regulatory policies affect these firms to reduce CO₂ emissions and to improve environmental performance in India? To the best of our knowledge, no one has explored this research area in India so far. Since there is no comprehensive comparison between FDI firms and domestic firms to determine the environmental efficiency of FDI in India, this paper attempts to compare FDI and domestic firms by measuring their environmental efficiency. Therefore, the purpose of this research is empirically to analyze whether FDI inflows to India increase its CO₂ emissions or vice-versa.

The structure of the paper is as follows; in Section 2, we present a literature review in the related areas to find out our strategic variables and methodologies; in Section 3, we develop our empirical models to evaluate the environmental efficiency of FDI and domestic firms in India; we discuss our empirical result and its implications in Section 4; in Section 5, we conclude our study by providing some policy implications.

2. Literature Review

Many policymakers and academics professionals have paid considerable attention to the relationship between FDI inflows and the effectiveness of environmental sustainability in the host country. However, the impact of FDI on the environment is still unclear. Some studies argue that FDI can improve the environmental efficiency of the host country [16–18], while others find that it can damage the environment of the host country [19].

Most of the literature in energy and environment (E&E) analysis uses the multi-inputs and outputs to handle the coupling and decoupling between the potentially conflicting variables of desirable outputs such as profits or GDP, and undesirable outputs such as CO₂ emission, as shown in Table 1. Since the data envelope analysis (DEA) is very popular for handling multi-inputs/outputs models, it is also possible to utilize this approach for our research in the comparison between FDI and domestic firms as well [20,21]. The DEA approach does not need any specific form of the production function for this multi-inputs/outputs model. Thus, it is very popular to evaluate the relative efficiency for all decision-making units (DMUs), FDI, and domestic firms in our model. Thus, we first examine research papers that are related to the environmental efficiency of FDI using DEA. As shown in Table 1, we classify the previous research into three categories. First, FDI has a positive effect on the environmental efficiency of the host country [16]. Second, FDI harms (negative) the environmental efficiency of the host country [19]. Third, FDI may have a mixed effect with positive and negative impacts on the environmental efficiency of the host country [22–24].

Table 1. Comparison of the research on the environmental efficiency of FDI.

Reference(s)	Field of Research	Measurement	Method	Input/Output	Conclusions
Pan et al. (2019) [25]	FDI Quality in China	Energy efficiency	SBM-DEA	Input—energy, capital, and labor. Desirable output—GDP of each province. Undesirable output—CO ₂ emissions.	Positive
Wang (2017) [26]	FDI on energy efficiency in China	Energy efficiency	Sequential DEA	Input—capital, labor, and energy. Desirable output—GDP. Undesirable output—SO ₂ and CO ₂ .	Positive
Mastromarco et al. (2017) [27]	FDI and time	Efficiency	DEA	Input—labor and capital. Output—GDP.	Positive
Yue et al. (2016) [28]	FDI from China's Experience	Efficiency	SBM-DEA	Input—capital, labor, and energy. Desirable output—GDP. Undesirable output—SO ₂ .	Positive
Song et al. (2015) [29]	FDI in China	Efficiency	DEA	Input—variables passed the test. Desirable output—the number of patents.	Positive
Yang et al. (2019) [30]	FDI and export in China	Environmental efficiency	SBM-DEA	Input—labor, capital stock, energy consumption, and water consumption. Desirable output—industrial added value. Undesirable output—CO ₂ emissions, SO ₂ emissions, and wastewater.	Negative
Lei et al. (2013) [31]	FDI attractiveness from Chinese provinces	Bottleneck	DEA	Input—material capital, human capital, energy, and degree of openness. Output—FDI Performance Index and FDI Potential Index.	Negative
Zang et al. (2012) [32]	FDI in developing countries	Energy efficiency	Super-efficiency DEA		Negative
Monaheng et al. (2019) [33]	FDI and economic performance (BRICS)	Economic performance	DEA (managerial disposability)	Input—oil, labor force, and capital. Desirable output—GDP. Undesirable output—economic production.	Mixed
Guo et al. (2013) [11]	Regional Influence of FDI in China	Energy efficiency	DEA	Input—capital, labor and energy. Desirable output—GDP. Undesirable output—environmental pollution	Mixed
Luo et al. (2013) [34]	FDI of China	Environmental performance	DEA	Input—capital, labor, and energy. Output—GDP.	Mixed

Pan et al. [25] used the slacks-based measure (SBM)-Data Envelopment Analysis (DEA) model to measure more accurately the energy efficiency of the quality of FDI in China. They found that the quality of FDI had a significant positive effect on energy efficiency in China. Wang [26] measured the energy efficiency of FDI on energy efficiency in China and concluded that FDI significantly improves energy efficiency. Mastromarco et al. [27] analyzed FDI and time on catching up and found that FDI influences productivity by increasing efficiency and improving technological change. Yue et al. [28] measured the effectiveness of FDI from China using the SBM-DEA. They found that FDI significantly improved energy efficiency. Song et al. [29] examined FDI in China using the DEA model to measure efficiency. They found that FDI inflows can play a positive role in local economic and technological development in China, especially in some rapidly economically developing areas.

However, Yang et al. [30] compared the environmental efficiency of FDI and exports from China. They concluded that FDI reduces industrial environmental efficiency in China. Likewise, export from China also has a significant negative impact on industrial environmental efficiency. Lei et al. [31] have researched the attractiveness of FDI in Chinese provinces and found that only eastern provinces have great development potential. Zang et al. [32] have used a super-efficiency DEA model to evaluate energy efficiency from FDI in developing countries and found that FDI has a negative impact in developing countries.

Monaheng et al. [33] examined FDI and economic performance in BRICS countries. They found that FDI had a positive impact on the economic performance of the BRICS countries except for China. Guo et al. [11] analyzed the regional influence of FDI in China by measuring energy efficiency using the DEA model. They recognized that FDI inflows improve local energy efficiency in the central and eastern regions but reduce energy efficiency in the western region. Finally, Luo et al. [34] have studied FDI from China to measure environmental performance. They have argued that FDI has a positive

impact on the environment as well as a negative impact on the country's environmental efficiency. For example, FDI has improved local energy efficiency in the eastern and central regions due to the aggregate result of the technological effect, the scale effect, and the structure effect of FDI. However, FDI has reduced energy efficiency in the western zone due to the lower level of economic development.

As shown in Table 1, the authors used diverse DEA models to measure economic performance, environmental efficiency, energy efficiency, CO₂ emission performance, and efficiency of FDI in the host country. Existing literature has extensively studied the effects of FDI on a country's economic development and environmental pollution simultaneously. However, there is no comprehensive comparison between FDI firms and domestic firms to evaluate the environmental performance of FDI. Therefore, this paper attempts to measure the environmental efficiency of FDI in India by comparing the environmental efficiency of FDI and domestic firms in India.

3. Model Design and Specification

3.1. Production Technology Set

In E&E studies, the term “environmental production technology” is defined as the basic directional distance function of all the interrelated variables without any specific production frontier constraints a priori, because environmental production technology unambiguously encompasses multiple outputs, differently from other parts of traditional production theory in economics. This environmental production technology encompasses two classical inputs of the capital (x^1) employees (x^2) and the specialized input of energy (x^3), with the sales turnover variables (B) as desirable output and CO₂ (C) as an undesirable output. Therefore, we selected the three inputs and two outputs in this study, based on the traditional approach to the production function. We collected data from the annual reports of each FDI and domestic firms from different sectors that emit CO₂. Environmental production technology is defined as the causal relationship between the firm's capital (x^1), employee (x^2), and energy (x^3) as an input, and the desirable as well as undesirable outputs of firms' sales turnover (B) and CO₂ (C), respectively. According to Lee and Choi (2018), this can be expressed in the mathematical form [35]:

$$T = \{(x^1, x^2, x^3, B, C) : x \text{ can produce } (B, C)\} \quad (1)$$

where the set of production possibilities T is assumed to satisfy the standard axioms of the production theory [36]. For example, finite amounts of input can only produce limited amounts of output because inactivity is always possible [37]. Additionally, inputs and desirable outputs are often assumed with undesirable output freely disposable (weak disposability), implying that a reduction of the undesirable output such as CO₂, should match with less desirable outputs in the production process. The elimination of CO₂ can be possible if and only if by stopping production, on T concerning regulated environmental technologies (null-jointness) [38]. These two hypotheses can be expressed in the mathematical expression as follows:

- i. If $(x^1, x^2, x^3, B, C) \in T$ and $0 \leq \theta \leq 1$, then $(x^1, x^2, x^3, \theta B, \theta C) \in T$
- ii. If $(x^1, x^2, x^3, B, C) \in T$ and $B = 0$, then $C = 0$

Once the environmental production technology (T) is defined, we can specify the frontier. Consequently, we can formulate T for N FDI and domestic firms under constant returns to scale as follows [39]:

$$T = \{(x^1, x^2, x^3, B, C) : \sum_{n=1}^N Z_n x_{in} \leq x_i, \text{ where } i = x^1, x^2, x^3, \sum_{n=1}^N Z_n B_n \geq B, \sum_{n=1}^N Z_n C_n = C, Z_n \geq 0, n = 1, 2, \dots, N\} \quad (2)$$

where Z_n is an intensity variable. By using a convex combination, it can build environmental production technology. Although the assumptions of variable returns to scale are widely adopted in the various literature, we selected the constant returns to scale (CRS) for T in this study because the CRS method is easily generalized to multiple types of firms.

3.2. CRS Non-Radial Directional Distance Function

There are two types of distance functions for E&E studies, which are widely adopted Shephard distance function and the directional distance function (DDF) [40,41]. Shephard distance function is known for minimizing the inputs and undesirable output, at the same rate, maximizes the desirable output simultaneously. However, this function has several limitations. The most outstanding difficulty in Shephard distance function may come from the radial approach for its coupling issues between the desirable and undesirable outputs. To solve this coupling issue of the radial approach, the generalized directional distance function is introduced. The common limitation is that the Shephard distance function may overestimate the effectiveness when some slacks exist [42]. Using the directional weight vector (g), conventional DDF can overcome this overestimation. It can be expressed in mathematical form as follows:

$$\vec{D}(x^1, x^2, x^3, B, C; g) = \sup\{\beta : ((x^1, x^2, x^3, B, C) + g \cdot \beta) \in T\} \quad (3)$$

On the other hand, the non-radial efficiency measure is more generalized and personalized for E&E studies due to its advantage to overcome the many limitations of the radial efficiency functions, with a more generalized form that takes into account undesirable outputs [37,43,44]. Thus, our study also adopts the non-radial DDF (NDDF), which is expressed mathematically as follows:

$$\vec{D}(x^1, x^2, x^3, B, C; g) = \sup\{W^T \beta : ((x^1, x^2, x^3, B, C) + g \cdot \text{diag}(\beta)) \in T\} \quad (4)$$

The symbol 'diag' in the Equation (4) denotes diagonal matrices, which are related to the numbers of all variables and can be expressed as follows: $W^T = (W_{x^1}, W_{x^2}, W_{x^3}, W_B, W_C)^T$ denotes a normalized weight vector; g denotes an explicit directional vector which can be expressed as $g = (-g_{x^1}, -g_{x^2}, -g_{x^3}, g_B, -g_C)$; $\beta = (\beta_{x^1}, \beta_{x^2}, \beta_{x^3}, \beta_B, \beta_C)^T \geq 0$ represents individual inefficiency measures by denoting the scaling vector for all variables. In order to avoid the diluting effect of non-energy variables, we set the directional vector of capital and labor to be zero, because capital and labor do not directly affect CO₂ emissions [45]. Therefore, the directional vector of this study is $g = (0, 0, -g_{x^3}, g_B, -g_C)$ and the weight vector is $(0, 0, 1/3, 1/3, 1/3)$. We can, therefore, define NDDF value in the mathematical form [46]:

$$\begin{aligned} \vec{D}(x^1, x^2, x^3, B, C; g) &= \max W_{x^3} \beta_{x^3} + W_B \beta_B + W_C \beta_C \\ \sum_{n=1}^N Z_n x^1_n &\leq x^1_{n'}, \quad \sum_{n=1}^N Z_n x^2_n \leq x^2_{n'}, \quad \sum_{n=1}^N Z_n x^3_n \leq x^3_{n'} - \beta_{x^3} g_{x^3} \sum_{n=1}^N Z_n B_n \\ &\leq B_{n'} + \beta_B g_B \sum_{n=1}^N Z_n C_n = C_{n'} - \beta_C g_C \\ Z_n &\geq 0, \quad n = 1, 2, \dots, N \\ \beta_{x^1}, \beta_{x^2}, \beta_{x^3}, \beta_B, \beta_C &\geq 0. \end{aligned} \quad (5)$$

In Equation (5), we can modify the directional vector g , according to our different political objectives of reducing CO₂ emissions. If $\vec{D}(x^1, x^2, x^3, B, C; g) = 0$, this would indicate that a specific FDI or domestic firm under the evaluation is located in the best-practice production frontier in the g direction [37]. We also formulated the static total-factor CO₂ emissions performance index (TCPI) as the ratio of the actual carbon intensity to the potential target carbon intensity [43]. If β_C^* and β_B^* are the

optimal solutions that correspond to undesirable output CO₂ emissions and desirable output sales turnover in Equation (5), then, the TCPI can be described as follows,

$$TCPI = \frac{(C - \beta_C^* C / (B + \beta_B^* B))}{C/B} = \frac{1 - \beta_C^*}{1 + \beta_B^*} \quad (6)$$

In this study, Equation (6) can be used to measure the performance of CO₂ emissions from FDI and domestic firms and measure the maximum possible reductions in CO₂ intensity over the 2012–2018 period. If the TCPI is higher, then the CO₂ emission performance will be better. Besides, the TCPI lies between zero and unity; therefore, the best CO₂ emission performance of FDIs and domestic firms will be located along the frontier when the TCPI is equal to unity.

3.3. Non-Radial Metafrontier Malmquist CO₂ Performance Index (NMMCPI)

Based on the metafrontier Malmquist index, some authors have proposed a *Non-radial Metafrontier Malmquist CO₂ Performance Index (NMMCPI)* to measure the dynamic total-factor CO₂ emission performance [47,48]. Here, the MMCPI is defined as the difference between the weighted average rates of change of (negative) inputs, (positive) outputs, and (negative) outputs. The NMMCPI measures the change in TCPI during period t and $t + 1$. It is useful to evaluate environmental performance change over time. Thus, we adopted the non-radial metafrontier Malmquist CO₂ Performance Index (NMMCPI) to examine the environmental efficiency of FDI and domestic firms in India.

To define and decompose the NMMCPI in this study, we need to define the three sets of environmental technologies, i.e., contemporaneous environmental technology, intertemporal environmental technology, and global environmental technology. We determine these sets as follows [49]. The first sets of environmental technologies called the contemporaneous environmental technology of R_h can be expressed as $T_{R_h}^C = \{(x^1, x^2, x^3, B^t, C^t) : (x^1, x^2, x^3) \text{ can produce } (B^t, C^t)\}$ where $t = 1 \dots T$. For a particular period t and group R_h , it constructs production technology set in Equation (2). The second set of environmental technologies is an intertemporal environmental technology and its R_h can be expressed as $T_{R_h}^I = T_{R_h}^1 \cup T_{R_h}^2 \cup \dots \cup T_{R_h}^T$. This is constructed from observations for group R_h which consists of a single technology over the whole period. This implies that the observations for an intertemporal environmental technology are assumed to be unable to access different intertemporal environmental technologies easily. For the distinct intertemporal technologies, we assumed that there are h groups subsequently. Finally, global environmental technology is considered in the third set of environmental technologies that can be expressed in the form: $T^G = T_{R_1}^I \cup T_{R_2}^I \cup \dots \cup T_{R_H}^I$, which is constructed from all observations for FDI and domestic firms groups over the 2012–2018 period. This implies that global environmental technology encompasses all intertemporal environmental technologies. For the sake of analysis, we assume that every observation (theoretically and potentially) can access global technology through its innovations.

Based on these three decomposed technologies, our environmental technologies under the non-radial directional distance functions in Equation (4) can be expanded as follows. First, based on contemporaneous environmental technology ($T_{R_h}^C$) we define contemporaneous NDDF of a specific group R_h as $\vec{D}_D C(.) = \sup \{w^T \beta^C : ((x^1, x^2, x^3, B, C) + g * \text{diag}(\beta_C)) \in T_{R_h}^C\}$. Second, we define intertemporal NDDF as $\vec{D}_D I(.) = \sup \{w^T \beta^I : ((x^1, x^2, x^3, B, C) + g * \text{diag}(\beta^I)) \in T_{R_h}^I\}$ of a specific group R_h based on the intertemporal environmental technology $T_{R_h}^I$. Following global environmental technology, we define global NDDF as $\vec{D}_D G(.) = \sup \{w^T \beta^G : ((x^1, x^2, x^3, B, C) + g * \text{diag}(\beta^G)) \in T_{R_h}^G\}$. Therefore, the following six different NDDFs could be solved in order to decompose and compute the NMMCPI as follows: $\vec{D}_D C = (x^{1^S}, x^{2^S}, x^{3^S}, B^S, C^S)$, $\vec{D}_D I = (x^{1^S}, x^{2^S}, x^{3^S}, B^S, C^S)$,

and $\vec{D} G = (x^{1S}, x^{2S}, x^{3S}, B^S, C^S)$, where $S = t, t + 1$. With these three technologies, NDDF can be solved using Equation (5) as follows:

$$\begin{aligned} \vec{D} d = (x^{1S}, x^{2S}, x^{3S}, B^S, C^S; g) = \max & W_{x^3} \beta_{x^3}^d + W_B \beta_B^d + W_C \beta_C^d \\ & \sum_{\text{con}} Z_n^S x_n^{1S} \leq x_{n'}^1 \quad \sum_{\text{con}} Z_n^S x_n^{2S} \leq x_{n'}^2 \\ & \sum_{\text{con}} Z_n^S x_n^{3S} \leq x_{n'}^3 - \beta_{x^3}^d g_{x^3} \quad \sum_{\text{con}} Z_n^S B_n^S \geq B_{n'} + \beta_B^d g_B \quad \sum_{\text{con}} Z_n^S C_n^S \geq C_{n'} - \beta_C^d g_C \\ & Z_n^S \geq 0, \beta^d \geq 0 \end{aligned} \quad (7)$$

where the superscript d on $\vec{D} d$ can be a contemporaneous, intertemporal, and global environmental technology, which represents the type of NDDF. Besides, the symbol “con” under $\sum$ designates the construction conditions of three environmental technologies. If we want to construct the contemporaneous NDDF, we required the conditions $d \equiv C$ and $\text{con} \equiv \{n \in R_h \text{ to build the intertemporal NDDF, we need the conditions set } d \equiv I \text{ and } \text{con} \equiv \{n \in R_h \text{ s } \epsilon 1, 2, T\}\}$; and the requirements should be $d \equiv G \text{ con} \equiv \{n \in [R_1 \cup [R_2 \cup \dots \cup R_H], s \epsilon 1, 2, \dots, T]\}$, for the global NDDF. Using Equation (7), we can solve the six different NDDF models in Equation (6).

$$\text{TCPI}^d(x^{1S}, x^{2S}, x^{3S}, B^S, C^S) = \left[\frac{(C - \beta_C^{d*} C / (B + \beta_B^{d*} B))}{C/B} \right]^S = \left(\frac{1 - \beta_C^{d*}}{1 + \beta_B^{d*}} \right)^S \quad (8)$$

where $S = t, t + 1$ and $d = (C, I, G)$. We define the NMMCPI, based on the formulation of the metafrontier Malmquist index within the framework of the global environmental technology set [46]. It can be expressed as the ratio.

$$\text{NMMCPI}(x^{1S}, x^{2S}, x^{3S}, B^S, C^S) = \frac{\text{TCPI}^G(x^{1t+1}, x^{2t+1}, x^{3t+1}, B^{t+1}, C^{t+1})}{\text{TCPI}^G(x^{1t}, x^{2t}, x^{3t}, B^t, C^t)} \quad (9)$$

NMMCPI measures the variations of the TCPI from Equation (9), on the T^G for the period between t and $t + 1$. Now, NMMCPI can be decomposed into a technical efficiency change (EC) index of CO₂ emissions, a best-practice gap change (BPC) index of CO₂ emission reduction technologies, and a technology gap change (TGC) as follows [47,48]:

$$\begin{aligned} \text{NMMCPI}(x^{1S}, x^{2S}, x^{3S}, C^S) &= \frac{\text{TCPI}^G(.^{t+1})}{\text{TCPI}^G(.^t)} \\ &= \left\{ \frac{\text{TCPI}^C(.^{t+1})}{\text{TCPI}^C(.^t)} \right\} * \left\{ \frac{\text{TCPI}^I(.^{t+1}) / \text{TCPI}^C(.^{t+1})}{\text{TCPI}^I(.^t) / \text{TCPI}^C(.^t)} \right\} * \left\{ \frac{\text{TCPI}^G(.^{t+1}) / \text{TCPI}^I(.^{t+1})}{\text{TCPI}^G(.^t) / \text{TCPI}^I(.^t)} \right\} \\ &= \left[\frac{\text{TE}^{t+1}}{\text{TE}^t} \right] * \left[\frac{\text{BPR}^{t+1}}{\text{BPR}^t} \right] * \left[\frac{\text{TGR}^{t+1}}{\text{TGR}^t} \right] = \text{EC} * \text{BPC} * \text{TGC} \end{aligned} \quad (10)$$

In the Equation (10) the term efficiency change or EC index measures the “catching-up” effect, which measures the technical efficiency changes of CO₂ emissions for a specific FDI or a domestic firm for two time periods ($t, t + 1$) within a specific group. The EC Index captures how close an FDI or a domestic firm is toward contemporaneous environmental technology. If $\text{EC} > 1$, there is an efficiency gain, and if the $\text{EC} < 1$, there is a loss of efficiency [39]. The best practice gap change or BPC index is the change in the best practice gap in two adjacent periods between contemporaneous environmental technology and intertemporal environmental technology. Here, if $\text{BPC} > 1$, the contemporaneous environmental technological frontier in period $t + 1$ is closer to intertemporal environmental technology than in period t , and if $\text{BPC} < 1$, the contemporaneous technological frontier is further from the intertemporal environmental technological frontier [45]. BPC is also seen as the innovation effect since

innovation allows a shift of the frontier. The Technology Gap Change or TGC Index is the change in technological leadership during the two periods between the intertemporal environmental technology frontier and the global environmental technology frontier for reducing CO₂ emissions. For example, $TGC > (or <) 1$ indicates that a technical gap between a specific group of intertemporal technology and global technology is reduced (increased). Therefore, TGC measures the effect of technological leadership for a given group.

Figure 3 shows NMMCPI and its decomposed components. Here, contemporaneous environmental technology is presented as $T_{R_1}^C$ and $T_{R_1}^{C+1}$ in the group R_1 or the periods t and $t + 1$. Intertemporal environmental technology is presented as $T_{R_1}^I$ for group R_1 and global environmental technology for two groups is presented as $T_{R_1}^G$ [50]. Here, the intertemporal technological set is the envelope of all contemporaneous technological set in the current period of a particular group, and the global technological set is the envelope of all intertemporal technologies set. Here, the observed FDI and domestic firms for the two periods t and $t + 1$ are a_1 and a_2 because it is a case of two groups (R_1, R_2) and two periods ($t, t + 1$), respectively.

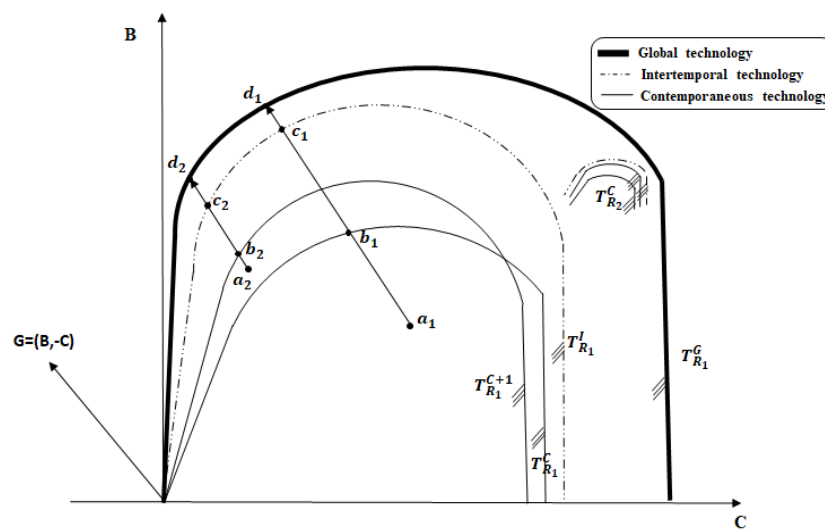


Figure 3. Graphic illustration of non-radial metafrontier Malmquist CO₂ performance index (NMMCPI) and its decomposition components. Source: Zhang and Choi, 2014 [37], Oh et al., 2010 [49].

4. Analysis and Discussion

4.1. Data Collection and Preprocessing

Since this study aims to compare the environmental efficiency of FDI firms with domestic firms, we collected data on 50 firms belonging to both groups from 2012 to 2018. Concerning the industrial sector, the following sectors were chosen: chemicals, constructions, pharmaceuticals, power, automobile, infrastructure, and others. We selected these sectors because they have the largest inflow of FDI to India, subject to the percentage of total inflows in 2018 (see Figure 2). Additionally, we selected 25 FDI companies and 25 domestic companies in India, based on the availability of firm data and FDI equity inflows by sector in India as of 2018. These firms could be considered the representative companies of these sectors, which have high CO₂ emissions [51]. The service sector and telecommunications sectors were excluded because of their low emission volume and the scarcity of data. Based on the argument on Table 1, we collected three input variables, capital (x^1) labor (x^2) and energy (x^3) and two output variables, sales turnover (B) and CO₂ emissions (C). All the data concerning capital, labor, energy, sales turnover, and CO₂ were collected in the annual report of each FDI and domestic firm between 2012 and 2018. We selected seven-year data from 2012 to 2018 because the classification in this study was based on two types of the policy paradigm shift in India to reduce CO₂ emissions. These two policies are energy and carbon taxes under the United Nations Framework Convention on Climate

Change, 2010, and Nationally Determined Contributions (NDCs) under the Paris Agreement, 2016. According to THE HINDU in 2018, environmental regulations in India have very few impacts on FDI firms [13]. The World Resources Institute India declared in June 2019 that after biomass combustion, companies are the second largest contributor to PM2.5 in India [52]. Concerning this, we wanted to analyze the environmental efficiency of FDI and domestic firms in India based on the policy paradigm shift in India.

For the capital input, we extracted the data on fixed assets from the published annual reports of each FDI and domestic firms from 2012 to 2018. We collected the employees per head of each company, as shown in the annual report of each DMU. For energy input data, since there is no right amount of energy consumption provided by each firm in their report, we had to convert the power and fuel consumption into total energy consumption equivalent value from the annual report published by the firms. For sales turnover output, we collected the revenues of the firms generated by the operations. For the CO₂ emissions data, we extracted the CO₂ values using the macro level of the FDI and domestic firm's data of power and fuel consumption rate [37,53]. These descriptive statistics (all the variables) are shown in Table 2.

Table 2. Descriptive statistics of input and output variables from 2012–2018.

Group	Variable	Input/Output	Unit	Mean	Std. Deviation	Maximum	Minimum
FDI	Capital	Input	Million rupees	16,134.19	29,101.62	145,220.00	103.85
	Employee	Input	Per person	3387.12	4968.39	24,491.00	48.00
	Energy	Input	Gj	362,115.59	654,115.20	3,195,000.00	3116.16
	Sales Turnover	Desirable output	Million rupees	49,033.27	90,114.70	493,699.73	813.75
	CO ₂ Emissions	Undesirable output	Tons	17,782.89	36,434.82	218,541.00	111.40
Domestic	Capital	Input	Million rupees	173,821.11	4,315,63.83	3,004,470.00	549.20
	Employee	Input	Per person	10,790.33	14,906.18	71,826.00	133.00
	Energy	Input	Gj	1,981,662.00	3,012,483.17	13,180,794.43	17,142.97
	Sales Turnover	Desirable output	Million rupees	305,544.82	738,513.58	3,990,530.00	1082.51
	CO ₂ Emissions	Undesirable output	Tons	100,795.48	159,748.60	636,676.79	612.86

Table 3 illustrate the correlation matrix of input and output variables of FDI and domestic firms from 2012–2018. The result shows that the correlation between all types of input and output variables is positive. Capital and labor are positively linked to sales turnover because they are representative variables to explain production; in particular, capital and turnover show a highly significant relationship. On the other hand, energy shows a positive relationship for both sales turnover and CO₂ emissions; in particular, energy and CO₂ emissions show a highly significant relationship [54,55]. In this study, the result verifies the suitability of analyzing the data from an environmental point of view.

Table 3. Correlation matrix of input and output variables.

Variables	Capital	Employee	Energy	Sales Turnover	CO ₂
Capital	1.00				
Employee	0.27	1.00			
Energy	0.50	0.50	1.00		
Sales turnover	0.82	0.22	0.29	1.00	
CO ₂ emission	0.48	0.41	0.96	0.26	1.00

4.2. Result and Its Implications

Table 4 shows the average value of the NMMCPI index and its decomposition for FDI and the domestic firm in India. Due to the firm's confidentiality, we used the firm's *id* in our results in Table A1.

Table 4. Comparison of average NMMCPI and its decomposition.

Year	FDI				Domestic			
	NMMCPI	EC	BPC	TGC	NMMCPI	EC	BPC	TGC
2012–2013	1.0046	0.9972	1.0457	0.9634	0.9925	0.9554	1.0075	1.0311
2013–2014	0.9989	0.9932	1.0316	0.9749	1.0029	0.9766	1.0075	1.0193
2014–2015	0.9969	1.0189	0.9649	1.0140	1.0101	1.0481	0.9800	0.9834
2015–2016	1.0019	0.9970	1.0044	1.0005	1.0129	1.0094	1.0054	0.9981
2016–2017	1.0007	1.0190	0.9466	1.0374	1.0120	1.0618	0.9854	0.9672
2017–2018	1.0062	1.0065	1.0007	0.9990	1.0585	1.0174	1.0281	1.0120
Average	1.0015	1.0053	0.9990	0.9982	1.0148	1.0115	1.0023	1.0019

First, we can see that the overall NMMCPI of the FDI firms remains stable with a slightly lower growth rate of 0.15%, while domestic firms show 1.48%. This result implies that domestic firms improve their performance in implementing the environmental regulatory regime during the study period, compared to FDI firms in India. In terms of the average EC index of FDI firms, the growth rate is 0.53%, indicating a lower growth rate in efficiency during the study period. At the same time, domestic firms show an annual increase of 1.15%, implying that domestic firms do better for the best catch-up effect, suggesting the more proactive movement towards the contemporary environmental technological frontier. In terms of the average BPC index, FDI firms show the value lower than unity (0.9990), while domestic firms show a 0.23% increase. Since the BPC index captures the “innovation effect,” this result implies that domestic firms expanded their production level under the environmental regulatory regime. The average annual TGC index of FDI and domestic firms is 0.9982 and 1.0019, respectively. This implies a lack of technological leadership among FDI firms in India during the study period. The gap between the intertemporal frontier and the global frontier has narrowed for FDI firms, as the TGC index is a measure of changes in technological leadership for a given group.

Figure 4 shows the trends in the NMMCPI for FDI and domestic firms during 2012–2018. Regarding the dynamic perspective over time, we can see that the performance of FDI firms in annual total factor CO₂ emissions shows a lower growth rate during the study period, which is close to unity. This could be due to the lack of policy effect on FDI firms in India because policy in India has a soft signal for the foreign market [13]. Therefore, there is a missing link in the role of the Indian government for FDI firms. We suggest that the Indian government should be aware of this phenomenon and take certain measures to reduce the differences between local firms and FDI firms. Like FDI firms, domestic firms also show a low growth rate in the performance of total factor CO₂ emissions from 2012 to 2017, which is 1.0120. However, after 2016–2017, the graph shows an upward trend, which is above the unity of 5.85% in 2018. This J-curve effect means that there is an effect of government regulation on domestic firms in India. This may be due to the implementation of the policy that the Indian government has adopted. Indian government set a very clear and strong CO₂ reduction target in 2016, called Nationally Determined Contributions (NDC), under the Paris Climate Agreement. Consequently, all of the firms that emit the most CO₂ are under pressure to reduce their CO₂ emissions. Due to the higher regulatory costs, this type of strict regulation could affect a firm’s performance at the initial level. That is why the performance of domestic firms was observed highly enhanced after 2016–2017. Even if there are no strong regulations yet for the FDI firms in India, they should show their efforts to reduce CO₂ emissions under the mixed economy such as India. It also supports Porter’s hypothesis that if a country has tighter environmental regulations, it will increase the efficiency of that particular country and encourage innovation for a more environmentally friendly production process [53].

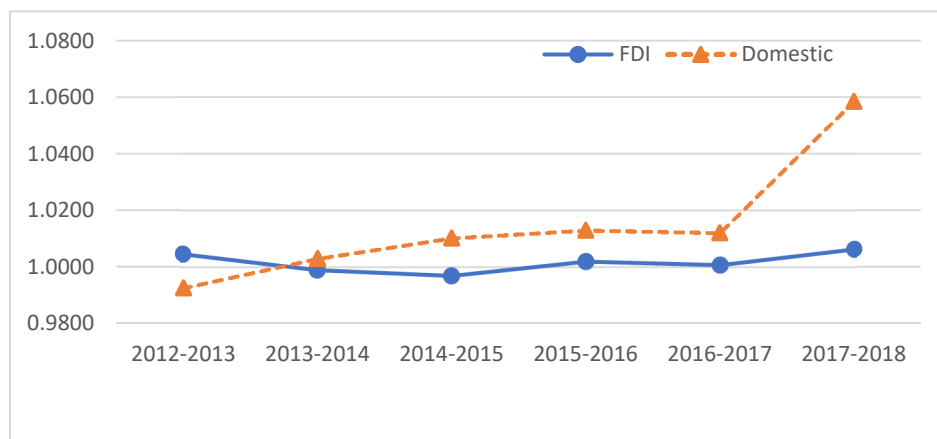


Figure 4. Change in the NMMCPI for FDI and domestic firms during 2012–2018.

Figure 5 shows the trends in the EC index of FDI and domestic firms from 2012–2018. In this figure, the FDI shows an M-shaped trend. The EC index of FDI firms for 2012–2014 shows a value less than or equal to unity, indicating the loss of catch-up performance. However, the EC index alternately goes above or below, for the 2014–2018 period, but remains close to unity. This means that the catch-up performance of FDI firms remains unchanged during the study period. This needs to be investigated by Indian policymakers to determine why there is a lower growth rate efficiency of FDI firms in India. Policymakers should, therefore, come up with appropriate policy solutions that will be easily adopted by FDI firms in India, as some foreign firms are not very sensitive to local regulations. The EC index of domestic firms for the period 2012–2014 shows a value of less than unity. This indicates that during these years, the catch-up performance decreased. However, after 2013–2014, the EC index was higher than unity, which suggests that their catch-up performance in reducing CO₂ emissions has improved. Given that, in a specific group, the EC index measures to what extent an FDI and domestic firm increase its efficiency. There is a gain in efficiency if $EC > 1$, and there is a loss in efficiency if $EC < 1$ [39]. Therefore, in terms of the catch-up effect, domestic firms perform better than FDI firms. This means that domestic firms in India have improved efficiency by the catch-up effect of the best practice frontier during the period 2012–2018. This may be because most of the FDI companies come from market-oriented economies and are therefore not very serious about emission reduction policies. Therefore, Indian policymakers should adopt more robust, transparent, and predictable policies for FDI companies in India.

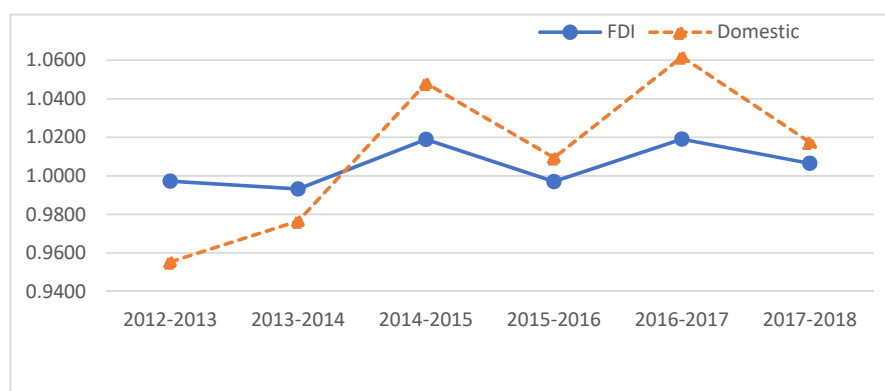


Figure 5. Change in the efficiency change (EC) index.

Figure 6 shows the trends in the BPC index of FDI and domestic firms during the period 2012–2018. From Figure 6, we can see in the BPC index that FDI and domestic firms show a similar trend. For both the FDI and domestic firms, the BPC index was higher than unity during the 2012–2014

and 2017–2018 periods, which suggests a benefit from better innovation performance as well as fast upgrading of equipment and technology. However, during the 2014–2015 and 2016–2017 periods, the BPC index of FDI and domestic firms declined, while 2016–2017 was the lowest growth rate in FDI firms. The reasons could be due to the slowdown in Indian economic growth in 2016–2017, reflecting lower growth of industry and other sectors due to several factors [56]. Overall, domestic firms perform better than FDI firms in terms of the innovation effect in the Indian firm scenario. We suggest that policymakers should support innovative companies and offer them a reward for sustainable development. Additionally, other companies should consider particular innovative companies as their benchmark for creating sustainability.

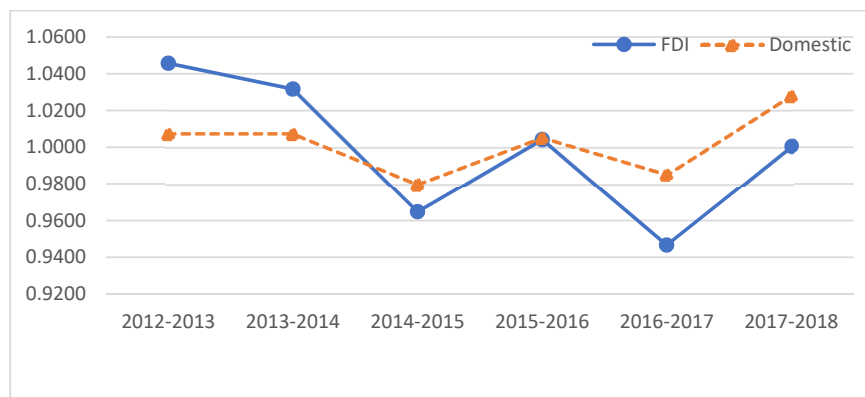


Figure 6. Change in the best-practice gap change (BPC) index.

As shown in Figure 7, the TGC index of FDI and domestic firms shows the contradictory trend between them. For example, in 2012–2014 and 2017–2018, the performance of FDI was less than unity, indicating a decrease in the performance of technology leadership. At the same time, the performance of domestic firms in terms of technology leadership is greater than unity in the same year. However, in 2014–2017, the results show that the performance of FDI was greater than unity, indicating an improvement in the performance of technology leadership and vice-versa for the domestic firms. This suggests that there has been conflicting technological leadership performance by FDI and domestic firms during the study period. Compared to unity, if $TGC >$ (or $<$) 1, there is a decrease (increase) in the technology gap between the intertemporal technology and the global technology for a specific group. Although the average annual value of domestic firms in the TGC index is a little higher than that of FDI firms, dynamic trends show that there is an increase in the performance of FDI firms during the study period from 2012–2018. Policymakers should understand technological revolutions and encourage companies to initiate and lead the commercialization of technological advancements and coordinate their use of technology to achieve sustainable goals.

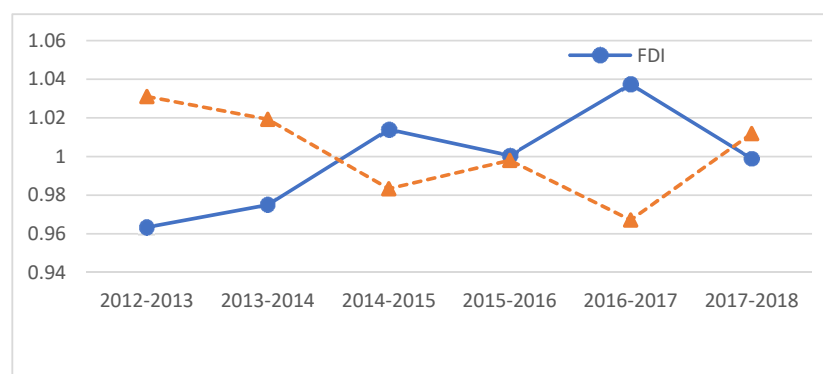


Figure 7. Change in technology gap change (TGC) index.

5. Conclusions

In this study, we analyzed the environmental efficiency of both FDI firms and domestic firms in India for the seven years (2012–2018), based on NMMCPI. This methodology could incorporate group heterogeneity; it could provide each firm with more optimized implications and solutions.

Our main findings and suggestions are summarized as follows: first, according to the NMMCPI index, the result implies that domestic firms have improved their performance in the implementation of the environmental regulatory regime, compared to FDI firms in India. This could be due to the lack of policy effects on FDI firms in India. Therefore, there is a missing link in the role of the Indian government for FDI firms. We suggest that the Indian government should be aware of this phenomenon and take certain measures to reduce the differences between local firms and FDI firms. Second, based on our study, we found that domestic firms showed better catch-up performance (EC) and better innovation performance (BPC) than FDI firms in India. This may be since most of the FDI firms come from market-oriented economies, and thus they are not very serious for the emission abatement policies. Therefore, Indian policy-makers should adopt stronger transparent and predictable policies for the FDI firms in India. Otherwise, it is just a tiger drawn in the paper for the FDI firms with negotiable powers with the local government. Third, although the average annual value of domestic firms in the TGC index is higher than that of FDI firms, the overall dynamics of the TGC index of FDI firms show an increasing trend. In contrast, domestic firms decline from the period 2012–2018. Many global companies are not sustainable in their host country due to their weak accountability of global standards in the host economy and lack of surveillance of local government. Finally, many local governments expect too much of FDI firms with the same level of regulations as domestic firms. Still, this is not strong enough for global companies. Therefore, they must understand that their bad behavior can have a significant negative effect not only on the host country but also on all other local markets in the world, especially developing countries. It is time for FDI firms to shift their paradigm of local management in the host country into sustainable and inclusive economic perspectives.

Due to the scarcity of data and the low volume of emission, we excluded the service sector and telecommunications sectors, which represented the highest FDI inflows to India in 2018. Our future research will include both the service sector and the telecommunications sectors to analyze the efficiency of FDI and domestic firms in India. In addition to our model, we could use regression analysis for local and global companies to thoroughly test Porter's hypothesis through statistical analysis on the determinants of CO₂ emission performance. On the other hand, this paper could be further extended with the MNMCPI bootstrap for total factor CO₂ emission performance and its decompositions to perform statistical inference.

Author Contributions: The authors contributed to each part of the paper by: conceptualization, Y.C.; methodology and software, H.L.; validation, Y.C.; formal analysis, J.D.; investigation, J.D.; resources and data collection, J.D.; writing—original draft preparation, J.D.; writing—review and editing, Y.C.; supervision, Y.C.; project administration, Y.C.; funding acquisition Y.C. All authors have read and agreed to the published version of the manuscript.

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

Appendix A

Table A1. The average value of the NMMCPI for FDI and domestic firms.

DMU	Group	NMMCPI	EC	BPC	TGC
FDI 1	FDI	1.0001	1.0008	1.0217	0.9781
FDI 2	FDI	0.9997	1.0057	0.9971	0.9969
FDI 3	FDI	1.0015	1.0056	1.0001	0.9958
FDI 4	FDI	1.0004	1.0024	0.9705	1.0283
FDI 5	FDI	0.9989	0.9999	0.9973	1.0017
FDI 6	FDI	0.9964	0.9997	0.9897	1.0071
FDI 7	FDI	1.0029	1.0143	0.9932	0.9955
FDI 8	FDI	1.0007	1.0022	1.0345	0.9652
FDI 9	FDI	1.0013	1.0071	1.0474	0.9492
FDI 10	FDI	1.0152	1.0383	1.0150	0.9633
FDI 11	FDI	1.0014	1.0041	0.9984	0.9989
FDI 12	FDI	1.0004	1.0013	1.0019	0.9972
FDI 13	FDI	1.0285	1.0389	1.0503	0.9426
FDI 14	FDI	1.0001	1.0016	0.9893	1.0093
FDI 15	FDI	1.0000	1.0004	0.9911	1.0086
FDI 16	FDI	1.0002	1.0011	0.9982	1.0009
FDI 17	FDI	1.0000	1.0004	0.9899	1.0098
FDI 18	FDI	0.9876	0.9805	0.9991	1.0081
FDI 19	FDI	1.0003	1.0011	0.9650	1.0354
FDI 20	FDI	1.0023	1.0115	0.9945	0.9964
FDI 21	FDI	0.9999	1.0051	0.9942	1.0006
FDI 22	FDI	1.0003	1.0016	0.9790	1.0201
FDI 23	FDI	1.0009	1.0031	0.9977	1.0001
FDI 24	FDI	0.9997	1.0002	0.9598	1.0414
FDI 25	FDI	0.9996	1.0062	0.9999	0.9935
	FDI	1.0015	1.0053	0.9990	0.9978
Dom1	Domestic	1.0535	1.0000	0.9993	1.0542
Dom2	Domestic	1.0011	1.0041	1.0023	0.9947
Dom3	Domestic	0.9465	0.9523	1.0126	0.9815
Dom4	Domestic	1.0003	1.0020	0.9981	1.0002
Dom5	Domestic	1.0012	1.0040	0.9990	0.9982
Dom6	Domestic	0.9915	0.9900	1.0137	0.9880
Dom7	Domestic	1.0012	1.0081	1.0063	0.9869
Dom8	Domestic	0.9949	0.9821	0.9986	1.0145
Dom9	Domestic	1.0524	0.9892	1.0111	1.0522
Dom10	Domestic	1.0182	1.0000	0.9813	1.0376
Dom11	Domestic	1.0908	1.0662	0.9973	1.0258
Dom12	Domestic	0.9978	0.9962	0.9990	1.0026
Dom13	Domestic	1.0148	0.9709	1.0055	1.0395
Dom14	Domestic	1.0024	1.0136	0.9988	0.9901
Dom15	Domestic	1.0033	1.0130	0.9996	0.9908
Dom16	Domestic	1.0002	1.0001	0.9992	1.0009
Dom17	Domestic	0.9995	1.0017	1.0163	0.9818
Dom18	Domestic	0.9985	0.9995	1.0102	0.9889
Dom19	Domestic	1.0148	1.0575	1.0158	0.9447
Dom20	Domestic	1.0003	1.0041	0.9916	1.0047
Dom21	Domestic	1.1657	1.1630	0.9951	1.0073
Dom22	Domestic	0.9563	0.9837	0.9987	0.9734
Dom23	Domestic	1.0001	1.0008	0.9978	1.0015
Dom24	Domestic	1.0650	1.0846	1.0162	0.9663
Dom25	Domestic	0.9997	0.9998	0.9941	1.0058
	Domestic	1.0148	1.0115	1.0023	1.0013

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