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The Moderating Role of Income on the Complexity–Sustainability Nexus: Evidence from BRICS Members

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Abstract: This research paper explores the relationship between economic complexity and environmental degradation by highlighting the moderating role of income level. The paper focuses on the BRICS member economies "Brazil, Russia, India, China, South Africa" and utilizes data for the period 1998–2022. Several suitable econometric estimators such as "Fixed Effects (FE)", "Feasible Generalized Least Squares (FGSL)", and "Two Stages Least Squares (2SLS)" are used to obtain results. The main findings show that economic complexity degrades the quality of the environment significantly. However, the results further indicated that income level helps the economic complexity to improve environmental quality. Moreover, the results also revealed that trade openness, income level, and energy use have also significantly degraded the quality of the environment. The causality analysis performed demonstrated a one-way causal relationship running from economic complexity to environmental degradation. Our results have important policy implications for the policymakers of the BRICS economies.

Keywords: economic complexity; environmental degradation; income level; BRICS

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1. Introduction

Environmental degradation significantly influences advanced and developing economies in several aspects, as documented in the literature [1]. Increased global temperature is a serious threat to the "sustainable development goals (SDGs)" as endorsed by [2]. This implies that global efforts are needed to address the problem of environmental degradation and help economies achieve their SDGs. Several respiratory diseases in humans, extreme weather conditions, and loss of biodiversity are the direct noticeable consequences of environmental degradation. Human activities during the last few decades have worsened environmental quality. These activities include but are not limited to farming, deforestation, buildings, the extraction of natural resources, fuel burning, and solid waste generation [3].

Refs. [4,5] demonstrated that increased use of energy degrades the environment enormously. [6] demonstrated that urbanization and income are the primary drivers of environmental degradation. [7] displayed that income level, natural resources, and the level of urbanization linked to environmental degradation positively. Moreover, some researchers have shown that the policy of trade openness also contributes significantly to the process of environmental degradation [1,4,7].

The level of earnings moderates the influence of intricacy and results in lower CO_2 emissions in BRICS nations. [3] defined economic complexity as "the structural changes existing in the production structure as it moves towards more technological- and knowledge-based production processes". Economic complexity is basically the reflection of knowledge-based and sophisticated production processes in an economy, as documented by [8]. This definition of economic complexity implies that environmental degradation is dependent on the level of economic complexity. Advancements in technologies in the process of production may help economies to mitigate CO_2 emissions. [9] endorsed that increased economic complexity is responsible for improved environmental quality, better health, higher birth expectancy, and lower mortality rates.

Economic complexity is one of the main factors that could explain disparities in income levels across countries, as pointed out by [10]. However, increased income due to economic complexity may help economies to address the issue of environmental degradation. In other words, increased income level may be the likely channel by which complexity improves the quality of the environment by curbing greenhouse gas emissions. However, prior literature has been silent on the role of income in the complexity–environment nexus.

This research paper focuses on the BRICS member economies "Brazil, Russia, India, China, South Africa" to assess the influence that complexity has on the environment. The BRICS economies have registered significant improvement in terms of improving their growth process, and further, they are responsible for a large part of the global emissions [11]. The combined GDP of BRICS economies is 23% of the global GDP, and they are further responsible for 41% of worldwide CO_2 emissions, as pointed out by [2]. The BRICS economies are also responsible for 40% of global energy consumption [11]. The BRICS members are emerging economies using sophisticated production techniques to increase the production of goods and services and to improve the performance of their export sector. In such a situation, economic complexity, which is the modern name of advanced technologies and sophisticated techniques of production, could play an important role in reducing emissions. Economic complexity as a determinant of environmental degradation has received some attention recently. Some studies have focused on the BRICS economies to explore the complexity–environment nexus; however, the findings reported are contradictory and inconclusive. For instance, [11] reported that complexity could stimulate environmental quality in BRICS economies. On the other hand, [12] provided evidence about the positive influence of complexity on environmental degradation in the BRICS economies. The observed contradictory findings could be explained by highlighting the role of income level in the relationship between complexity and environmental quality. However, the available literature on the moderating role of income level. Moreover, the process of industrialization has also gained enormous momentum recently among all BRICS members. Therefore, amid all these recent developments in BRICS economies, it becomes important to quantify the impacts of complexity on environmental degradation by focusing on the moderating role of income level. The outcome of this paper will contribute to the policymaking process in the BRICS economies.

Consequently, we contribute to the ongoing literature in four ways. Firstly, we provide significant fresh evidence on the potential linkages between complexity and environment. Secondly, we intend to highlight the moderating role of income level while exploring the impact of economic complexity on environmental degradation. Thirdly, the current study is also interested in exploring whether economic complexity causes environmental degradation or environmental degradation leads to economic complexity. Fourthly, the present study contributes to the BRICS context, which has recently focused on more advanced and sophisticated tools of production.

This research paper is divided into several interconnected sections. Section 2 pays attention to relevant literature. Section 3 discusses key statistics of BRICS economies. The modeling and methodology part is presented in Section 4. Results are analyzed in Section 5. Section 6 includes causality findings. The final Section includes concluding remarks, implications, and limitations.

2. Review of Literature

Economic complexity and its potential influence on environmental degradation is a recent phenomenon in literature. Economic activities in the early stages do not harm the environmental quality as they are based on the traditional agrarian sector, as discussed by [8]. They further endorsed that in the second stage of the development process, due to the structural changes in the economy, the process of industrialization flourishes, which worsens environmental quality.

There are several empirical research studies available on the potential linkages between complexity and environment. For instance, using data from 35 OECD economies for the period 1998–2017, [3]. demonstrated that complexity directly degrades the quality of the environment. They further showed that increased income levels help economic complexity by decreasing CO2 emissions and improving the quality of the environment. It seems that income level works as a moderating factor. [13] have focused on ecological footprints as an indicator of environmental sustainability and demonstrated that economic complexity increases ecological footprint by utilizing data for the period 1980–2017. These recent studies show that economic complexity matters for the quality of the environment.

In the most complex economies, [14] provided some empirical evidence about the relationship between economic complexity and environmental degradation. Their results based on several econometric techniques indicated that complexity and energy use significantly contribute to CO_2 emissions. They further documented that policymakers should adopt policies to encourage greener technologies in production to meet the SDGs. Achieving SDGs is important as they have a direct, significant impact on the lives of humans. Moreover, the recent study of [15] also endorsed the hypothesis that economic complexity is responsible for degrading the quality of the environment by focusing on 20 African economies using data for the period 1991–2014. [16] carried out a detailed empirical study on the relationship between economic complexity and environmental degradation and demonstrated an inverted U-shaped relationship that exists between economic complexity.

There are also some studies that believe that economic complexity may cure environmental problems. For instance, [17] focused on 88 countries and utilized annual data from 2002 to 2012, which showed that increased economic complexity does not induce environmental degradation. Their results are encouraging, and hence, economies must try to use advanced knowledge and technologies in the production process to address the environmental degradation problem more effectively. [11] also demonstrated that economic complexity stimulates environmental quality while natural resources and growth are responsible for environmental degradation.

In the context of BRICS economies, [18] endorsed that environmental-related technologies have improved environmental quality. Similarly, [19] provided evidence about the validity of the EKC hypothesis for all BRICS economies. Some researchers have tried to focus on the BRICS region to uncover the influence of complexity on the environment. However, the findings are mixed and largely inconclusive. For instance, [11] reported that complexity could stimulate environmental quality in BRICS economies. On the other hand, [12] provided evidence about the positive influence of economic complexity on environmental degradation in the BRICS economies. These contradictory findings are the main motivation behind the current study.

3. Key Statistics on Economic Complexity and Environmental Degradation

In Table 1, we have provided statistics. Data are converted into averages for all BRICS member economies. Carbon emissions (CO_2) “metric tons per capita” have increased by 18 percent. On the other hand, economic complexity has exponentially increased. According to the statistics, the economic complexity index, which was 0.270 on average in 1998, increased to 0.464 in 2022. At the same time, “GDP per capita (Constant US $)” has increased by 110 percent between 1998–2022. The enormous increase observed in per capita income could be explained by the rising economic complexity in the BRICS member economies.

Trade openness also showed an upward trend. The statistics show that trade openness “trade as a % of GDP”, which was 34.474 in 1998, has reached 47.109 in 2022. Finally, the energy statistics show that energy used has increased by more than 41 percent on average for BRICS economies between 1998–2022. Increased energy consumption is directly linked with rising CO_2 emissions, although energy use is important for the growth and development process.

Table 1. Key statistics (Whole Region).

Variables	Description	1998	2022	% Change
CO_{2it}	"Metric tons per capita"	4.331	5.142	18.719
ECI_{it}	"Index of economic complexity"	0.270	0.464	72.060
ENG_{it}	"kg of oil equivalent per capita"	1734.285	2460.832	41.893
YPC_{it}	"GDP per capita (Constant US $)"	3652.764	7706.714	110.983
$OPEN_{it}$	"Trade as a % of GDP"	34.474	47.109	36.652

In summary, the variables of interest, such as CO_2 emissions, economic complexity, and income level, have shown a positive trend. The positive trend shown by the variables observed points out the possibility of a potential relationship between them.

The statistics presented in Table 1 are informative about the overall performance of BRICS members. However, these statistics are less informative about the performance of individual member economies of BRICS. Amid this backdrop, we have presented statistics country-wise in Table 2 to provide more detailed insights.

Table 2. Individual numbers.

Economies	"Variables"	1998	2022	"% Change"
Brazil	CO_{2it}	1.698	1.726	1.594
	ECI_{it}	0.651	0.290	−55.352
	ENG_{it}	1067.313	1764.960	65.364
	YPC_{it}	6613.983	8831.128	33.522
	$OPEN_{it}$	16.438	39.339	139.315
Russia	CO_{2it}	10.076	10.102	0.260
	ECI_{it}	0.689	0.421	−38.957
	ENG_{it}	3981.499	3856.869	−3.1302
	YPC_{it}	4515.509	10,030.040	122.124
	$OPEN_{it}$	55.772	43.774	−21.512
India	CO_{2it}	0.818	1.223	49.405
	ECI_{it}	−0.115	0.566	590.994
	ENG_{it}	398.735	870.379	118.284
	YPC_{it}	693.408	2089.734	201.371
	$OPEN_{it}$	23.699	49.229	107.724
China	CO_{2it}	2.605	7.977	206.141
	ECI_{it}	−0.387	1.013	361.490
	ENG_{it}	869.358	2385.248	174.368
	YPC_{it}	1909.622	11,560.240	505.368
	$OPEN_{it}$	32.424	38.143	17.639
South Africa	CO_{2it}	6.459	4.684	−27.476
	ECI_{it}	0.512	0.033	−93.535
	ENG_{it}	2354.517	3426.702	45.537
	YPC_{it}	4531.296	6022.428	32.907
	$OPEN_{it}$	44.035	65.060	47.745

The country-wise statistics show what some economies have done to control CO_2 emissions. For example, the South African economy has performed remarkably well in controlling CO_2 emissions. The statistics show that CO_2 emissions have declined by more than 27 percent during the study period. Similarly, in the case of Russia and Brazil, CO_2 emissions have increased by just 0.260 and 1.594 percent, respectively. The highest increase in CO_2 emissions, 206.141 percent, is experienced by China, followed by India, where an increase of 49.405 percent is observed. The statistics for 2022 show that CO_2 emissions are still highest in Russia, followed by China. India has the lowest CO_2 emissions among the BRICS members.

In terms of economic complexity, the statistics show mixed results. Economic complexity has decreased in "Brazil, Russia, and South Africa". The highest drop in economic complexity occurred in South Africa, followed by Brazil and Russia. On the other hand, economic complexity has remarkably improved in the case of the Indian and Chinese economies. Economic complexity has increased by more than 590 percent in India and 361 percent in the case of the Chinese economy. China is the most economically complex economy, while South Africa is the least complex economy among the BRICS members in 2022.

The energy statistics show that, except for Russia, energy use has increased in the remaining BRICS economies. The highest increase in energy use is observed in China, followed by India. Energy use has also significantly increased in Brazil, followed by South Africa. In the case of the Russian economy, the use of energy has slightly declined between 1998–2022. However, the current statistics show that energy use is still the highest in Russia.

Further statistics show that the economic performance of all BRICS members is excellent. The highest increase in income is observed in China, which is more than 500 percent. Similarly, GDP per capita increased by more than 200 percent in the Indian economy during the study period. The Russian economy has also witnessed an increase of 122.124 percent between 1998–2022. The statistics for 2022 show that per capita GDP is highest in China, followed by Russia and Brazil.

Finally, the "trade openness index" of all BRICS members is reasonable except for the Russian economy, where the trade openness index declined by 21 percent. The statistics show that trade openness has increased by 139 percent for the Brazilian economy and 107 percent for the Indian economy. Similarly, the trade openness of the South African economy has also increased significantly. China has observed the lowest increase in trade openness as compared to other BRICS members. The statistics for 2022 show that the South African economy is the most open economy while China is the most closed economy among the BRICS members.

4. Modeling and Methods for Estimation

4.1. Modeling for Analysis

The main objective is to figure out the influence of economic complexity on environmental degradation by considering the moderating role of income level. However, environmental degradation could be dependent on trade openness and energy consumption, as is evident from the previous literature [7]. Similarly, environmental degradation is also dependent on the degree of urbanization and financial development [4,7,20]. However, to address issues with degrees of freedom, both the cross-sectional and time dimensions are regulated in data analysis. For the empirical analysis, we have specified the following functional form as represented by expression (1).

$$CO_{2it} = f\left(ECI^{a}\ ,\ YPC^{b}, ENG^{c}, OPEN^{d}\right) \quad (1)$$

Expression (1) indicates that environmental degradation is dependent on economic complexity, income level, the use of energy, and the degree of trade openness. We have used the logarithmic transformation to transform the expression into a log-linear model as represented by expression (2).

$$CO_{2it} = \gamma_0 + \gamma_1 ECI_{it} + \gamma_2 ECI_{it} * YPC_{it} + \gamma_3 YPC_{it} + \gamma_4 ENG_{it} + \gamma_5 OPEN_{it} + \eta_{it} \quad (2)$$

Environmental degradation is approximated through CO_2 emissions. Economic complexity is captured by the "economic complexity index". The higher value of the index reflects more economic complexity, and lower values show relatively less economic complexity [3]. For trade openness, we have taken "trade as % of GDP". Income level is approximated by taking the "GDP per capita (Constant US $)" while energy use is measured in "kg of oil equivalent per capita".

Data for all five members of BRICS are taken from credible sources. Data on environmental degradation, income level, energy use, and trade openness are taken from "World Development Indicators". Similarly, data on economic complexity are sourced from the "Observatory of Economic Complexity (OEC)".

4.2. Estimation Methods

Panel data collected for analysis from reliable sources has both time and cross-country dimensions. Panel data, due to their potential benefits, have been used extensively in applied research studies. Among them, the "Fixed Effects (FE)" and "Random Effects (RE)" have received significant attention [21]. FE modeling is considered superior by researchers as it can effectively control unobserved heterogeneity and further effectively control the possibility of unwanted serial correlation problems. The RE modeling is considered very effective in handling time-invariant factors. However, the main problem with the RE framework is its poor performance in controlling the serial correlation problem, which is a likely problem, particularly in panel data. Both the FE and RE estimators are presented below [22,23].

$$y_{it} = (\alpha + u_i) + X_{it}^{/}\beta + v_{it} \quad (3)$$

$$y_{it} = \alpha + X_{it}^{/}\beta + (u_i + v_{it}) \quad (4)$$

To determine the suitability of using the FE or RE estimators, [24] specified a testing procedure. We have also adopted the [24] testing procedure for choosing a suitable estimator for the estimation of the specified models. Results are shown in Appendix A Table A2. The results confirmed the superiority of the FE modeling over the RE modeling.

In addition to the FE estimator, we have also utilized the "Feasible Generalized Least Squares (FGLS)" and the "Two-Stages Least Squares (2SLS)" estimators to confirm the robustness of the findings and cure the potential endogeneity problem, respectively. The literature also believes that the FGLS addresses the robustness issue while the 2SLS addresses the likely endogeneity issue in panel data [25,26]. The study also conducted the "Pesaran cross-sectional dependence test (CD test)" to see whether cross-sectional units are dependent or not. Table A3 (Appendix A) shows that the "null hypothesis" of "no cross-sectional dependence" cannot be rejected.

5. Results

5.1. Descriptive

Table 3 includes descriptives of variables. According to the results, the average value of "CO_2 emissions (metric tons per capita)" is 5.465 for the BRICS economies for the study period. Russia experienced the highest value of CO_2 emissions (11.884) in 2011, while India experienced the lowest value in 1998. Similarly, the economic complexity index takes an average value of 0.486. China experienced both the maximum (1.065) and minimum values (−0.387) for the years 2021 and 1998, respectively.

The trade openness index, which is the indicator of outward-oriented policies, has an average value of 43.783. The highest value of trade openness was experienced by Russia in 1999, while Brazil experienced the lowest value in 1998. Further statistics show that the mean value of income is 5840.991 "Constant US $". Finally, the statistics show that the mean value of energy use is 2191.319 "kg of oil equivalent per capita".

Table 3. Descriptive statistics.

	CO_{2it}	ECI_{it}	$OPEN_{it}$	YPC_{it}	ENG_{it}
Mean	5.465	0.486090	43.78368	5840.991	2191.319
Maximum	11.884	1.065742	69.39328	11560.24	5167.010
Minimum	0.818	−0.387521	16.43858	693.4085	398.7358
Std. Dev.	3.753	0.286175	12.32465	3012.520	1405.305
Observations	125	125	125	125	125

5.2. Correlation Analysis

In Table 4, we reported the correlation among the variables. The statistics show that all independent variables are correlated. The highest correlation is witnessed between economic complexity, which is 0.695, while the lowest correlation is witnessed between trade openness and economic complexity.

Table 4. Correlation analysis.

Variables	CO_{2it}	ECI_{it}	YPC_{it}	$OPEN_{it}$	ENG_{it}
CO_{2it}	1				
ECI_{it}	0.392	1			
YPC_{it}	0.553	0.695	1		
$OPEN_{it}$	0.594	−0.079	−0.119	1	
ENG_{it}	0.660	0.397	0.622	0.513	1

5.3. Main Regression Findings

Regression-based results are depicted in Table 5. It is noted that economic complexity has significantly degraded the environment. The results included in the third column show that the joint term of economic complexity and income per capita is negative and significant. The results imply that income helps the economic complexity to mitigate CO_2 emissions and improves the quality of the environment. It means that GDP per capita acts as a moderating factor in the relationship between economic complexity and environmental degradation. Therefore, the economic complexity coupled with high per capita income is a potential remedy for overcoming the issues of the environment. Increased income brings enormous awareness among people, which is why they act responsibly. Our results are well supported by the recent research study of [3]. They also demonstrated that income level facilitates economic complexity to mitigate emissions and improve environmental quality in the context of OECD member economies. This implies that income level is the main channel through which economic complexity improves the environment. Therefore, the benefits of economic complexity, when translated in such a way as to increase the income of the population, would also improve environmental quality.

Trade openness has played a dominant role in increasing emissions in the context of BRICS economies. The coefficient of openness to trade is positive and significant. Prior literature has also demonstrated the adverse consequences of trade openness on the environment. Our results are in line with the recent research study [1]. However, [4,7] provided evidence about the insignificant role of trade openness.

Energy use is found to be the main determinant of environmental degradation, as confirmed by results in Table 5. The massive industrialization in the early stages of the development process is heavily dependent on the use of traditional and dirty energy sources. Previous research studies have also blamed energy use as the main determinant of environmental degradation [4,7,27]. The BRICS member economies are suggested to switch to cleaner and greener technologies for the production process. [27] rightly commented that energy efficiency, energy-saving projects, and conservation of energy are potential solutions to reduce pollution and consequently improve the quality of the environment. The changes mentioned, if adopted by the BRICS economies, will improve their environmental quality significantly.

Table 5. Regression results.

Variables	**"FE"**	**"FE"**
	"Coefficients"	**"Coefficients"**
ECI_{it}	0.254 *** (0.091)	0.885 *** (0.364)
$OPEN_{it}$	0.236 *** (0.044)	0.187 *** (0.064)
ENG_{it}	0.431 *** (0.142)	0.425 *** (0.140)
YPC_{it}	0.325 *** (0.038)	0.348 *** (0.039)
$ECI_{it} * YPC_{it}$		−0.074 * (0.045)
CONSTANT	7.025 (0.966)	7.067 (0.948)
Regression Diagnostics	"R-Squared": 0.922 "Adjusted R-Squared": 0.902 "S.E.R": 0.090	"R-Squared": 0.944 "Adjusted R-Squared": 0.943 "S.E.R": 0.091

Note: "The asterisks show significance level at 1 percent (***) and 10 percent (*). The dependent variable is CO_2 emissions, which is used as a proxy for environmental degradation. Values in parenthesis reflect standard errors".

5.4. Robustness

For robustness, we have employed the FGLS and 2SLS estimators. Results for both the estimators are shown in Table 6. According to the results, complexity is the main factor behind environmental degradation in BRICS economies. However, the moderating role of income level is the main channel by which complexity cures environmental problems. Moreover, the results obtained with the help of the 2SLS estimator have also proved that income level in the host economy is the main channel by which economic complexity reduces emissions and enhances the quality of the environment.

Table 6. Robustness testing.

Variables	**FGLS**	**FGLS**	**2SLS**	**2SLS**
	"Coefficients"	**"Coefficients"**	**"Coefficients"**	**"Coefficients"**
ECI_{it}	0.222 *** (0.072)	0.721 ** (0.301)	0.258 ** (0.100)	8.795 ** (3.466)
$OPEN_{it}$	0.160 *** (0.034)	0.119 *** (0.038)	0.358 *** (0.055)	−0.404 (0.277)
ENG_{it}	0.614 *** (0.111)	0.605 *** (0.119)	0.286 (0.179)	0.312 ** (0.155)
YPC_{it}	0.209 *** (0.040)	0.233 *** (0.053)	0.428 *** (0.054)	0.626 *** (0.154)
$ECI_{it} * YPC_{it}$		−0.058 * (0.032)		−1.002 ** (0.406)

Table 6. *Cont.*

Variables	FGLS	FGLS	2SLS	2SLS
	"Coefficients"	**"Coefficients"**	**"Coefficients"**	**"Coefficients"**
CONSTANT	6.938 (0.687)	6.962 (0.684)	6.767 (0.999)	7.875 (0.742)
Regression Diagnostics	"R-Squared": 0.941 "Adjusted R-Squared": 0.920 "S.E.R": 0.086	"R-Squared": 0.952 "Adjusted R-Squared": 0.932 "S.E.R": 0.087	"R-Squared": 0.912 "Adjusted R-Squared": 0.909 "S.E.R": 0.092	"R-Squared": 0.948 "Adjusted R-Squared": 0.923 "S.E.R": 0.144

Note: "The asterisks show significance level at 10 percent (*) 5 percent (**) and 1 percent (***). The dependent variable is CO_2 emissions, which is used as a proxy for environmental degradation. Values in parenthesis reflect standard errors".

Finally, both in the FGLS and 2SLS estimations, our major findings remained the same. Trade openness has lost its significance level and sign of the coefficient in one of the specifications where the moderating impact of income level is tested. Similarly, energy use has maintained its significance but lost its significance level in the estimated model.

6. Causality Analysis

We have focused on studying the direction of relationships among the variables chosen for this study as shown in Table 7. A one-way causality is observed from economic complexity to environmental degradation. It implies that environmental degradation is caused by economic complexity. Similarly, a one-way relationship running from environmental degradation towards income and from energy use towards environmental degradation is observed. Moreover, a unilateral causal relationship is observed between energy use towards income and trade openness. The income level is unilaterally linked with economic complexity. Furthermore, the results have also displayed some two-way relationships among the variables. For instance, trade openness is bidirectionally linked with environmental degradation, economic complexity, and income level. Finally, energy use and economic complexity are also bidirectionally connected with each other.

Table 7. Causality testing.

Null Hypothesis:	Zbar-Stat.	Prob.
$ECI_{it} \Rightarrow CO_{2it}$	3.45502 ***	0.0006
$CO_{2it} \Rightarrow ECI_{it}$	0.65196	0.5144
$OPEN_{it} \Rightarrow CO_{2it}$	3.91486 ***	9×10^5
$CO_{2it} \Rightarrow OPEN_{it}$	2.00503 **	0.0450
$YPC_{it} \Rightarrow CO_{2it}$	0.42079	0.6739
$CO_{2it} \Rightarrow YPC_{it}$	5.36063 ***	8×10^8
$ENG_{it} \Rightarrow CO_{2it}$	3.83617 **	0.0001
$CO_{2it} \Rightarrow ENG_{it}$	−1.20704	0.2274
$OPEN_{it} \Rightarrow ECI_{it}$	1.76481 *	0.0776
$ECI_{it} \Rightarrow OPEN_{it}$	3.89487 ***	0.0001
$YPC_{it} \Rightarrow ECI_{it}$	3.26059 ***	0.0011
$ECI_{it} \Rightarrow YPC_{it}$	1.41360	0.1575
$ENG_{it} \Rightarrow ECI_{it}$	3.97636 ***	7×10^5
$ECI_{it} \Rightarrow ENG_{it}$	8.51435 ***	0.0000
$YPC_{it} \Rightarrow OPEN_{it}$	3.47358 ***	0.0005
$OPEN_{it} \Rightarrow YPC_{it}$	2.53170 **	0.0114

Table 7. *Cont.*

Null Hypothesis:	Zbar-Stat.	Prob.
$ENG_{it} \Rightarrow OPEN_{it}$	3.38313 ***	0.0007
$OPEN_{it} \Rightarrow ENG_{it}$	1.24973	0.2114
$ENG_{it} \Rightarrow YPC_{it}$	2.05506 **	0.0399
$YPC_{it} \Rightarrow ENG_{it}$	0.94747	0.3434

Note: "The asterisks show significance levels at 10 (*), 5 percent (**) and 1 percent (***)".

7. Concluding Remarks and Implications

7.1. Conclusions

This empirical paper has investigated the potential influence of economic complexity in the presence of the role of income in the context of BRICS economies. The paper utilized annual data for the period 1998–2022, and several suitable econometric tools were employed to extract results from the designed models.

The results showed that economic complexity is responsible for the problem of environmental degradation problem due to its positive impact on all the proxies used for the measurement of environmental degradation. However, the interaction of economic complexity with income level shows that economic complexity improves environmental quality. This implies that income level significantly helps economic complexity curb CO_2 emissions and thus improve environmental quality. However, it is pertinent to mention that the independent impact of income level on environmental degradation is positive as well as statistically significant. Moreover, we found evidence of the positive impact that trade openness has on environmental degradation. Finally, increased energy use for the purpose of industrialization has also had a significant impact on environmental degradation.

7.2. Implications

(1) The process of economic complexity degrades the quality of environmental quality in isolation. However, if the benefits associated with economic complexity are translated in such a way as to increase the income of the population, then the quality of the environment would be improved. Increased income brings enormous awareness among the population regarding the benefits associated with better environmental quality;
(2) The BRICS member economies should opt for cleaner and environmentally friendly energy sources for production purposes. Similarly, renewable energy is an excellent alternative for the BRICS economies, as compared to traditional sources of energy;
(3) The BRICS economies are further suggested to shift their export-oriented industries to renewable and cleaner sources of energy.

7.3. Limitations and Future Research Directions

(1) The period of the current study is not very long as data on economic complexity was not available for a longer period. The current study only covers the period 1998–2022. Future research studies are advised to use a more comprehensive sample of countries to provide more robust results;
(2) The current study has only used traditional econometric tools, including the FE, FGLS, and 2SLS. Advanced econometric tools, including GMM and panel cointegration tools, are not considered due to the relatively small cross-sectional and time dimension. Future researchers could consider a comprehensive sample both in terms of time and cross-sectional dimensions and apply advanced econometric tools;
(3) The results obtained could not be generalized on a large scale as the BRICS economies have unique characteristics in terms of their economic size and economic structure. Future studies are suggested to test our designed models by focusing on other regions to address the problem of generalization of results.

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Data Availability Statement: Data will be provided upon receiving suitable request.

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

Appendix A

Table A1. "List of Countries".

"Country Name"	"Country Name"	"Country Name"
Brazil	People's Republic of China	South Africa
Russian Federation	India	

Table A2. "Hausman Test".

"Test Cross-Section Random Effects"			
"Test Summary"	**"Chi-Sq. Statistic"**	**"Chi-Sq. d.f"**	**"Prob".**
"Cross-section random"	14,582.411960	4	0.000

Table A3. "CD Test".

"Test"	"Statistic"	"d.f"	"Prob".
"Pesaran CD"	−0.312150	10	0.7549

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