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Research Article

Factors Affecting Co2 Emission in BRICS Nations: An Empirical Study

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ARTICLE INFO	ABSTRACT

This study investigated the factors that affect CO_2 emission in BRICS nations. This research paper studies the panel data for 1990 to 2022 years and a panel model is used to establish a relationship between the variables. Co2 Emission is the dependent variable whereas the independent variables are Urbanisation, FDI net Inflow, Exports of goods and Services, Energy consumption, and share of coal in power generation. The study uses the unit root test, and Breusch Pagan Godfrey (BPG) Heteroskedasticity Test to check the model fit for the equation, the study uses FMOLS and DOLS to check the robustness of results. The study implies that urbanisation, the Share of Coal in Power Generation, and Energy consumption per capita show a strong relationship with CO_2 emission. BRICS is one of the fastest emerging groups in the world and plays a significant role in the world order, this study provides a debate on the unplanned urbanisation and share of coals in power generation that is leading to CO_2 emission. The research finds a positive association between Urbanisation and the share of coal in power generation with Co2 emission. Thus, this study argues that an effective policy on coal in power generation and planned urbanisation can help to reduce Co2 emissions in emerging nations. The findings of this study can be used by policymakers, researchers, and Government bodies to form policies, this study can be used by other emerging economies to check the effect of these variables.

Keywords: CO_2 emission; Share of Coal in Power Generation; FDI net inflows; Sustainable Development Goals; Urbanization

1. Introduction

Finding the causes of high carbon dioxide emissions and those that potentially harm the environment has gained a lot of attention in recent years. Wang et al. (2020). After the first half of the 20th century, the dynamics of energy use, economic expansion, and the ensuing rise in environmental pollution have attracted attention on a global scale Pradhan et al. (2024). Rapid urbanization is typically accompanied by ongoing changes in the industrial and economic structures, which have a big impact on energy use and CO_2 emissions across a variety of businesses Wang et al. (2019). The main concern of the contemporary era is global warming. Countries choose to use an increasing dependence on natural resources and energy from various sources to reach the highest possible degree of economic development, and this leads to an extraordinary rise in the emission of pollutants into the atmosphere. Jafri et al. ((2022). Urbanisation now accounts for a large portion of energy consumption and CO_2 emissions in Asian nations due to the rapid urbanization trend. There is no doubt that the use of fossil fuels for energy in metropolitan areas has disrupted and elevated atmospheric carbon levels, leading to global warming. Yazdi & Dariani, (2019). As greenhouse gas emissions cross national borders, they currently represent a very serious threat to the global community. There must be a broad consensus that all countries must demonstrate their commitment to reducing their greenhouse gas emissions. Africa and Asia are experiencing a comparatively rapid rate of urbanization, with a projected doubling of the proportion of the population living in cities between 2000 and 2030. By 2030, there will be 4.6 billion people living in urban areas worldwide, up from 1.52 billion in 1970. Most of these people will live in Asian and African cities. Lee, (2019). Rapid economic expansion combined with ever-increasing urbanization will cause energy demand to increase CO_2 emissions globally. (Tan et al.2020). Trade, economic expansion, and energy use all had a favourable impact on carbon dioxide emissions. Kwakwa & Alhassan, (2018). All the 198 countries that have

committed to achieving carbon neutrality goals, 4.5% have done so already, 10.6% have declared or committed to doing so, 8.6% have passed legislation to do so, 29.3% have developed pertinent policies to do so, and the remaining 47% are debating pertinent documents to do so. By 2050–2070, 120 out of 198 countries, or 60.6%, want to be carbon neutral. Chen et al. (2022).
Global surface and ocean temperatures, together with the average atmospheric CO_2 concentration, will both continue to rise in the absence of effective policies or technology to limit or regulate CO_2 emissions. Chen et al. (2022). It is now urgently necessary to find a global solution to the dilemma of how to balance the relationship between energy consumption structure, economic growth, and carbon emission reduction. Jin et al. (2022). The entire cost of climate change as a result of carbon emissions is thought to be equal to a 5% annual decline in GDP. Acheampong, (2018). It is also the duty of developing nations to lower their greenhouse gas emissions. Major developing nations including Brazil, China, India, Malaysia, Mexico, the Philippines, South Africa, Thailand, and Turkey have experienced a sharp rise in energy consumption, which has led to a rise in greenhouse gas emissions. Chen et al. (2016). The commitment of the major polluting nations is crucial to the attainment of targets to reduce global CO_2 emissions. Mirzaeia & Bekri, (2017). Reducing CO_2 emissions has emerged as a desirable aim for modern academics by taking into account a variety of contributing aspects, such as economic growth, technical innovation, export quality, and renewable energy. Rahman et al. (2022). Global temperatures have risen by almost one degree over the past century, which could have catastrophic effects on human life and the ecosystem. These effects include rising sea levels, flooding, decreased food yields, and the extinction of entire species. Adedoyin et al. (2022). The main concern of the contemporary era is global warming. Countries choose to use an increasing dependence of natural resources and energy from various sources in order to reach the highest possible degree of economic development, and this leads to an extraordinary rise in the emission of pollutants into the atmosphere. Jafri et al. (2022)

2. Review of Literature

2.1 Co2 Emission

One of the most serious environmental dangers the world is currently facing is climate change, and carbon emissions are widely acknowledged as one of the primary drivers of the issue. Tan et al. (2020). In addition to other human activities, burning fossil fuels for transportation, heat, and electricity has been the primary source of the rise in CO_2 concentrations. Nondo & Kahsai, (2020). One of the most significant components of greenhouse gasses is the emission of carbon dioxide. One of the major contributors to climate change, which is generating natural disasters and economic losses, is carbon dioxide emissions. It's widely accepted that if current trends continue, the planet will experience environmental and climatic problems within the next ten years. Ardakani et al. (2019). Global CO_2E has increased in many areas as a result of the fast-growing human population, socioeconomic advancements, urbanization, and technological advancements. Ahmed et al. (2020) The climate is changing dramatically as a result of greenhouse gas-induced increases in global temperatures. Carbon dioxide is the main greenhouse gas in the atmosphere, accounting for about 99.4% of all emissions. Kumar & Muhuri, (2019). Financial growth drives economic expansion, and the two main factors driving up CO_2 emissions are economic growth and energy use. Khan et al. (2019)

2.2 Urbanisation & Co2 Emission

Some researchers have worked on how urbanization raises the temperature. Chapman et al. (2017). Most of the studies have long focused on the connection between urbanization and CO_2 emissions. Tan et al. (2020). Urbanization is a dynamic process that balances the social and economic potential of rural areas, which have an agrarian economic base, with urban areas, which have an industrial economic base. Yazdi & Dariani, (2019). China's rapidly urbanizing population is said to be one of the main causes of the country's high carbon emissions. (Wang et al. (2019). The construction of residential buildings and urban infrastructure requires more energy as a result of the fast urbanization process, which exacerbates the rate of CO_2 emissions in urban regions relative to rural ones. (Bo et al. (2018), Zhu et al. (2017)). There are several variables that can significantly raise a nation's energy consumption and, consequently, its carbon dioxide emissions, but the most essential ones are population expansion, urbanization, and industrialization. Wang et al. (2019). Based on a comparative examination of economic statistics, emerging nations experienced rapid urbanization and industrialization during the 1970s as a result of their economic sector's advancements. Wang et al. (2019). According to an IEA analysis from 2017, urbanization accounted for over 70% of energy-related worldwide emissions; by 2030, this percentage will rise to 76%. In addition to the consumption of fossil fuels, which accounts for the majority of emissions globally, the urbanization of these nations has also been demonstrated to have a detrimental impact on the environmental quality of these places. Koengkan et al. (2020). Urbanisation and rapid population growth go hand in hand. The construction of infrastructure and residential buildings results in energy consumption. In addition, the emergence of several industries as a result of industrial development increases a nation's need for energy to sustain economic expansion. Tan et al. (2020). Urbanization is anticipated to stimulate economic growth by boosting economic output and consumption. The burgeoning urban population will drive demand for essential infrastructure like buildings, transportation, and related facilities. However, this growth may also exacerbate environmental issues, particularly greenhouse gas emissions Liu & Bae, (2018). The urban transition hypothesis posits a correlation between prosperity and

environmental awareness. Initially, it proposes that as cities reach middle-income levels, their population, manufacturing, and consumption become more centralized, leading to heightened industrial pollution. Subsequently, as urban areas progress, pollution is reduced through environmental regulations, technological advancements, and a transition from industrial to service-oriented sectors. Kongkuah et al. (2021)
Carbon dioxide (CO_2) emissions are recognized as a primary contributor to Earth's climate change. Despite occupying just 0.4–0.9% of global land surfaces, urban areas are accountable for over 70% of these emissions Ribeiro et al. (2019). Urban residents tend to consume more energy compared to rural counterparts, leading to a significant rise in CO_2 emissions driven by urbanization itself.

2.3 Energy Consumption & Co2 Emission

Energy is indispensable for economic production, thus facilitating economic growth and societal development Kwakwa & Alhassan, (2018). Energy consumption and economic growth are widely acknowledged as two primary drivers of carbon dioxide (CO_2) emissions. In recent decades, the correlation between societal economic growth and environmental sustainability has been a focal point of research Ardakani et al. (2019). Excessive energy consumption contributes significantly to CO_2 emissions, exacerbating environmental concerns. The expansion of urban populations generates substantial demand for infrastructure such as buildings and regional transportation networks. In China, rapid development in the construction and transportation sectors relies heavily on energy consumption, leading to a notable increase in carbon emissions Liu and Bae, (2018). Carbon dioxide (CO_2) emissions stemming from energy consumption have experienced a notable increase in newly industrialized nations since the 1990s, in contrast to industrialized countries Yazdi & Dariani, (2019). The environmental impact of energy lies in its combustion processes, which release greenhouse gases (GHGs) such as nitrogen oxides, sulfur dioxide, and carbon dioxide, thereby polluting the environment Kwakwa & Alhassan, (2018). The concept that energy drives growth aligns with the growth hypothesis, which posits that energy serves as an essential factor of production, directly or indirectly complementing capital and labor in the production process Nondo & Kahsai, (2020). In recent years, energy consumption has emerged as a crucial determinant of human prosperity. The disparity in growth rates and standards of living between developed and developing nations has been significantly influenced by variations in energy consumption levels Pradhan et al. (2024). Energy consumption directly influences carbon dioxide (CO_2) emissions Zhou, (2023). Over the past three decades, there has been extensive research into the interplay between energy consumption and economic growth, as well as the relationship between economic growth and environmental pollution Acaravci & Ozturk,(2010). Some of the reports suggest that energy-related CO_2 emissions will surge by 40–110% by 2030 Chen et al. (2016). Energy, alongside capital, labor, and raw materials, constitutes essential inputs in the production of most goods and services. Energy consumption and efficiency impact all economic and industrial activities, making energy productivity and improved energy consumption crucial topics that influence a country's economy Mirzaeia & Bekri, (2017).

2.4 Exports of goods and services & Co2 Emission

There has been a longstanding concern that countries may decrease emissions through international trade in a manner that merely shifts emissions elsewhere, a phenomenon known as carbon leakage. Evidence suggests that the impacts of trade variables on Consumption-based CO_2 emissions are more pronounced in the long run than in the short run Hasanov et al. (2018). International trade encompasses the supply chains involved in production and transportation from the production country to the consumption country Lee, (2019). There is substantial evidence indicating that international trade significantly contributes to the carbon footprint, particularly in developing nations. For instance, research by Ben Youssef (2017) highlighted the importance of international trade in explaining a significant portion of the carbon footprint in developing countries.
Some authors have examined the pollution-haven hypothesis in the context of trade, which posits that polluting industries relocate their environmentally impactful operations from countries with stringent environmental regulations to nations with more lenient laws and enforcement. This phenomenon leads to environmental contamination in the receiving countries, particularly in developing nations Kongkuah et al. (2021). According to Teng (2021), increased trade openness is associated with higher carbon emissions due to the substantial energy consumption involved in the manufacturing and transportation of goods. Additionally, research by Zhang et al. (2018) found that trade liberalization leads to increased deforestation in non-OECD countries but decreases it in OECD nations. Khan et al. (2019) found that in Pakistan, trade initially has a negative and insignificant effect on environmental degradation in the short run, but in the long run, it has a positive impact on environmental degradation. Mahmood et al. (2020) emphasized the significance of trade and foreign direct investment (FDI) for economic growth while also raising concerns about environmental issues. Their study revealed that exports have both negative direct effects on CO_2 emissions and positive indirect effects on the CO_2 emissions of neighboring countries. Additionally, Rahman et al. (2022) suggested that improving export quality through cleaner and more efficient production techniques can help reduce CO_2 emissions. It’s also analysed that higher levels of export are often linked to increased energy consumption, leading to higher CO_2 emissions, as highlighted by Salman et al. (2019). Similarly, Aghasafari (2021) noted in their study in the MENA region that producing goods in these countries increases carbon dioxide emissions due to energy consumption, ultimately driving export growth but also contributing to environmental pollution. Pie et al. (2018), highlighted that emissions were shown to grow when there are more imports and decrease with higher exports, Carbon

emissions arise from the economic activities carried out, as well as from higher production and consumption, and they have increased because of globalization.
Exports of higher quality goods enable high-income countries to reduce the production of manufacturing items that contribute more heavily to pollution and environmental damage Apergis et al. (2018). As the quality of exports increases, more high-quality products are manufactured and exported, leading to expectations of simultaneous economic growth and decreased CO2 emissions Dogan et al. (2020). In the GCC region, exports play a role in supporting environmental sustainability by influencing consumption-based emissions in local, neighboring, and regional economies Mahmood, (2022). Shahzad et al. (2020) recommends that governments, both in developing and developed countries, establish independent regulatory bodies to formulate sustainable economic policies related to exports, manufacturing, and environmental concerns. These policies should encompass export diversification, trading relations, and the promotion of new products to address externalities related to climate change.

2.5 Net inflow of foreign direct investment & Co2 Emission

Foreign direct investment (FDI) is recognized as a key driver of economic growth, employment creation, and technology transfer to host countries Demena & Bergeijk, (2019). However, the impact of FDI on environmental pollution is subject to debate, with contrasting views in the literature. The pollution haven hypothesis (PHH) suggests that increased competition for FDI leads polluting industries in developed countries to relocate to developing countries with less stringent environmental regulations, potentially exacerbating pollution in host countries Demena & Afesorgbor, (2020). Conversely, the pollution halo hypothesis posits that FDI inflows can effectively reduce host country pollutant emissions through the introduction of green technologies and sound environmental management practices Nie et al. (2022). Despite the potential for pollution-intensive sectors to increase CO2 emissions through FDI inflows, research indicates that the relationship between FDI and environmental quality may vary depending on factors such as institutional quality, total factor productivity, and human capital levels Khan et al. (2023); Baksh et al. (2021). While some studies find a positive relationship between FDI and CO2 emissions, others report a negative relationship or no significant association Zhang et al. (2023). Efforts to mitigate CO2 emissions and promote environmental sustainability through FDI include diverting funds towards green technology and energy consumption efficiency Jafri et al. (2022), as well as improving institutional quality to decrease CO2 emissions and enhance environmental quality Baksh et al. (2021). Overall, the relationship between FDI and CO2 emissions remains controversial and uncertain, reflecting the complex interplay between economic growth, technological innovation, institutional quality, and environmental management practices.

2.6 Share of coal in power generation & Co2 Emission

Non-renewable energy remains the primary driver of carbon emissions, and while the consumption of renewable energy also contributes to carbon emissions, its impact is comparatively weaker. This underscores the necessity of artificially controlling the growth of carbon emissions to prevent the formation of a vicious circle of environmental pollution and energy consumption, which could impede sustainable socio-economic development Jin et al. (2022). While the demand for oil and coal persists in the energy market, natural gas and renewable energy sources are gaining increasing importance Paraschiv & Paraschiv, (2020). Coal combustion produces the largest amount of CO2 among fossil fuels, with coal emitting nearly two times more CO2 per MJ of energy compared to natural gas combustion Lizica et al. (2020). Research conducted in China by Junling et al. (2019) examined the relationship between coal power plant development and CO2 emissions, identifying different stages for emission peaks based on factors like new plant additions, operational efficiency, and renewable energy improvements. Efforts to reduce CO2 emissions from electricity generation under a coal-based energy structure primarily rely on efficiency improvements, aiming to produce the same amount of power with less coal Zhao et al. (2019). Mendonça et al. (2020) suggest that countries can decrease their CO2 emissions by utilizing renewable energy sources, thereby incentivizing the use of energy sources that reduce reliance on fossil fuels. Projections from the USEIA indicate a 0.6% annual growth in global energy-related CO2 emissions from 2018 to 2050 Andrae, (2020). Additionally, Andrae (2020) forecasts an increase in coal-based electricity generation by 2030, highlighting the heavy dependence of the sector on fossil fuels and the considerable potential for reducing CO2 emissions in electricity production Ang & Su, (2016).

3. Research Methodology

3.1. Equation Modelling

Co2 emission has been studied by many authors, authors have defined many variables in their study, but for this study the researchers have included the Co2 emission, Urbanization, FDI (Net Inflow), Exports of goods and services, Energy consumption per capita, Share of Coal in Power Generation. For this study our proposed model based on the literature is

Co2 Emission = f (U, FDI, E, ECPC, SCPG) .... (1)

Equation (1) states that Carbon emission (Co2 Emission) is a function of Urbanisation (U), Foreign Direct Investment (Net Inflow) (FDI), Exports of goods and services (E), Energy consumption per Capita (ECPC) and Share of Coal in power generation (SCPG).

Since our study is a panel data study, Eq. (2) can be written in panel data form as follows:

CO2=β0 + β1·Urbanization + β2·FDI + β3·Exports + β·Energy Consumption per capita + β5·Share Of Coal in power generation + ε .... (2)

gCO2it = β0 +β1gUit +β2FDIgit + β3Egit + β4ECPgCit + β5SCPGgit + εit ....(3)

Where *i* represents the individual country (in our study the studied nations are BRICS total of 5 countries) & *t* represents the time of the study. *g* represents the growth rate of the variables.

3.2 Data source & Time Frame

The data used in this study are taken from various sources, the sources of data are-

Sl. No.	Data	Source
1	Co2 emission	Climate watch
2	Urbanization (% of Population) FDI (Net Inflow) Exports of goods and services	WDI
3	Energy consumption per capita (Measured in kilowatt-hours per person.), Share of Coal in Power Generation	IEA

Source: Authors

The time frame for this study is 1990 – 2022 (the time frame is selected on the basis of data availability) and the selected countries for the study are BRICS, Brazil, Russia, India, China and South Africa.

4. Results and discussions

4.1 Results

Table 1. Descriptive Statistics of Countries-

Variables	Mean	SD	CV	Variables	Mean	SD	CV
Brazil				**China**			
CO2e	10.12	3.87	2.61	CO2e	124.83	66.93	1.87
E	159.04	104.08	1.53	E	1260.63	1157.32	1.09
ECPC	2.11	0.44	4.83	ECPC	2.48	1.76	1.42
FDI	2.72	1.42	1.92	FDI	3.13	1.35	2.32
SCPG	2.73	0.76	3.6	SCPG	73.77	5.52	13.37
U	82.33	3.96	20.81	U	44.24	11.73	3.77
India				**Russia**			
CO2e	29.24	14.63	2	CO2e	93.1	15.47	6.02
E	255.06	222.54	1.15	E	289	212.18	1.36
ECPC	0.58	0.24	2.39	ECPC	6.09	0.76	8.03
FDI	1.27	0.84	1.52	FDI	1.55	1.37	1.13
SCPG	70.42	3.28	21.49	SCPG	16.82	1.7	9.92
U	29.95	3.13	9.58	U	73.75	0.51	143.55
South Africa							
CO2e	14.89	4.11	3.62				
E	72.87	37.52	1.94				
ECPC	4.21	0.33	12.64				
FDI	1.41	1.85	0.76				

SCPG	91.82	2.42	37.91
U	60.13	4.98	12.07

Notes: SD. And CV indicate standard deviation and coefficients of variation (standard deviation-to-mean ratio), respectively.
Source: Authors complied the results.

Table-1 defines the descriptive statistics of all the five selected countries. CO2e is measured in per capita. Urbanisation is measured in the % of the total population living in urban areas. FDI (Net Inflow) is measured FDI (Net Inflow in % of GDP). Electricity consumption per capita & Exports of goods and services.
The mean of CO2e is highest in China and lowest in Brazil. Whereas the CV is lowest in China and highest in Russia. CV is a measure of relative variability. A lower CV indicates a low Variability whereas a higher CV indicates greater variability of series. The mean of E is highest in China and lowest in South Africa, whereas the CV of E is highest in South Africa at 1.94. The average growth rate for U is the highest in Brazil. Whereas CV is highest in Russia with 143.55. The mean of U is highest in Brazil 82.33, and lowest in India. This shows that Brazil has the highest number of Urban populations, whereas India has the lowest urban population.

Table 2: Breusch-Pagan-Godfrey test for heteroskedasticity:

Country	F-statistic	Prob(F-statistic)	Durbin-Watson stat
Brazil	2.777007	0.37763	1.354734
China	1.850182	0.136646	1.562878
India	1.042879	0.413066	2.122852
Russia	2.107552	0.095278	2.256299
South Africa	1.632984	0.185183	1.972515

Source: Authors complied the results

Table-2 shows Breusch-Pagan-Godfrey test for heteroskedasticity. We have observed that there is no heteroscedasticity is observed in any of the country. The researchers have included F statistic, P value and Durbin -Watson stat. the Durbin-Watson stat is low in the case of Brazil and China but P value is greater than 0.05 which shows no heteroskedasticity in the selected countries. Since all the P value is higher than 0.05, shows no significant heteroskedasticity.

Table 3: FMOLS & DOLS

FMOLS			**DOLS**		
Variable	Coefficients	t-Statistic		Coefficients	t-Statistic
Brazil			**Brazil**		
E	-0.004^	-3.577	E	-0.0081^	-4.001
ECPC	6.07	2.150	ECPC	23.91^	7.66
FDI	-1.22^	-6.364	FDI	-1.12^	-7.630
SCPG	-3.99^	-12.936	SCPG	-1.69^^	-12.782
U	-1.05^	9.226	U	2.39^	6.665
China			**China**		
E	-0.009	-2.502	E	-0.0123	-4.296
ECPC	24.68	4.482	ECPC	26.39807	5.521
FDI	-1.05^	-6.364	FDI	-0.952887	-3.897
SCPG	-1.56	-5.177	SCPG	-0.943687	-4.264
U	2.45	5.557	U	2.885375	7.010
India			**India**		
E	-0.0053^	-2.417	E	-0.01^	-7.866
ECPC	15.65	2.697	ECPC	33.37	2.878
FDI	-1.84	-4.851	FDI	-1.86	-3.238
SCPG	-0.16	-2.655	SCPG	-0.45	-1.203
U	-8.64	-5.63	U	9.02^	17.846
Russia			**Russia**		
E	0.031	4.145	E	0.039	5.080

ECPC	-0.99^	-5.526	ECPC	-2.06	-0.496
FDI	2.19	2.726	FDI	-0.77^	-5.398
SCPG	-0.23^	-4.378	SCPG	-0.45^	-3.207
U	22.84	6.109	U	14.91^	6.045
South Africa			**South Africa**		
E	0.0021	3.318	E	-0.055	-9.071
ECPC	0.37	-10.715	ECPC	27.770	13.827
FDI	-0.0123	-2.408	FDI	-0.110	-1.1297
SCPG	-0.0263	-3.868	SCPG	-1.449	-6.388
U	0.797	14.045	U	-0.442	-12.276

^ 1st difference
^^2nd difference
Source: Authors complied the results

Table-3 represents the results of the FMOLS & DOLS, "E" represents the Exports of Goods and Services: The coefficient of E is negative in Brazil, China, and India Whereas it is positive in Russia and South Africa. The negative coefficient suggests that for every unit increase in the E, CO2 emissions decrease by 0.004, 0.009, and 0.0053 respectively in Brazil, China, and India. The positive coefficients suggest that for every unit of E increase, CO2 emissions increase by 0.031 units in Russia's case & 0.0021 in South Africa's case. "ECPC "represents the Energy Consumption Per Capita: The coefficient ECPC is positive in Brazil, China, and India, which suggests that the coefficient of 6.07 suggests that for every unit increase in ECPC, CO2 emissions increase by 6.07 units in Brazil. The coefficient of ECPC is negative in Russia and South Africa. Suggests that the coefficient of -0.99 suggests that for every unit increase in ECPC, CO2 emissions decrease by approximately 0.99 units in Russia & South Africa is 0.37."FDI" represents FDI (Net Inflow) (% of GDP): The negative coefficient of FDI suggest that every unit increase in FDI, lead to decrease in CO2 emissions. Which shows a Halo Hypothesis effect in Brazil, China, India & South Africa. Russia is having a positive coefficient, which supports the "Pollution Haven" hypothesis. "U" represents Urbanisation (% of Population): The negative coefficient of Urbanisation suggests that every unit increase in urbanisation leads to a decrease in CO2 emissions. The coefficient U is negative in Brazil and India. Whereas the positive coefficient of U suggests that every unit increase in urbanization leads to an increase in CO2 emissions. China, Russia, and South Africa have a positive coefficient of Urbanisation.

Table 4
Summary of the results for all Five BRICS nations.

	Brazil	**Russia**	**India**	**China**	**South Africa**
Electricity consumption per capita	(+)	(-)*	(+)	(+)*	(-)*
Exports of goods and services	(-)*	(+)	(-)	(-)*	(+)*
Urbanization (% of Population)	(-)*	(+)*	(-)	(+)*	(+)*
FDI (Net Inflow) (% of GDP)	(-)*	(+)*	(-)	(-)*	(-)
Share of Coal in Power Generation	(-)*	(-)*	(+)	(-)*	(-)*

**Note: Denotes Statistical Significance, (+) Negative effect on Co2e per capita and (-) Shows a positive effect on Co2e per capita.*

5. Conclusion and policy implications

So far researchers have worked extensively in this area, especially this decade focusing on Co2e effects on different variables. There are very few studies that have examined the effect of the Share of Coal in Power Generation and CO2 emission using equation models. The effect of Urbanisation and Electricity consumption per capita still need to be explored by the researchers. The results are based on the timeline of 1990 to 2022. We have examined the BRICS nations for our study.

Our results show that the effect of Variables such as ECPC, U, FDI, and SCPG is statistically significant in BRICS nations. The variables of this study show different results for different countries. ECPC is positive in all the selected countries except Russia. Similarly, the results of FDI net inflow support the "Halo Hypothesis" in Brazil, China, India & South Africa, whereas Russia supports the "Pollution Haven Hypothesis". This result is generally consistent with those of Mulali, (2012), Aghasafari, (2021)). Brazil & India show a negative effect on Co2e of Urbanisation which suggests as the urban population increases it helps to reduce the Co2e. This result is supported by the study of Kongkuah et al. (2021). China is having a positive effect on Co2e of Urbanisation this suggests that if the urban population increases it increases the Co2e with it. This result is generally consistent with those (Wang et al. (2019), Bo et al. (2018), Liu & Bae, (2018)). The effect of Exports of goods and services have a positive impact in Brazil, China, and India. These results are consistent with the study of (Rahman et al. (2022), Pié et al. (2018), Dogan et al. (2020)), whereas the results of Russia and South Africa

show when Exports of goods and services increase it leads to more Co2e in the host country. These results are consistent with the results of (Jebli & Youssef (2017), Lee, (2019)).
The empirical results show that the impact of the E, ECPC, U & FDI is significant in BRICS nations. These variables can be used for policy implications in the selected nations as well as emerging nations. It is crucial for the studied countries to look into the conditions for foreign investment and manufacturing in their country to improve environmental protection. A reduced share of Coals in energy production can also help to reduce the Co2e. This can also help achieve a net zero emission target by the selected countries.

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