

# **Inter-relationship among Economic Growth, Environmental Protection and Social Capital Creation in the context of BRICS Nations: A Panel Data Analysis approach**

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## **Abstract**

Economic growth without sustainable parameters infused in it is valueless in the context of long-run equitable societal development. Growth all over the world should value ecological and social parameters apart from aggregate economic wellbeing.

The article here tried to unearth whether economic growth in the BRICS nations is all-inclusive and sustainable in nature.

The study considered CO<sub>2</sub> emission as a parameter for environmental sustainability and Life expectancy at Birth as a parameter for societal development in terms of equity in overall welfare. The researchers here used the Panel Regression Model approach in ascertaining the desired association. The study found that economic growths in BRICS nations are not at all sustainable in any respect and economic growths are mainly attributable to small rich and upper-middle-class sections of the societies. So, here equitable economic growth or more specifically sustainable economic development is basically unobserved. But, past economic performance positively motivates the future economic performance of the BRICS nations.

**Key Words:** BRICS, Economic Development, Environmental Sustainability, Equity & Life expectancy at Birth.

JEL Classifications: C33, C52, C87, I31, Q56.

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## **Inter-relationship among Economic Growth, Environmental Protection and Social Capital Creation in the context of BRICS Nations: A Panel Data Analysis approach**

**Background:** The BRICS nations accounted for 3.12 Billion population, which is around 40% of the total world population in the year 2019. The economic development of a country widely depends upon the degree of equity in the economic welfare of all sections of the society. All these five nations are more or less standing at the same stage of economic development and are widely comparable in terms of various socio-economic parameters. But, one thing that is certainly important in all these countries is poverty and in-equal wealth distribution. Considering the concept of sustainable development, improvement of the standard of living among all the sections of society is of utmost importance. BRICS nations have a vast population who are lying out of any of the social security services of the governments or any organizations and they are also standing on a very poor economic base. Sustainable economic development is extremely important for these countries considering the huge present working-age population and future growing population pressures. The demographic dividend available to these countries should be best utilized through the measurement of sustainable economic development.

The most vital challenge lies here for the policymakers in understanding the relationship among various macro socio-economic variables responsible for ensuring sustainable economic development of the country. Various macro socio-economic factors like literacy rate, life expectancy, under-five mortality rates, technological developments, sectoral investments, etc. are responsible for economic developments or growths of different nations. But the challenge exists in the identification of these factors for a country or a group of similar countries. Considering the huge population of the BRICS nations and over increasing significance in all aspects of the world, understanding these

factors is extremely important for social science researchers in fulfillment of their research interests.

**Review of Literatures:** The researchers have gone through several existing research works in the concerned area to find out desired research gap. Skilling of the labour force has a positive impact on increasing the service sector productivity, whereas skilling of the labour force has no such impact on increasing manufacturing sector productivity, as observed through a study on 14 major states in India from 1980 to 2000, **(Amin & Mattoo, 2008)**.

The financial development in India is responsible for the environmental degradation of the country through increased energy usage. There is also a significant predicted long-run association exists between financial development and environmental degradation, **(Boutabba, 2014)**.

In the case of non-financial Indian firms, it has been observed that better the financial performance of the firms; they are less cautious or thoughtful about the earnings management, as observed based on a study for the period 2007 to 2015, **(Debnath, 2017)**. The FDI in several sectors of India like Telecom, Pharmaceutical Services, Tourism, Automobiles, etc. is being motivated by growth and good prospects of the sector, but the reverse is not found statistically significant. Exports, Institutional Quality and Human Capital are significant factors for bettering of prospects of these sectors, **(Siddiqui & Ahmed, 2017)**.

The economic liberalization and free trade in India have a mixed impact on increasing concentration levels of various pollutants in the environment as observed from a study considering pollutants levels in several industrial states of India from 1991 to 2013. It has been finally observed that trade liberalization reduced SO<sub>2</sub> concentration; whereas NO<sub>2</sub> and SPM concentrations have not reduced, **(Jena, 2018)**.

GDP growth rate has a negative association with the capital structure in terms of long term debts to total assets, whereas inflation has a positive

association with capital structure in terms of both long term debts to total assets and total debts to total assets. Phenomena have been observed by considering 255 non-financial Indian listed companies for the period of 2008-2017, **(Goel, 2019)**.

Financial development, and GDP growth have a direct association with environmental degradation in both developed and developing countries because rising energy consumption leads to increase CO2 emissions during the phase of urbanization and industrialization. On the contrary, good quality organization, eco-friendly technology, ethnic diversity along with political freedom for decision-makers can reduce environmental degradation by way of reducing CO2 emissions, **(Wang et. al, 2020)**.

The researchers observed that none of the existing studies in the area has focused on understanding whether economic growths associated with the BRICS nations are sustainable or not. Hence, researchers tried to observe whether the economic growth of the BRICS nations is related to Environmental Protection and Social Capital Creation, through this understanding, the researchers can judge whether the growth ensures sustainability in the economy through equity and environmental protection. This study has been designed to full fill the said research gap.

### **Research Objectives:**

The study is based on following research objectives to fulfill above defined research gap:

1. To understand whether Environmental Protection has any impact on the growth economy of BRICS Nations.
2. To understand whether Social Capital Creation has any impact on the growth economy of BRICS Nations.
3. To understand whether past Economic Growth has any impact on the growth economy of BRICS Nations.

## **Research Questions:**

The above defined research objectives will be answered through following research questions:

1. Does Environmental Protection have any impact on the growth economy of BRICS Nations?
2. Does Social Capital Creation have any impact on the growth economy of BRICS Nations?
3. Does past Economic Growth have any impact on the future growth economy of BRICS Nations?

## **Research Hypothesis:**

The above defined research questions will be answered based on the following research hypothesis:

1.  $H_{01}$ : Environmental Protection has no significant impact on the growth of the economy in case of BRICS Nations.
2.  $H_{02}$ : Social Capital Creation has no significant impact on the growth of the economy in case of BRICS Nations.
3.  $H_{03}$ : Past Economic Growth has no significant impact on the future growth of the economy in case of BRICS Nations.

## **Research Methodology:**

### *Technical Aspects:*

The present study takes into account a remarkably large volume of data considering 29 years long time frame from the year 1990 to 2018 to understand the possible impact of Environmental Protection and Social Capital Creation and the past (lag effect) economic growth on the economic growth of the BRICS nations. This study covers both cross-sectional as well as time-series dimensions. The researchers seek to examine the possible impact of explanatory variables using a panel of five BRICS nations (Brazil,

Russia, India, China, and South Africa) over a period of 29 years. The study employs panel regression models as the data contains both cross-sectional as well as time-series observations, consists of 145 {29 years  $\times$  5 countries} pooled data point for each variable. In this research work, the researchers use a balanced panel {i.e., each cross-sectional unit has equal number of time-series observations}.

All the data have been collected from the official website of World Bank.

#### *Choice of Panel Regression technique:*

An important issue arises in the course of choosing appropriate regression technique for panel data analysis. There are three important techniques of panel regression, these are Pooled OLS Regression or Constant Coefficient Model, Fixed Effect Model (FEM) and Random Effect Model (REM).

For the purpose of analysis, firstly, the researchers have employed Pooled OLS model and then applied Fixed Effect and Random Effect Models respectively. Finally, the Wald Test and the Hausman Test have been used to choose the appropriate model. Before focusing on the formal regression models, researchers have computed the correlation matrix to know whether there is any significant correlation between the dependent variable with the explanatory/independent variables.

In case of Pooled OLS, it assumes that all coefficients remain unchanged across the cross-section dimension as well as time series dimension (S. K. Bhaumik, 2015). The major drawback of this method is it ignores individual heterogeneity across cross-sectional and time series units.

Subsequently, the other econometric models have been applied, these are FEM and REM. Fixed Effect Model (FEM) assumes that the individual specific effects are considered to be correlated with the independent variables. The term "Fixed Effects" is considered as the intercept is time-invariant. Whereas, Random Effect Model (REM) assumes that the individual specific effects are considered to be uncorrelated with the independent/explanatory variables.

Wald test has been used to choose the appropriate model between a Pooled OLS Model or FEM. The hypothesis of the model is:

Null Hypothesis: Absence of Fixed effect in the coefficients or Pooled Regression Model is appropriate

Alternative Hypothesis: Presence of Fixed effect in the coefficients or Fixed Effect Model is appropriate

Finally, Hausman test has been applied to choose the appropriate model between FEM and REM. The hypothesis of the model is:

Null Hypothesis: Both the coefficients of FEM and REM are consistent, but coefficients of FEM is inefficient

Alternative Hypothesis: Coefficients of FEM is consistent and efficient, but Coefficients of REM is inconsistent

The regression equation constructed is as below:

$$GDPG_{it} = \beta_1 + \beta_2 \times GDPG\_L1_{it} + \beta_3 \times LEXP_{it} + \beta_4 \times LDCO2E_{it} + \varepsilon_{it}$$

$$i = 1,2,3, \dots, 5$$

$$t = 1,2,3, \dots, 29$$

where,  $i$  represents the  $i^{\text{th}}$  country and  $t$  represents the  $t^{\text{th}}$  time point for the variables under study.

$\beta_1$  = Constant term/intercept

$\beta_2, \beta_3, \beta_4$  = Slope coefficient/Coefficient of the independent variables

$GDPG_{it}$  = Per Capita GDP Growth Rate

$GDPG\_L1_{it}$  = Lag Per Capita GDP Growth Rate

$LEXP_{it}$  = Life Expectancy at Birth

$CO2E_{it}$  = Per Capita CO<sub>2</sub> Emissions

$LDCO2E_{it}$  = Log difference of Per Capita CO<sub>2</sub> Emissions

$\varepsilon_{it}$  = Error term

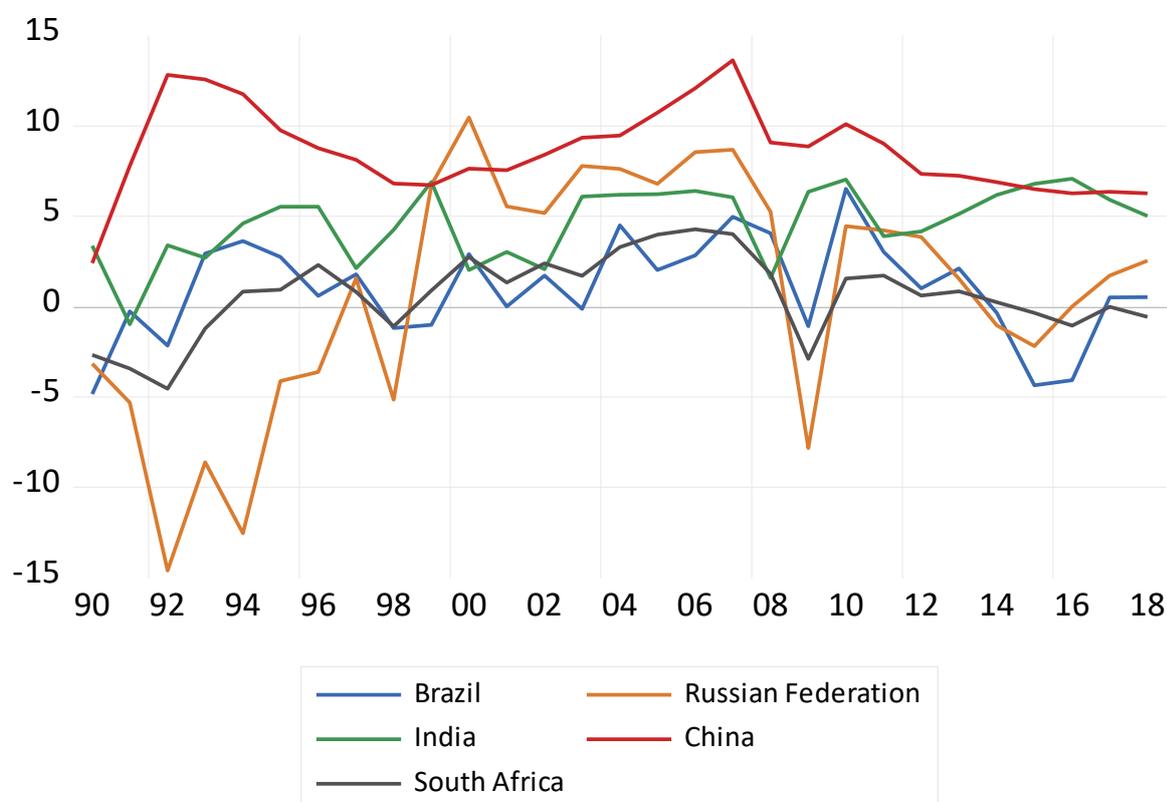
*Logic Behind Variable Selection:*

The researchers have chosen four variables in understanding the character of economic growth for the BRICS nations. To measure the rate of economic growth the researchers have chosen the annual GDP growth rate for individual countries. To measure the impact of past economic growth rates on future economic growth rates, the researchers have chosen the Lag GDP growth rate (Lag= 1 year) for individual countries for each year. To measure the environmental sustainability in terms of pollutant emissions, the researchers have chosen Annual CO<sub>2</sub> Emissions in terms of Metric tons / Capita for individual countries. Finally, to measure the equitable socio-economic welfare, which can be ensured through social capital creation and is also an important parameter for making the economic development a sustainable one; the researchers have chosen Annual Life Expectancy at Birth (in years) for individual countries (as per the study of **Borges et. al., 2021** on social capital).

**Analysis:**

In this study the researchers have covered 29 years containing two major crisis or recessionary period – namely, the Asian Financial Crisis during 1997 and Global Financial Crisis during 2007-2008. During this period of time the GDP Growth rates of the nations (except Brazil for Asian Financial Crisis) had experienced great downfall. The impact of Global Financial Crisis/the Great Depression is replicated through diminishing GDP growth across the globe.

**Figure 1: Per Capita GDP Growth Rate of BRICS Countries for the period 1990-2018**



Source: Authors' own Computation

The Descriptive Statistics of the variables under study are presented in the table 1. It depicts the mean, median, standard deviation, skewness, kurtosis with minimum and maximum values in the variables.

**Table 1: Descriptive Statistics**

	GDPG (%)	LEXP (in years)	CO2E (in Metric Tons)
Mean	3.150789	66.97500	5.525514
Median	3.027378	67.93100	3.954937
Maximum	13.63582	76.70400	17.06632
Minimum	-14.61392	53.44400	0.662657
Std. Dev.	4.748891	5.856650	4.138588
Skewness	-0.606352	-0.477186	0.422956
Kurtosis	4.145493	2.500597	1.892132
Observations	145	145	145

Source: Author' owns Computation

Panel Unit Root test by applying Levin, Lin & Chu t, the researchers have checked the panel stationarity. The result obtained from the table 2, depicts the variables GDPG, GDPG\_L1 and LEXP are stationary, whereas, the

variable CO<sub>2</sub>E is non-stationary at level. In the course of analytical procedures, the variable CO<sub>2</sub>E has been transformed to LDCO<sub>2</sub>E by taking log difference to make it stationary, and finally the variable LDCO<sub>2</sub>E becomes stationary. In this study, the LDCO<sub>2</sub>E has been used instead of CO<sub>2</sub>E with other explanatory variables to avoid spurious result.

**Table 2: Levin, Lin & Chu – the Panel Unit Root Test**

Variables	t Statistic	p value	Remarks
GDPG	-2.68617	0.0036*	Stationary
GDPG_L1	-2.68617	0.0036*	Stationary
LEXP	-4.33068	0.0000*	Stationary
CO <sub>2</sub> E	0.89751	0.8153	Non-stationary
LDCO <sub>2</sub> E	-3.32495	0.0004*	Stationary

*Source: Authors' own Computation*

The table 3 represents the results of Hausman Test. This test is applied to select the suitable model out of FEM and REM. The result of Hausman Test signifies that the Fixed Effect Model is suitable by rejecting the null hypothesis that both the coefficients of FEM and REM are consistent, but coefficients of FEM is inefficient at 1% Level of Significance.

**Table 3: Correlated Random Effects - Hausman Test**

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. df	p value
Cross-section random	30.966051	3	0.0000*

*Source: Authors' own Computation*

The table 4 depicts the summary of Wald Test. This test is applied to select the appropriate model out of FEM and Pooled OLS Model. The result of Wald test indicates that the Fixed Effect Model is suitable by rejecting the null hypothesis that there is absence of Fixed effect in the coefficients or Pooled Regression Model is appropriate at 1% Level of Significance.

**Table 4: Wald Test**

Test Statistic	Value	df	p value
F-statistic	104.7149	(4, 132)	0.0000*
Chi-square	418.8596	4	0.0000*

Source: Authors' own Computation

**Table 5: Variance Inflation Factors**

Variable	Variance Coefficient	VIF (Uncentered)	VIF (Centered)
C	6.920567	136.7663	NA
GDPG_L1	0.002802	1.825734	1.271033
LEXP	0.001570	140.5224	1.071173
LDCO2E	0.368644	1.198368	1.197627

Source: Authors' own Computation

Finally, the Fixed Effect Model has been interpreted as result of the Wald test followed by Hausman Test. Before proceeding to the regression, the correlation matrix has been computed and it shows that there exists significant correlation between the dependent variable, GDPG with other independent variables, GDP\_L1, LEXP and LDCO2E. The panel multicollinearity has been checked by computing variance inflation factor (VIF) and the result shows that the model free from multicollinearity as all the VIF value is less than the threshold limit (Table 5).

**Table 6: Empirical Result of the Fixed Effect Model**

Variable	Coefficient	Std. Error	t-Statistic	p value
C	9.442110	4.670362	2.021709	0.0452**
GDPG_L1	0.413927	0.060762	6.812223	0.0000*
LEXP	-0.111823	0.069479	1.60945	0.1099

			3	
			7.52920	
LD <sub>CO2E</sub>	4.266976	0.566723	9	0.0000*
Effects_Specification				
Cross-section fixed (dummy_variables)				
		Sum squared		
Akaike info criterion	4.670273	residual		780.3580
Schwarz criterion	4.838367	Log likelihood		318.9191
Hannan-Quinn				-
criterion	4.738581	F-statistic		56.20196
Durbin-Watson				0.000000
statistic	2.261147	p value(F-statistic)		*
Root_MSE	2.360929	R-squared		0.748769
Mean dependent				
variable	3.298380	Adjusted R-squared		0.735447
S.D. dependent				
variable	4.727192	S.E. of regression		2.431420

Source: Authors' own Computation

The empirical results of Fixed Effect Panel Regression Model are exhibited in table 6. From this model summary, it can be inferred that the model is significant as the p-value of the overall F-statistic is less than 0.01 and the adjusted R-square is 0.735447. The obtained result indicates that the Lag GDP growth (Lag = 1 year) and the Log Difference of CO<sub>2</sub> emission have positive and significant impact on GDP growth. The past GDP growth contributes 41.3927% to the current GDP growth positively whereas, the log difference of CO<sub>2</sub> emission contributes 4.266976 times to the GDP Growth in response to 1 time change in log difference of CO<sub>2</sub> emission. The Breusch-Pagan LM has been conducted to check the presence of residual heterogeneity and the results show there is no residual heterogeneity in the model and the model is also free from autocorrelation (Durbin-Watson stat = 2.261147).

### Discussions, Conclusions and Recommendations:

The statistical results associated with the study conclude that the Lag GDP growth rate (Lag = 1 year) is positively associated with the current GDP

growth rate for BRICS Nations. This signifies that higher economic growth in the past years creates more space for much higher economic growth in the future years. Increasing demand for goods and services of these countries creates more room for profitable opportunities and hence higher profits in the yester years motivate the economic units to produce more in the future years. Increasing population and technological advancement are attributable to higher demand for cheap products.

It has also been observed that the CO<sub>2</sub> emission has a significant positive association with the GDP growth rate, this signifies that over the years economic growth in BRICS nations is highly contributed by non-green technological advancements and mechanisms. The manufacturing sector of BRICS nations is mainly based on non-green technologies, except few large industries majority of others are contributing highly to increasing CO<sub>2</sub> emissions with increasing capacity. The agricultural or primary sector of BRICS nations has also prominent contributed to a considerable amount of CO<sub>2</sub> emissions through unscientific farming procedures. Finally, the growing tertiary sector; like tourism, food and lodging, transport, etc. is also contributing to increasing CO<sub>2</sub> emissions in the country. So, BRICS nations' economic growth is not at all environmentally sustainable, due to the lack of non-green technologies and mechanisms.

The life expectancy at birth has no relationship with the GDP growth rate of BRICS nations. This signifies economic growth or improvement in BRICS nations is in no way related to social capital creation, which is highly contributed by increasing life expectancy at birth. The equitable socio-economic welfare is not contributing to economic development in the BRICS nations through decreasing income inequality, self-employment, higher skill possession, better economic opportunities and social infrastructure, etc. The economic growths in the BRICS countries are largely attributable to a small section of rich and upper-middle-class of societies. Hence, economic improvements in BRICS nations are not at all sustainable in terms of equitable socio-economic welfare in the countries. Large sections of the population of these countries are totally out of any socio-economic security

net and hence socio-economically highly deprived and unable to contribute for sustainable economic development of the countries. The governments' apathy, faulty forecasting and planning, wrong political interests, corruption at various levels and section make the deprivation a long sustaining scenario for BRICS nations.

The study finally concludes that economic growths in BRICS nations are not at all sustainable in any respect and economic growths are mainly attributable to small rich and upper-middle-class sections of the societies. So, here economic development or more specifically sustainable economic development is basically unobserved and also past economic performance positively motivates the future economic performance of the BRICS nations.

For maintaining sustainability in economic development the BRICS nations should thrive for green technology development at a wide scale and replacement of non-green socio-economic mechanisms wherever used at present. The governments and non-government organizations should give the most serious look into these aspects through policy initiatives and actions and adequate resource allocations for a better sustainable future for the country.

For equitable and sustainable socio-economic development in the BRICS countries; the serious, planned and corruption-free initiatives and planning are extremely important for making a large section of the population an indispensable torch bearer of the overall sustainable development of the countries.

### **Limitations and Future Research Scope:**

The study is based on selected number of variables defining environmental protection and equity in development. The similar type of study can be done considering the more number of macro socio-economic variables defining or measuring environmental protection and equity in development. The similar type of study can be conducted by considering new combination of countries having some similaristic features. The similar statistical tool can be used for

achieving different other objectives considering same or other socio-economic units.

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**Annexure to the paper:**

Please visit the following link—

<https://drive.google.com/drive/folders/12WXrTQWWA-ROWLS90KlBeZxO5sorkLlF>