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THE ROLE OF ECONOMIC POLICY UNCERTAINTY AND ENVIRONMENTAL POLICIES IN SHAPING ENVIRONMENTAL SUSTAINABILITY: EVIDENCE FROM BRICS NATIONS

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Abstract

The intensity of environmental pollution has contributed to an immense depletion in our ozone layer and a recession in the global economy. Factors such as uncertainties in economic policies have resulted in the changes in fiscal and monetary policies, serving as limitation for environmental sustainability. However, this study seeks to explore how economic policy uncertainty (EPU) can interact with environmental policies (EPI) to enhance environmental sustainability in BRICS countries. It employs the clustered pooled least square (PLS) and Fixed-effect (FE) models to analyze data from 2000-2022. The findings indicate that EPU increases carbon dioxide (CO_2) emissions whiles EPI reduces CO_2 emissions. However, integrating EPU and EPI mitigates CO_2 emissions in BRICS nations. The study therefore asserts that policymakers can stabilize environmental commitment by implementing long-term, legally binding frameworks, ensuring that environmental policies remain consistent and unaffected by political or economic uncertainties.

Keywords:

Economic Policy Uncertainty, Environmental Policies, Carbon Dioxide Emissions, BRICS Countries

1. Introduction

Global warming has been one of the most critical issues in today's modern world. This has initiated great challenge to our economy and environment. Carbon dioxide (CO_2) emissions from the excessive utilization of fossil fuels and non-renewable energy sources are undeniable contributors to global warming (Zakari et al., 2022). Over the last decade, CO_2 emissions have increased by 88%, thus from 25 million kilotons (mkt) in 1990 to 40.84 million kilotons (World Bank 2020). BRICS countries (Brazil, Russia, India, China, and South Africa) have also seen tremendous economic development for the past decades. They constitute 45% of the world's population, represent 23% to the global GDP, 38% of the international energy and are accountable for a greater percentage of the global greenhouse gases (GHGs) (Sarfraz et al., 2021). This faster economic development has increased the challenge of our surroundings (Danish & Wang, 2019).

However, economic policy uncertainty (EPU) and environmental policies (EPI) are pivotal factors that influence the sustainability of the environment. EPU emphasizes on the unpredictable and unstable government policies that influence economic decisions. This uncertainty can result in the variation of fiscal, monetary, regulatory or trade policies and serve as both a barrier and a catalyst for environmental sustainability. Thus, while unpredictable policies slow progress, they can also drive innovation and public demand for clarity. Additionally, environmental regulations have become a medium of controlling the use of environmental resources and greater influence to strengthening environmental protection (Wang et al., 2021). It focuses on balancing economic development with environmental preservation, ensuring that human activities do not compromise the health of the planet for future generations.

The study empirically explores the influence of EPU and EPI on CO_2 emissions in BRICS countries. Previous studies have not adequately addressed the interaction of these variables, especially in heterogeneous emerging economies like BRICS. However, this study examines the integration of EPU and EPI in enhancing environmental sustainability. Relevant studies on the impact EPU and EPI on environmental sustainability show an inconsistent and mixed findings and therefore demands further studies. Javed et al. (2023) examined the influence of EPU on CO_2 emissions using an Auto-Regressive Distributed Lag (ARDL) model in Italy. The study concluded on a negative relationship between EPU on CO_2 emissions. In contrast, Farooq et al. (2022) used Fully modified ordinary least square (FMOLS) technique to explore the interconnection of EPU and CO_2 emissions. The results indicated that EPU increases carbon emissions. Moreover, Zhou et al., (2023) and Chen & Chen (2021) examined the influence of EPI and environmental pollution in China. The study revealed that EPI mitigates environmental pollution. This paper significantly fills a research gap by thoroughly examining how economic policies and environmental regulations complement or counteract each other, offering a roadmap for more resilient and adaptive policies. This provides policymakers with data-driven scenarios to understand the implications of EPU and regulatory changes. Moreover, BRICS countries play a significant role in global environmental governance. Insights from this study can help these nations align their policies with global climate commitments like the Paris Agreement. This can serve as a benchmark for other developing nations grappling with similar challenges, providing lessons on managing economic policy uncertainty and regulatory frameworks.

The study is organized as follows: section 1—Introduction; section 2—Methodology; section 3—Results and Discussion; section 4—Conclusion and Recommendation.

2. Methods

2.1 Sample Area

The study centers on BRICS nations as a sample area, encompassing Brazil, Russia, India, China and South Africa. BRICS nations are characterized by rapid industrialization and urbanization, resulting to environmental degradation. The study of these nations can highlight the trade-offs between economic development and environmental sustainability.

2.2 Data Source and variable description

This research uses secondary and quantitative data from 2000 to 2022 to investigate how Economic policy uncertainty (EPU) integrate with environmental policies (EPI) to influence GHG emissions. Data are sourced from World Development Indicator (WDI), Organization for Economic Co-operation and Development (OECD) and Federal Reserve Economic Data. As indicated in **Table 1**, CO_2 (metric tons), is chosen as the dependent variable. EPU, EPI, and UP (synergy of EPU and EPI) are used as the explanatory indicators. EPU is selected as an indicator from the World Uncertainty Index (WUI), accessed quarterly. However, the average data of the quarters, has been transformed into a yearly frequency (Javed et al., 2023). Other control variables used for the paper are Industrialization (IND), Government spending (GOVS) and Urbanization (URB).

Table 1. *Variable description*

Variable	Description	Unit	Sources
CO_2	Carbon dioxide emissions	Metric tons	WDI

EPU	Economic Policy Uncertainty	World uncertainty index	Federal Reserve Economic Data
EPI	Environmental Policies	Patent of environmental technology	OECD
IND	Industrialization	% of GDP	WDI
GOVS	Government spending	% of GDP	WDI
URB	Urbanization	% of total population	WDI

2.3 Model Specification

This research chooses panel data analysis models; clustered pooled least square (PLS) and Fixed-effects (FE) to run the analysis. These models are applied to investigate the correlation between the response and explanatory variables. Clustered PLS is an extension of pooled ordinary least square (PLS) that adjusts for within-cluster correlation in error terms. It ensures robust standard errors in panel data analysis by accounting for correlated errors within clusters. This helps achieve aggregated effects estimates, considering the overall impact of EPU and EPI on the carbon emissions. Moreover, Fixed effect model is utilized to control unobserved heterogeneity across cross-sectional units that may influence the dependent variable. It assumes that these unobserved characteristics are constant over time but vary across entities. The model for the study is specified as follows;

$$CO2_{it} = B_i + \theta_1 EPU_{it} + \theta_2 EPI_{it} + \theta_3 UP_{it} + \theta_4 GOVS_{it} + \theta_5 IND_{it} + \theta_6 URB_{it} + \varepsilon_{it} \qquad (1)$$

where, $CO2_{it}$ indicates carbon dioxide emissions, EPU_{it} shows Economic Policy Uncertainty, EPI_{it} reveals environmental policies, UP_{it} dennotes the integration of EPU and EPI. $GOVS_{it}$, IND_{it}, URB_{it} are Government spending, Industrialization and Urbanization respectively and the error term is also represented as ε_{it}. θ_1, θ_2, θ_3, θ_4, θ_5 and θ_6 are the underestimated parameters for the selected variables.

3. Results and Discussions

3.1 Descriptive statistics, multicollinearity test and Cross-sectional dependency

The study conducts a descriptive analysis to ascertain the variations among the selected indicators. It analyzes data from 2000 to 2022 and focus on standard deviations, means, minimum, and maximum based on 115 observations (see **Table 2**). Cross-sectional dependency (CD) test is also conducted, and the null hypothesis of no cointegration is rejected, revealing an interrelation among the chosen variables. Finally, the Variance Inflation Factor (VIF) examines the multicollinearity among the independent variables, however, the results indicate the absence of multicollinearity in the dataset.

Table 2. *Descriptive statistics and multicollinearity test*

VARIABLES	VIF	CD	MEAN	SD	MIN	MAX
CO_2		10.25*	0.189	0.279	0	1
EPU	1.80	4.835*	0.196	0.195	0	1
EPI	7.90	2.637*	0.911	0.183	0	1
UP	6.74	6.091*	30.174	80.559	0	620.095
GOVS	7.28	4.943*	0.593	0.287	0	1
IND	2.30	6.101*	0.397	0.265	0	1
URB	7.21	14.831*	0.549	0.319	0	1
OBS	115					

*denotes the presence of significant cross-sectional dependency

3.2 Unit root test

The unit root tests Levin–Lin–Chu (LLC) and Harris Tzavalis (Ht) are analyzed to prevent spurious regression results (see **Table 3**). The outcomes indicate that the chosen variables are stationary at both level and first difference. Moreover, cross-sectionally augmented panel unit-root test (CIPS) is conducted resolve the presence of cross-sectional dependency.

Table 3. *Unit root tests*

Variables	**Level**			**1st Difference**		
	LLC	Harris Tzavalis	CIPS	LLC	Harris	CIPS
CO_2	-2.162*	0.958	-1.201	-3.219*	0.387*	-3.328*
EPU	-2.088*	0.597*	-3.547*	-6.702*	-0.318*	-5.324*
EPI	-1.746*	0.985	-2.709*	-9.667*	-0.026*	-6.008*
UP	-2.110*	0.777*	-1.791	-7.718*	-0.154*	-5.490*
GOVS	-1.639*	0.663*	-2.543*	-4.736*	-0.097*	-3.244*
IND	-0.598	0.892	-1.932	-3.679*	0.171*	-3.114*
URB	-30.794*	0.994	2.438	7.315	1.012*	3.254*

* denotes stationarity for unit root tests

3.3 Regression results for the BRICS countries

From **Table 4**, the clustered pooled least square (PLS) and fixed-effect (FE) models are chosen using the STATA MP 17 software to explore the linear relationship of EPU, EPI and their interplay on CO_2 emissions. The outcomes indicate that EPU significantly increases CO_2 emissions, confirming the studies by Anser et al. (2021) and Arvas et al. (2023) who investigated the nexus between EPU and CO_2 emissions. This suggests that EPU disrupts the balance between economic growth and environmental sustainability by creating an environment where carbon-intensive activities are prioritized, green investments are delayed, and regulatory enforcement are weakened. For example, during the periods of economic policy uncertainty in China such as trade tensions or political reforms, industrial output tends to rise, leading to increased energy demand from coal.

Moreover, EPI shows a negative nexus with CO_2 emissions, validating the findings of Ghazouani et al. (2021) and Sarfraz et al. (2021) who examined the correlation between EPI and CO_2 emissions. This reveals that EPI can inadvertently lead to increased CO_2 emissions in BRICS countries due to gaps in implementation, high transition costs, reliance on fossil fuels, and economic priorities. While EPI aims to reduce emissions, complementary measures such as technological support, capacity building, and global collaboration are essential to avoid these unintended consequences. Furthermore, the integration of EPU and EPI mitigates CO_2 emissions, asserting that when governments exhibit unclear or inconsistent policies, businesses hesitate to invest in long-term projects, including those aimed at reducing emissions.

However, integrating environmental goals with economic policies can reduce this hesitation. For instance, if BRICS nations align fiscal policies with environmental goals, businesses gain the confidence to invest in green technologies. Furthermore, GOVS as the control variable statistically curbs CO_2 emissions, implying that a percentage increase in GOVS results in 10.4% and 15% reduction in CO_2 emissions. Finally, IND and URB reveal positive relations with CO_2 emissions.

Table 4. *Regression results for the BRICS countries*

Variables	**Co_2 emissions**	
	PLS	FE
EPU	0.079* (0.048)	0.086*** (0.030)
EPI	-1.3687*** (0.097)	-0.373*** (0.101)
UP	-0.001*** (0.001)	-0.001*** (0.001)

GOVS	-0.104* (0.059)	-0.150*** (0.051)
IND	0.567*** (0.032)	0.146* (0.075)
URB	0.127** (0.051)	1.202*** (0.114)
OBS.	115	
Sample	2000-2022	
Cross-Section	5	

4. Conclusion and Recommendations

4.1 Conclusion

This research explores how EPU and EPI can be integrated to enhance environmental sustainability through empirical approach. Clustered PLS and FE methods are selected to ascertain data from 2000 to 2022. Diagnostic tests, encompassing VIF, unit root and cross-sectional dependence tests, are analyzed to avoid spurious results. The findings indicate no spurious results and multicollinearity among the variables. The outcomes of the linear regression demonstrates that EPU has positive connection with CO_2 emissions, EPI mitigates CO_2 and the synergy of EPU and EPI curbs CO_2 emissions. Moreover, GOVS statistically reduces CO_2 emissions whiles IND and URB increases CO_2 emissions.

4.2 Recommendation

Based on the findings of this study, it provides the following recommendations;

Firstly, considering the positive impact of EPU on CO_2 emissions in BRICS nations, governments should implement long-term, stable environmental policies that remain consistent across political or economic cycles. For instance, legally binding emission reduction targets should be introduced and multi-year green investment plans should be created to link to climate goals. Moreover, policymakers should transparently communicate environmental goals and regulations to reduce uncertainty for businesses and investors.

Furthermore, with respect to the negative effect of EPI on CO_2 emissions in BRICS nations, governments and policymakers should strengthen their policy enforcement by establishing robust systems for tracking emissions and compliance with environmental policies and ensuring that these regulations are followed. For instance, satellite data and AI-powered analytics can be used to monitor industrial emissions. Additionally, higher penalties can be imposed for industries and corporations that fail to comply with environmental regulations, creating a strong deterrent against violations.

Finally, due to the reduction in CO_2 emissions through the integration of EPU and EPI, government officials and policymakers can design policies where economic strategies explicitly incorporate environmental objectives. For instance, fiscal stimulus measures can be linked to green projects, such as renewable energy installations or public transportation expansion and also economic recovery packages to fund sustainable infrastructure can be used. Additionally, policymakers can stabilize environmental commitment by creating long-term, legally binding frameworks to ensure environmental policies remain consistent and unaffected by political or economic uncertainties. For example, climate action plans can be incorporated into national constitutions or five-year economic strategies.

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