Does Diversifying Energy Consumption Foster Economic Growth? A BRICS Perspective

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Overview

Energy is indispensable for industrialization, which is a key engine of economic growth. The availability of reliable and affordable energy sources fosters industrial development by powering machinery, factories, and production facilities. According to Stern and Kander (2012), the industrial revolution marked a turning point in economic history, largely driven by the adoption of coal as a primary energy source. Similarly, contemporary economies rely heavily on electricity and other energy forms to sustain manufacturing and production processes. Modern industries, such as steel, cement, and chemical production, are particularly energy-intensive, underscoring the necessity of a robust energy supply.

Each nation utilises distinct energy sources in varying proportions. This matter is designated as the "energy mix." Energy diversification incorporates several energy sources into the energy portfolio. In other terms, it is characterised as augmenting the proportion of energy sources to reduce reliance on a singular energy source (Stirling, 2010). Energy concentration refers to a nation's significant dependence on a singular energy resource. Energy resources are not evenly distributed globally. A few countries possess efficiency and potential cost advantages in specific energy production methods (Muller and Yan, 2018). The shift from traditional to modern energy sources has also been instrumental in increasing productivity. Technological advancements in energy generation and utilization have enabled firms to achieve greater output with lower input costs. For instance, renewable energy technologies, such as solar and wind, have not only reduced dependence on fossil fuels but have also driven innovation in energy efficiency, contributing to long-term economic growth (Apergis and Payne, 2010).

The adoption of renewable energy technologies has also opened new avenues for economic growth. Countries investing in renewables have witnessed the emergence of green industries, generating employment opportunities and fostering economic diversification. For instance, China’s substantial investments in solar and wind energy have positioned it as a global leader in renewable energy manufacturing, contributing significantly to its GDP growth (Zhang et al., 2017) in other sectors to stimulate economic growth.

Empirical studies have extensively examined the energy-growth nexus, with mixed findings depending on the methodology, country context, and time period analyzed. In this context, understanding the relationship between energy consumption, energy diversification, and economic growth has become increasingly vital, especially in the face of climate change and growing energy demands.

This research delves into the dynamic relationship between energy consumption diversification and economic growth, specifically within the BRICS economies—Brazil, Russia, India, China, and South Africa. These emerging markets are characterized by rapid industrialization, urbanization, and evolving energy landscapes, making them a compelling case for investigating the broader implications of energy transitions.

This study examines whether such diversification fosters economic growth by promoting technological innovation, reducing resource dependency, and addressing sustainability challenges, or if it introduces structural inefficiencies that hinder development.

In the context of BRICS countries, unique challenges such as institutional differences, varying levels of economic development, and disparities in energy infrastructure warrant careful analysis. By employing advanced econometric techniques like asymmetric cross sectional ARDL, this research aims to capture both short-term and long-term

impacts of energy diversification in consumption on growth. Additionally, it evaluates the role of complementary factors, including gross capital formation, foreign direct investment, and labor force dynamics, in shaping this relationship.

Ultimately, the findings of this research are expected to provide valuable insights for policymakers seeking to design sustainable energy strategies while ensuring steady economic progress in emerging economies.

Methods

This research explores the relationship between energy diversification and economic growth in BRICS countries. GDP is employed as a proxy for economic growth, while explanatory variables include total labor force , foreign direct investment (FDI), and gross capital formation, which are critical factors influencing growth. The primary focus of the study is on the energy diversification index, calculated as the ratio of all energy sources utilized by a country to its total primary energy consumption. This index captures the extent to which a country diversifies its energy mix.

To investigate both short-run and long-run asymmetries in the impact of energy diversification, the cross-sectional ARDL (CS-ARDL) model is employed. This method accounts for potential heterogeneities across countries while offering a robust framework to derive long-run and short-run results. The findings provide valuable insights for policymakers, highlighting the dual influence of energy diversification on growth over different time horizons and underscoring its importance for sustainable economic development.

Results

The results of this study highlight the critical role of energy diversification in driving economic growth in BRICS countries. The energy diversification index shows a significant positive impact on GDP in both the short and long run, with a stronger emphasis on its long-term effects. Specifically, a 1% increase in the index contributes to a 0.0621% rise in GDP in the long run, underscoring the importance of diversifying energy sources to enhance economic resilience and sustainability. This finding suggests that energy diversification fosters long-term economic stability by reducing reliance on a single energy source and mitigating risks associated with energy price volatility or supply disruptions. In addition to energy diversification, gross capital formation and foreign direct investment (FDI) emerge as key drivers of long-term growth, with significant and positive contributions to GDP. A 1% increase in FDI and gross capital formation boosts GDP by 0.0693% and 0.4051%, respectively, in the long run. These results reaffirm the importance of fostering investment and attracting FDI for sustained economic development. In contrast, labor force participation and CO_2 emissions do not exhibit significant long-run effects on GDP, suggesting that their contributions to growth are either negligible or influenced by structural inefficiencies in the region. Overall, the findings emphasize that energy diversification, alongside investment and FDI, is crucial for achieving long-term economic growth and sustainability in the BRICS economies.

Conclusions

This study provides important evidence on the key factors driving economic growth in BRICS countries, with a particular emphasis on energy diversification. The results clearly demonstrate that energy diversification significantly boosts economic growth in both the short and long term, making it a vital component of sustainable economic strategies. A diverse energy mix helps to mitigate risks associated with overdependence on specific energy sources, enhances energy security, and supports long-term economic stability. Additionally, foreign direct investment (FDI) and gross capital formation are found to be strong contributors to growth, highlighting the need for policies that attract investment and encourage the accumulation of productive capital. On the other hand, labor force participation and CO_2 emissions do not show significant long-term effects, suggesting potential inefficiencies or underutilization in these areas. These findings underline the importance of adopting policies that prioritize energy diversification.