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Nexus between Life Expectancy, Economic Growth, and Renewable Energy Transition and Carbon Footprints in BRICS Economies: Evidence from Panel ARDL Approach

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Abstract

This research investigates the intricate nexus between CO_2 emissions, economic growth, population dynamics, and the energy transition in the BRICS economies. Employing a panel ARDL approach, robust cointegration analyses provide proof of the long-run equilibrium relationship among the variables. The panel ARDL model reveals that higher GDP per capita (indicating greater affluence) and population growth had positive long-run impacts, driving up CO_2 emissions. However, these effects are counterbalanced by the negative consequences of increased renewable energy consumption (reflecting technological progress) and longer life expectancy (demographic transition), which help reduce emissions. Interestingly, the Panel Causality assessment uncovered bidirectional causality among GDP per capita and CO_2 emissions, highlighting their complex interplay. Additionally, the research found that renewable energy consumption, population growth, and life expectancy had unidirectional causal impacts on CO_2 emissions. Notably, the significant error correction term confirmed that the BRICS nations converge towards a long-run sustainable equilibrium path balancing these factors over time. The robustness estimation using the fully modified ordinary least squares and the dynamic ordinary least squares confirmed the results from the ARDL. The findings reinforce the validity of the IPAT (Impact = Population * Affluence * Technology) framework, recognizing the interconnectedness of population, affluence, and technology as key drivers of environmental impact. This study provides empirical insights to guide policymakers in designing coordinated interventions to promote sustainable economic development while mitigating adverse ecological consequences in the BRICS economies.

Keywords: CO_2 emissions, Economic growth, Population dynamics, Energy transition, IPAT model