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Beyond the threshold: Understanding the asymmetric effects of renewable energy on CO2 emissions

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Abstract

While renewable energy deployment is essential to mitigate climate change, the interplay between renewable energy consumption and environmental degradation may not be linear. The environmental aspect of renewable energy consumption may change over time, depending on the scale and technique effects. This may be due to asymmetry in the relationship. Nonetheless, most current literature either assumes linearity, or ignores the turning point of the behavioral change. This results in inconclusive empirical findings at the disaggregated level of renewable energy consumption. This paper utilizes threshold estimation technique to capture the asymmetry in the renewable energy-CO2 emissions relation in the top ten renewable energy consumers covering the period 1990–2020. The literature gap is addressed by deriving the threshold effect at the aggregate and disaggregated levels to prevent aggregation bias. Understanding the thresholds of different renewable energy sources would improve policy effectiveness and resource allocation at different consumption levels to better curb climate change. The threshold estimation technique measures total renewables, hydro, solar, wind, and others (bioenergy and geothermal) as threshold variables. The findings indicate that total renewables and solar consumptions have stronger mitigating effects on CO2 emissions beyond the consumption levels of 4363.37 and 43.58 kWh, respectively. The advantageous environmental effect of wind consumption only manifests above the consumption level of 657.40 kWh. For policy implication, this study recommends an increase in the weightage of renewables in the energy mix by formulating energy-specific policies, in order to optimize the environmental benefits of renewable energy adoption.

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