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Asymmetric Vehicle Transition and Decarbonization in the EU: The Mediating Role of Environmental Policy Stringency

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Extended Abstract

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Abstract Summary

This paper investigates how passenger-vehicle fleet composition, specifically electric vehicles (EVs) and internal combustion engine vehicles (ICEVs), shapes transport-sector carbon emissions across the European Union (EU) and whether environmental policy stringency (EPS) moderates this relationship. Despite EU climate targets, transport emissions have risen by 18.4% since 1990, with passenger cars contributing nearly 60% of road transport emissions. While EV adoption is expanding, progress remains fragmented across member states, raising questions about the effectiveness of current decarbonization strategies. Using a balanced panel dataset for 26 EU countries (2010-2023), the analysis applies the STIRPAT framework with country- and year-fixed effects, complemented by causal mediation analysis to assess the role of EPS. Robustness is ensured through Driscoll-Kraay Standard Errors, System Generalized Method of Moments to address endogeneity, and Method of Moments Quantile Regression to capture heterogeneous effects across the emissions distribution. Findings reveal that EV adoption significantly reduces transport emissions, whereas ICEVs remain the dominant driver of emissions growth. EPS partially mediates the EV-emissions relationship, which amplifies decarbonization gains in a mutually reinforcing dynamic consistent with the Porter hypothesis. However, EPS does not significantly attenuate ICEV-related emissions, which reveal the structural rigidity of fossil-fueled transport systems. Heterogeneity analysis shows EVs yield stronger emission reductions in low-emitting countries, while ICEVs exert increasingly severe impacts in high-emitting contexts. The results imply that achieving EU climate neutrality requires more than promoting EVs to binding ICEV phaseout mandates; targeted scrappage schemes for older vehicles; and accelerated charging infrastructure deployment, especially in lagging regions. Policy stringency should be differentiated, with stricter measures in high-emitting countries and stability-focused frameworks in advanced adopters to sustain progress.

Presenting Author Biography

Joshua Adeyemi Afolabi is a postdoctoral researcher at the Institute of Economics, Technische Universität Ilmenau, Germany, with a proven record of several scientific peer-reviewed articles published in high-profile international journals. His research areas include environmental economics, energy economics, development economics, and international macroeconomics.