The Sustainability Gap: Vertical Specialization, Global Value Chains Integration and Environmental Degradation in Africa's Mineral-Led Growth

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The global transition toward electric mobility, framed within the "Green Policy" agendas developed with particular intensity by the European Union, has exponentially increased the demand for critical minerals essential for the manufacturing of electric vehicles (EVs) and batteries. While these policies are presented as a primary solution for decarbonization in the Global North, their domestic impact on resource-rich developing regions remains controversial. This research investigates the relationship between the surge in critical mineral exports and socio-economic and environmental outcomes in Sub-Saharan Africa, examining whether a form of what has been termed "Green Colonialism" has emerged. Specifically, this study examines the impact of Sub-Saharan African countries' integration into Global Value Chains (GVCs) through mineral exports on environmental degradation. To this end, we measure the impact of exports of minerals identified by the International Energy Agency as critical for EV and battery production—specifically cobalt, lithium, nickel, copper, rare earths, and aluminum—on Green GDP. Unlike conventional GDP, Green GDP accounts for environmental depletion and the degradation of natural capital, providing a more accurate measure of sustainable development. Subsequently, the study examines the impact of environmental degradation, and the economic model driving it, on institutional quality. The empirical analysis is conducted within a panel data framework, where several models are estimated. Among the techniques employed, the Generalized Method of Moments (GMM) is used to account for unobserved heterogeneity and potential endogeneity across the sample. A key methodological innovation is the construction of an interaction term between vertical specialization (normalized as a share of total exports) and critical mineral exports. This variable allows us to capture the specific intensity of resource dependency and the nature of the region's integration into Global Value Chains.

The model incorporates key control variables to ensure the robustness of the estimates, including trade openness (TO), official development assistance (ODA), economic freedom index (EF), institutional quality (IQ), and foreign direct investment (FDI) inflows. The sample comprises all Sub-Saharan African countries over the last few decades, utilizing data from the United Nations Comtrade database and Green GDP estimates following the methodology of Skare, Tomic, and Stjepanovic (2021).

Empirical results reveal a statistically significant negative impact of critical mineral exports on the region's Green GDP. These findings suggest that the intensive extraction required for the global energy transition leads to a net loss in ecological wealth and a

potential deterioration of domestic governance structures. This phenomenon indicates that the current "Green Policy" framework could be reinforcing an ecologically unequal exchange, where environmental and institutional costs are outsourced to other regions. The study concludes that without significant reforms in mining governance and the implementation of compensatory mechanisms for natural capital loss, the electric vehicle boom may undermine the long-term sustainability of African nations.

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