



A disaggregated approach to analyzing the effect of electricity on carbon emissions: Evidence from African countries

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ABSTRACT

This paper investigates the effects of electricity consumption and generation on carbon emissions in 25 African countries for the 1980–2016 period. Specifically, it examines the effects of diverse electricity sources (e.g. hydro, oil, natural gas, coal) and renewable electricity output on carbon emissions. It employs estimation techniques that are appropriate for cointegrated panels such as Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS) and Augmented Mean Group (AMG). The panel cointegration tests reveal a cointegration relationship between the variables. The estimation results show that electricity consumption has a detrimental effect on carbon emissions, while renewable electricity output mitigates carbon emissions in African countries. Moreover, electricity generation from oil, natural gas and coal have detrimental effects on carbon emissions while electricity generation from hydro alleviates carbon emissions. This implies that electricity consumption and generation are significant determinants of carbon emissions in African countries, hence efforts to abate carbon emissions should incorporate them in order to achieve sustainable development.

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1. Introduction

The importance of energy in fostering economic growth and development of any country cannot be overemphasized. The theoretical and empirical literature posited that energy consumption enhances the growth of economic activities (Narayan and Smyth, 2008). This implies that a higher level of economic development can be achieved with a higher level of energy consumption. However, energy consumption could take place at the expense of carbon emissions which worsen environmental degradation. Infact, carbon emissions are considered as one of the main causes of climate change and global warming, issues that have occupied global discourse in recent decades. It is necessary to control climate change and global warming because of their detrimental effects on the ecosystem and human existence. Consequently, several scholars have devoted considerable attention to unveil the main determinants of carbon emissions. Although other views exist, most of the empirical outcomes revealed that energy consumption is deleterious to carbon emissions (Acaravci and Ozturk, 2012; Ehigiamusoe and Lean, 2019; Ehigiamusoe et al., 2020, 2019). Nevertheless, the empirical literature provided evidences that non-renewable energy consumption aggravates carbon emissions, while renewable energy consumption has a mitigating effect (see Dogan and Seker, 2016a).

One aspect of energy that has not received a considerable attention (especially in developing countries) is the nexus between electricity generation/consumption and carbon emissions, albeit evidences abound that electricity consumption enhances economic growth (Khan et al., 2018). The previous empirical outcomes on the effect of electricity consumption on carbon emissions are mixed, with some studies reporting a detrimental effect (e.g. Al-mulali and Che Sab, 2018; Lean and Smyth, 2010a; Salahuddin et al., 2015) while other studies documented a mitigating or insignificant effect (e.g. Belaid and Youssef, 2017; Belaid and Zrelli, 2019; Cowan et al., 2014). Moreover, Belaid and Youssef (2017) noted that renewable electricity consumption enhances environmental quality in Algeria, while Cowan et al. (2014) revealed absence of any causal relationship from electricity consumption to carbon emissions in Brazil, Russia, China and South Africa. The differences in the empirical results of previous studies could be attributed to failure to account for some economic and econometric issues such as heterogeneity and cross-sectional dependence. Dogan and Aslan (2017) posited that one main criticism of the extant studies on energy-growth-environment nexus is the use of panel empirical methodologies that do not consider heterogeneity and cross-sectional dependence across countries, which may engender forecasting errors. In developing countries, the effect of renewable electricity output on carbon emissions has not received adequate attention.

Besides, some empirical studies indicated that electricity generation has a significant influence on economic growth (Altintas

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