FOSSIL FUEL ENERGY CONSUMPTION, ECONOMIC GROWTH, URBANIZATION, AND CARBON DIOXIDE EMISSIONS IN KENYA

Jacob Otim, Kyambogo University, Phone: +256772831133, Email: Email: jotim@kyu.ac.ug
Susan Watundu, Makerere University Business School, Phone: +256782658703, Email: swatundu@mubs.ac.ug
John Mutenyo, Makerere University, Phone: +256750504217: Email: jkmutenyo@yahoo.com
Vincent Bagire, Makerere University Business School, Phone: +256772433670, Email: vbagire@mubs.ac.ug

Overview

Carbon dioxide (CO_2) emissions from the combustion of fossil fuels are one of the most serious environmental threats of our time, contributing to global warming and eventual climate change (Zhang et al. 2018). The Kyoto Protocol was signed by 192 parties in 1997 as a component of the United Nations Framework Convention on Climate Change (UNFCCC) to significantly reduce the impact of greenhouse gas emissions (Maamoun 2019; Torrey 2007). Total global greenhouse emissions increased by 1.1 % in 2019, with the combustion of fossil fuels accounting for 0.9% of total global CO_2 emissions (Olivier & Peters 2020). Kenya like many other developing countries is experiencing increased economic growth and transformation, which is leading to urbanization as a new development trend. Urbanization and economic growth increase the demand for energy to power industries, homes, and automobiles used to transport people to cities (Bakirtas & Akpolat 2018). Urbanization entails the movement of labour from rural areas with zero marginal product to urban areas, where labour has a positive marginal product. This is a precursor to economic growth in developing countries due to the rise of modern service and industrial economies (Timmer & Akkus 2008). The effects of economic growth and urbanization on CO_2 emissions, on the other hand, remain inconclusive and contentious.

The novelty of the study is based on the ground that most previous studies on the energy-growth-environmental nexus used the Engle-Granger cointegration approach, which is often inappropriate when the sample size is small (Odhiambo 2009). To ensure the health of the estimate of the long-run cointegrating relationship through triangulation, the current study employs the Autoregressive Distributed Lag (ARDL) bounds cointegration test, Johnsen and Juselius cointegration tests, and Gregory-Hansen cointegration tests. Specifically, Gregory-Hansen structural tests for cointegration are very helpful in testing for cointegration in case the structural breaks exist in the data where the conventional cointegration tests become inappropriate. Some existing studies such as the empirical work of Altinay and Karagol (2005) and Narayan and Narayan (2010) used bivariate analysis which makes their models suffer from the omitted variable bias (Alkhathlan & Javid 2013). To address the issue of omitted variable bias, we used a multivariate framework. The empirical findings of this study are expected to contribute to the existing body of knowledge on Kenya and other developing countries and are relevant for their long-term growth trajectory.

Methods

The study employs lin-log and log-lin models and uses the autoregressive distributed lag bounds cointegration test, the Johansen-Juselius cointegration test, and the Gregory-Hansen structural breaks test for cointegration to determine the presence of a long-run causal relationship between variables. The study investigates the relationship between the variables by employing a Granger causality test based on a vector error correction model (VECM).

Results

The long-run causation was detected, indicating that fossil fuel consumption, Gross Domestic Product (GDP), and urbanization cause CO_2 emissions and the coefficient of Error Correction Term (ECT) of 0.479, was negative and statistically significant at 5%. The result of short-run Granger causality reveals that GDP is caused by fossil fuel consumption. Interestingly, there is no direct causal relationship between fossil fuel energy consumption and CO_2 emissions, although numerous empirical articles claim that fossil fuel consumption is the primary source of CO_2 emissions and climate change. In addition, in the short-run, our findings reveal a positive relationship between CO_2 emissions and fossil consumption, but with no causality. However, we found GDP to cause CO_2 emissions. Further, urbanization was found to reduce CO_2 emissions in Kenya, implying that encouraging urbanization will go a long way in reducing the amount of CO_2 emissions the country generates. Besides there is no evidence of a causal association

between urbanization and GDP, according to the study. Generally, our results support energy conservation and efficiency policies such as developing fuel efficiency yardsticks for heavy and light-duty vehicles, using solar lighting systems in public squares and using programmed motion sensors in offices and street lighting. Such measures reduce carbon emissions, energy waste, and energy inefficiency, and are more likely to have no negative impact on Kenya's economic growth.

Conclusions

Using data from 1971 to 2014, this research investigates the effects of fossil fuel energy consumption, GDP, and urbanization on CO_2 emissions in Kenya. The study uses different cointegration approaches to established long-run relationship and tests the causality between the variables using VECM. Our empirical investigation not only add to the literature but also provide policy implications that are expected to guide Kenyan and other neighbouring countries' policymakers. Besides, the research strengthens and expands our understanding of the relationship between fossil fuel energy consumption, economic growth, urbanization, and carbon dioxide emissions in Kenya. This research can be expanded by incorporating other environmental degradation proxies such as methane, nitrous oxide and fluorinated pollutants. In the future, a similar study could be undertaken at the regional level. The variability of connections may also be revealed by regional outcomes. These findings could lead to locally-focused varied policy recommendations, and considering regional realities would allow for bigger samples, ensuring the robustness of empirical results and delivering more credible conclusions.

References

Alkhathlan, K., & Javid, M. (2013). Energy consumption, carbon emissions and economic growth in Saudi Arabia: An aggregate and disaggregate analysis. *Energy Policy*, *62*, 1525–1532. https://doi.org/10.1016/j.enpol.2013.07.068

Altinay, G., & Karagol, E. (2005). Electricity consumption and economic growth: Evidence from Turkey. *Energy Economics*, *27*(6), 849–856. https://doi.org/10.1016/j.eneco.2005.07.002

Bakirtas, T., & Akpolat, A. G. (2018). The relationship between energy consumption, urbanization, and economic growth in new emerging-market countries. *Energy*, *147*, 110–121. https://doi.org/10.1016/j.energy.2018.01.011

Maamoun, N. (2019). The Kyoto protocol: Empirical evidence of a hidden success. *Journal of Environmental Economics and Management*, *95*, 227–256. https://doi.org/10.1016/j.jeem.2019.04.001

Narayan, P. K., & Narayan, S. (2010). Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. *Energy Policy*, *38*(1), 661–666. https://doi.org/10.1016/j.enpol.2009.09.005

Odhiambo, N. M. (2009). Energy consumption and economic growth nexus in Tanzania: An ARDL bounds testing approach. *Energy Policy*, *37*(2), 617–622. https://doi.org/10.1016/j.enpol.2008.09.077

Olivier, J. G. ., & Peters, J. A. H. w. (2020). Trends in global CO2 and total greenhouse gas emissions. *PBL Netherlands Environmental Assessment Agency, The Hague., December*.

Timmer, B. C. P., & Akkus, S. (2008). Working Paper Number 150 July 2008 The Structural Transformation as a Pathway out of Poverty : Analytics , Empirics and Politics The Structural Transformation as a Pathway out of Poverty : Analytics , Empirics and Politics. *World Development*, *150*.

Torrey, M. (2007). The Kyoto Protocol. *INFORM - International News on Fats, Oils and Related Materials*, *18*(8), 527. https://doi.org/10.4324/9781315147024-21

Zhang, H., Bucior, B. J., & Snurr, R. Q. (2018). Molecular Modeling of Carbon Dioxide Adsorption in Metal-Organic Frameworks. In *Modelling and Simulation in the Science of Micro- and Meso-Porous Materials*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-805057-6.00004-1