SUSTAINABILITY OF ENERGY TRANSITION ON OUTPUT GROWTH AND CARBON EMISSION ABATEMENT IN SUB SAHARA AFRICA

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Overview

Despite the growing efforts to curb carbon emission, all attempts to curb emission which does not consider the need for changes in energy production and consumption seem not sustainable and end in futility. In other words, the challenge facing every country is the access to energy to such that facilitate economics growth without sacrificing environmental integrity,Darmstadter (2001). In this light, the dominating effects of energy such as non-renewable energy or the fossil fuel has paved the need for the gradual moving to renewable energy. Energy transition implies a structural shift from the existing forms and patterns of energy production and consumption system which is basically on non-renewable energy sources like oil, natural gas and coal into less carbon energy mix -renewable energy.

The major challenge of energy use in the recent time is the incessant increase in carbon emission creating doubts for possible sustainability of Energy use to drive output growth and carbon abatement. The emission of carbon dioxide has been a common challenge that bedevils possibility of clean climate system vis a viz environmental regulation across countries. Global Carbon emission intensity has of recent gained attention from the world international community. Although in the words of Toman (2001), Life on earth is possible partly because of some gases like carbon dioxide CO_2 and water vapour which naturally occur in Earth's atmosphere, trap heats like greenhouse gases but the emerging risks from the carbon emission has become a subject for debate in the literature. The current global warming of 2.5^{o}C caused by disaggregated carbon emissions has forced countries and organisations into emission targeting agreement and climate treaty as evidence by the United Nation conference in Berlin, Germany which focused on limiting emission in the years 2005, 2010 and 2020 respectively. Developed and industrialized nations have been fingered to hold a larger share of carbon emissions due to the heavy reliance on fossil fuel energy. Amidst of the growing carbon emission in the developed nations, developing nations are said to be the hardest hit by climate change as it is primarily caused by carbon emission. With the growing challenges arising from carbon emission, the possible prospects of energy transition and sustainability of renewable energy in driving economic activities and output growth in Africa is worth a debate. In order to buttress the need for the debate, the answers to the following questions asked in this study forms the objectives for the study: *Is renewable energy a sustainable energy use for the mitigation and or adaptation mode for carbon emission in Africa? Can African output growth catch up with the industrialized economy on the wheel of renewable energy use and at what speed will it adjust?*

Methods

Principal Component Analysis

In order to understand the strength of the correlates between the carbon emission and renewable energy use as stated in the first research question, Principal Component Analysis and correlation matrix will be adopted. Principal component analysis is primarily targeted to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set (Jolliffe 2002). The Principal component values for each observation are given by

$$Z = X_i A ...(1)$$

Where the (i k)th element of is the value (Score) of the kth principal component for the ith observation, and A is a (p x p) matrix whose kth column is the kth eigenvector of $X^{1}X$.

Solow Growth Model

Solow growth model relates the total output of a country to the country's aggregate inputs of the factors of production. In order to examine the effect of renewable energy use on the output growth in Africa as in second objective, the popular Solow growth model of Cobb Douglass production function is specified below:

$$Y_t = (A_t L_t)^{\alpha} K_{t-1}^{1-\alpha} ...(2)$$

The Solow residual method will be adopted to determine the speed of the output adjustment in Africa on the wheels of renewable energy use.

Model Specification

$$C_{02}I = \alpha i + \beta_1 REUC + \beta_2 REHYDRO + \beta_3 NHYDROREU + \varepsilon_t, ...(3)$$

Where $C_{02}I$ = carbon emission intensity, REUC = renewable energy consumption, REHYDRO = Hydro form of renewable energy and NHYDROREU = non-Hydro renewable energy. The model in equation (3) tends to investigate the effects of the renewable energycomponents on carbon emission intensity in **African.**

Model II

$$Output_i = \alpha i + \beta_1 Capitalt + \beta_2 Labour + \beta_3 REUC + \beta_4 REUO + \beta_5 REHYDRO + \beta_6 NHYDROREU + \phi SR + \varepsilon_i, ...(4)$$

Where output is the economic growth in sub-Sahara African, SR= Solow residual and other variable remain as defined above. Model II in equation 4 tends to investigate both the correlates of renewable energy components on output growth and the adjustment speed of output growth on the wheel of renewable energy in Africa.

Data Source.

All the data for this study are sourced from World Bank development indicator for Sub-Sahara Africa collected annually 1990 -2014 converted into quarterly frequency.

Result and Conclusion

Result of the component analysis show that Hydro renewable energy and outputs of renewable energy are the principal components in the model of carbon abatement. Carbon emission intensity show a negative correlate with hydro renewable energy (-0.326055), non-hydro renewable energy (-0.11302), Renewable energy consumption (-0.010217) and outputs of renewable energy (-0.295112). Evidence above show that renewable energy use could be a mitigating model for carbon emission.

Secondly, renewable energy use on consumption, hydro renewable use and non-hydro renewable are negatively related with output in sub-Sahara Africa with (-0.006101, -0.148774 and -0.115739) respectively. Likewise, the Solow residual is significant but with wrong sign for adjustment. Therefore, output on the wheel of renewable energy use may not adjust to catch up with the developed nation.

In summary, government, agencies and department should make policies that will run renewable energy and fossil fuel side by side but gradually substituting the non-renewable energy with the renewable. A sharp program for energy transition could bring an unfavourable shock on the output growth in Africa.

References

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