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Emission policies and the Nigerian economy: simulations from a dynamic applied general equilibrium model

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Abstract

Recently, there has been growing concern that human activities may be affecting the global climate through growing atmospheric concentrations of greenhouse gases (GHG). Such warming could have major impacts on economic activity and society. For the Nigerian case, the study uses multisector dynamic applied general equilibrium model to quantify the economy-wide, distributional and environmental costs of policies to curb GHG emissions. The simulation results indicate effectiveness of carbon tax, tradable permit and backstop technology policies in curbing GHG emissions but with distorted economy-wide income distributional effects. However, the model was found to be sensitive to three key exogenous variable and parameters tested: lower GDP growth rate, changed interfuel substitution elasticity and autonomous energy efficiency factor. Unlike the first test, the last two tests only had improved environmental effect but stable economy wide effect. This then suggest that domestic energy conservation measures could be a second best alternative.

JEL classification: Q43; C63; C68; D58

Keywords: Greenhouse gases (GHG); Dynamic applied general equilibrium model; Carbon tax; Tradeable permits; Backstop technology; Carbon dioxide (CO_2); Sulphur oxides (SO_x); Nitrogen oxides (NO_x)

1. Introduction

The current international efforts to address the issue of climate change follow from the imbalance between environmental and economic considerations. Industrialized

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countries are strongly pushing for a global adoption of very strict and drastic measures to combat climate change. And there is a strong call by these countries to achieve global stabilization and reduction of greenhouse gas emissions during this decade and the next. Studies have revealed that the economy-environment linkages may be substantial (see Whalley and Wiggle, 1990b; Burniaux et al., 1992a,b; Jorgenson and Wilcoxen, 1990). These studies used computable general equilibrium models to trace such linkages. The model encompasses all major economic sectors, recognizing feedbacks and inter-relationships between sectors and allows all economic agents within all sectors to optimize. By adding environmental data to such a model, it may provide a tool to be used to capture the economic and distributional impacts of GHG abatement policies.

It is therefore the concern of this paper to present a dynamic applied general equilibrium model of the Nigerian economy through which the various macroeconomic, distributional and environmental impact of GHG abatement policies could be investigated and simulated. Indeed, Nigeria is one of the lowest income developing countries in the world. And for the past two decades, there has been a growing public and government concern about the pollution of the Nigerian environment. The country's energy consumption has previously contributed an insignificant fraction the past energy driven greenhouse gas emission because of its low share of the global energy consumption linked up with its low level of social and economic development (Iwayemi, 1990). However, this is not likely to remain so in the future due to expected increase in aggregate commercial energy demand needed to support a higher level of economic growth. The incremental contribution of Nigeria to global carbon dioxide and methane emissions may likely increase given the higher level and energy intensity of production at lower level of industrialization and the high level of dependence on fuel wood, oil and coal.

Given these initial but unfavorable energy and economic conditions of recent year, and the high financial cost of a significant improvement in environmental quality in the country, what are then the prospects for Nigeria playing an effective role in stemming global warming and enhance a cleaner environment. Obviously, the key is to attain a sustainable trade-off between the economic and environmental dimensions of development and avoid irreversible damages (Panayotou and Sussangham, 1992). But, there is rarely any policy measure that explicitly attempts to either internalize environment cost or determine this important trade-offs. Yet there is no policy that does not have positive or negative environmental impacts. Thus, analysis of the environmental and macroeconomic outcomes of GHG abatements policies should be undertaken in the formulation of policy programmes in the future.

The fundamental aim of these paper therefore, is to present a dynamic computable general equilibrium model that will enable us to identify and analyze the implications of GHG abatement policies on the natural resource base and the macroeconomic environment of Nigeria. The rest of the paper is divided into three sections. In Section 2, we present the theoretical and methodological framework. Simulations and sensitivity analysis are performed in Section 3, while the paper is concluded in Section 4.