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Dynamics between energy consumption and economic growth in Ecuador: A granger causality analysis

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ABSTRACT

Energy consumption (EC) in Ecuador has increased significantly during the past five decades. This has negatively affected the financial position of the country because (1) large EC subsidies are provided in its internal market, and (2) Ecuador is mostly a crude oil exporter and oil-derivatives importer country. Here, I aim to determine the Granger causal relationship between EC and economic growth (EG) in Ecuador by analyzing aggregated and disaggregated data for 1970–2015. Vector autoregressive (VAR) models considering structural breaks are estimated, and Granger causality tests are performed. I found that, in Ecuador, the following occurs: (1) EC causes EG (with no feedback effect) and is caused either directly or indirectly by the EG of its primary, secondary, and tertiary economic sectors; (2) oil and hydroelectricity consumption are the cause and the consequence, respectively, of EG; and (3) EC has a bi-directional causality relationship with transportation sector EG. Finally, for Ecuador to achieve more sustainable development dynamics, I recommend raising the price of oil-based energy (especially when it is used for unproductive activities) while subsidizing the consumption of renewable energy (specially oriented to the industrial sector).

0. Introduction

Energy consumption (EC) is implied in every economic activity – in activities related to production as well as those related to consumption – such that it is one of the major factors involved in the economic system. Furthermore, it is demanded in such a recursive way that not only do enterprises demand energy for carrying out their activities but also those enterprises' performance allows people to demand more energy goods, encouraging, in turn, even greater production levels. Dhungel (2003), in this regard, even mentions that, with an expansion in the economy, production increases over time, which results in greater energy requirements to sustain the pace of development. Therefore, the EC in a given country is directly related to its economic performance.

According to the information published in the BP[1] Statistical Review of World Energy 2016, the global EC has maintained an increasing trend over the last 25 years, showing a mean annual growth rate of 1.9%. In 2015, it stood at 13,147.3 Mtoe[2] (1% greater than in 2014), showing the same trend that the world GDP (at purchasing power parity, measured in U.S. dollars

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1 "BP Global" is one of the world's leading integrated oil and gas companies. One of its key reports is the "BP Statistical Review of World Energy", which provides information regarding global energy trends and projections.

2 Million tons oil-equivalent (Mega-toe) is a unit of energy. A ton of oil-equivalent (toe) is the amount of energy released by burning one ton of crude oil; although there are several kinds of crude oil that have different calorific values, the exact value is defined by convention, so that 1 toe equals approximately 42 Gigajoules (GJ).

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at 2011 prices) presented. The latter grew at a mean rate of 3.37% during the same period, according to the World Bank. Most countries, in fact, present growth trends in EC; however, some of them – mostly in Europe and Eurasia – keep their levels relatively constant. EC, therefore, is induced differently by different countries. Moreover, as Phoumin and Kimura (2014) mention, such differences depend on factors such as GDP level, industrial structure, lifestyle of citizens, geographical location, and energy prices (especially relative energy prices).

EC has been empirically supported to influence positively the economic performance of several countries. Significant causal relationships have been empirically found between EC and economic growth (EG) in many studies (e.g., Al-mulali and Binti Che Sab, 2012; Masih and Masih, 1996). Nonetheless, it has also had negative ecological and financial effects. First, its negative environmental impact has been expressed in an upward trend of CO2 emissions (Ang, 2008; Soytas et al., 2007; Halicioglu, 2009; Dhakal, 2009). According to the information of the BP Statistical Review of World Energy 2016, world CO2 emissions, such as EC, have also maintained an increasing trend over the last 50 years, with a mean growth rate of 2.2%. This has been mainly caused by the consumption of energy from fossil fuels, which are the most polluting among current fuels,[3] and whose participation in the total world EC, according to the World Bank, was approximately 80% in 2013. Such adverse ecological effects either directly or indirectly generate costs to be covered by governments, not just in the present but also in the future (e.g., investment in public health and nature preservation). Second, in several countries nowadays, this is also causing budget disequilibrium difficulties due to the subsidies to which some of the kinds of energy are subject in the internal markets, in addition to the price volatility of such goods at the international level. In Latin America and the Caribbean, for instance, where energy use has also increased significantly over the last years (at a mean growth rate of approximately 3.9% between 1965 and 2015), the costs generated due to negative externalities of energy use reached approximately 2% of GDP during 2011–2013. Additionally, the costs generated by providing fuel and electricity subsidies reached about 1.8% of GDP in the same period (Di Bella et al., 2015).

In Ecuador, the scene is pretty similar. The EC in this country is barely 2% of the total EC in Latin America and the Caribbean. Nevertheless, although its GDP has been increasing over the last 45 years at a mean rate of 1.76%, in constant terms, the EC has also been increasing at a mean rate of 6%. This behavior is reasonable, given that developing countries tend to present levels of growth in EC that are higher than their levels of EG (Dhungel, 2003). However, such a trend of EC, along with the strong dependence of the Ecuadorian economic system on oil-based fuels' consumption and the existence of large indirect subsidies oriented to such fuels, have affected negatively the financial position of Ecuador, because they have supposed a successively greater assignment of monetary resources – by the government – to fund EC. According to information from the Finances Ministry of Ecuador, in 2011, the contribution of the Central Government to import oil derivatives was of $145.9 million (6.2% of the total DDFA[4]), whereas in 2015 it was $1,252.77 million and represented 27.1% of the total DDFA.

As Aziz et al. (2013) mention, spurred by the oil price shocks in late 1973 and 1979–1980, much attention was devoted to the analysis of energy demand as a consequence of the dramatic events in energy markets and the increasing importance of this sector in national economies. Thus, a great effort was made to investigate issues related to EC and, particularly, the relationship between energy demand and EG in several countries. Nevertheless, in Ecuador, research aimed at analyzing this relationship has been less than in other countries. To the best of my knowledge, in this country, no work of this specific kind has been carried out before. This is despite (1) the budget problems that the current upward trend of energy demand represents and (2) the potential usefulness of estimates that currently inform policies directed at reducing EC.

Nowadays, the behavior of energy prices internationally is affecting Ecuador, as well as several other countries. This effect, as mentioned by Jobling and Jamasb (2017), is stronger in developing countries, such as Ecuador, than in developed countries. In Ecuador, the increasing energy demand, along with the high volatility of oil prices in the external market, has generated high costs for the government, given the existing trend to import some types of secondary energy and the significance of energy subsidies in its economy. This finally states the solution of the issues related to energy usage as one of the most important topics to consider about economic policy. Consequently, it becomes essential to know what the effects of energy conservation policies in Ecuador could be. Such an analysis could suggest appropriate responses of economic policy that would lead the country to more ecologically and financially sustainable growth.

This paper attempts to determine the dynamic relationship between EC and EG in Ecuador by applying a Granger causality analysis and using aggregated and disaggregated data regarding both variables. The results will allow conclusions that can inform effective economic policy on this issue. The results obtained are robust. The structure of this paper is as follows. Section 1 depicts the results of previous studies performed in relation to this topic. Section 2 states the background of EC and EG in Ecuador. Section 3 explains the methodology applied and data used. Section 4 details the results obtained and their interpretation. Section 5 states the conclusions and policy implications of the research.

[3] The amount of CO2 produced when a fuel is burned is a function of the carbon content of the fuel. Fossil fuels, such as coal, oil, and natural gas, emit more CO2 per unit of energy output or heat content, than non-fossil fuels do.

[4] In 2008, given the great gap that existed between the volumes of national demand and supply of oil derivatives in the country, an account called the "Deficit Derivatives Financing Account (DDFA)" was created as part of the General State Budget, with the objective of keeping permanently the necessary funds to import oil derivatives to cover the internal demand. Such an account gathers (1) a transfer of the income perceived from oil derivatives sales done by the public enterprise "PETROECUADOR",; (2) a transfer done by the Central Government, and (3) a transfer regarding revenues from certain exports of crude oil.