The linkage between crude oil consumption and economic growth in Latin America: The panel framework investigations for multiple regions

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A B S T R A C T

In this study we examine the cointegration and the Granger causality relationships among crude oil consumption and economic growth in Latin America during 1980—2012. We apply a multivariate panel framework model with including crude oil price as a control variable. The Latin American region is divided into three groups: a panel of six Caribbean countries, a panel of six Central American countries, and a panel of eight South American countries. The long-run causality results indicate that in the Caribbean and South America, economic growth and crude oil consumption do not Granger cause each other, therefore policy makers can pursue crude oil conservation policies without a significant negative effect on economic growth, however in Central America there is a unidirectional causality relationship from crude oil consumption to economic growth, which shows that in this region crude oil conservation policies should be implemented more carefully.

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1. Introduction

During recent years, tendency of countries to reduce their energy consumption increases attentions to the causal relationships between energy consumption and economic growth. This can be traced to two principle drivers: environmental depreciation and crude oil price shocks.

The environmental problem has increased global concern toward reduction of fossil fuels consumption, promoting energy conservation policies and substitution of the alternative energy sources rather than fossil fuels (Behmiri and Manso [1]). Reason why renewable energies have witnessed a very rapid increase, they have become the fastest growing source of energy with a 3% increase in global consumption per year (OECD (organization for economic cooperation and development) Economic Outlook [2]), especially after the acceptance of the Kyoto protocol by developed and developing countries in 1997.

With a glance at historical data we find that in Latin America, during the recent years the percentage change of CO_2 emission was higher than the previous years, moreover during 1980—2012 positive changes in Latin America were higher than the whole world.

For instance, during 1980—2005 the average increase of CO_2 emission was 1.76% annually in Latin America; this was 0.94% for rest of the world (Chang and Carballo [3]). However, percentage change of CO_2 emission for year 2006 over 2005 was 3.8%, which was 2.8% for the whole world, change 2007 over 2006 was 4.4%, which was 2.9% for the whole world, change 2008 over 2007 was 4%, which was 1% for the whole world, change 2009 over 2008 was −2.1% that was −1.1% for the whole world, change 2010 over 2009 was 5.9%, which was 5.8% for the whole world, change 2011 over 2010 was 3.1%, which was 3% for the whole world, and change 2012 over 2011 was 2.8%, which was 1.9% for the whole world (BP, 2013). Therefore, CO_2 emissions in Latin America were increased more than the whole world. As the result, they have strong motivation to reduce their air pollution by reduction of fossil fuels consumption.

The main concern in conjunction with reducing crude oil consumption policies is the oil dependency of each country, as crude oil consumption might affect economic growth. The energy conservation hypothesis asserts that implementing energy conservation policies, the rational usage of energy and reduction of energy consumption are achievable without a significant negative effect on economic growth. In order to assess the accuracy of this hypothesis, several studies investigate energy consumption and economic growth nexus. Payne [4,5] performs two comprehensive literature surveys on this issue and finds that there is no clear

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consensus regarding the direction of causality relationship among the series in the case of an individual country or for a panel of countries. These contradictory results are due to various reasons, such as the heterogeneity of countries conditions, the varying energy consumption patterns, the degree of each country's economic development, the alternative econometric methodology, the existence of omitted variable bias and the different time horizons that have been employed (Yu and Choi [6], Ferguson et al. [7], Toman and Jemelkova [8], Apergis and Payne [9], Behmiri and Manso [10]).

In this study we extend the existing literature by examining the causality relationship between crude oil consumption and economic growth in Latin America. We use annual data from 1980 to 2012 and we apply a multivariate panel framework model. Moreover we include crude oil price as control variable of the model. The main goal is to investigate the possibility of reducing crude oil consumption without a significant negative impact on economic growth of Latin America. To achieve this goal, we categorize the homogenous countries as three separate panels, comprising of (i) a panel of six Caribbean countries, (iii) a panel of six Central American countries and (iii) a panel of eight South American countries.

Among Latin American countries, seven of them are net oil exporting, including Argentina, Belize, Colombia, Ecuador, Suriname, Trinidad and Tobago and Venezuela, which all except Belize are located in South America, and other regions of Latin America don't contain any net oil exporting country (only Belize in Central America with very small amount of 500 barrel per day net export). Therefore panel of South America can be considered as panel of oil exporting countries[1] and panels of the Caribbean and Central America can be considered as panels of net oil importing countries.

To empirically examine this relationship, we apply the Breitung [11] panel unit root test to determine the variables' order of integration and the Pedroni [12] panel cointegration test to examine the existence of long-run relationships among the series. Finally we perform a dynamic panel Granger causality test to assess the direction of short-run and long-run causality relationships among the series.

This study contributes to the existing literature by several themes. The first issue is that most of the existing studies on Latin America are focused on individual countries. They usually do not provide reliable results due to the short data span that reduces the power of unit root and cointegration tests, however the panel framework methods increase their power by combining the cross-section and time series data while allowing the heterogeneity across the countries (Narayan and Smyth [13]).

There are three panel framework studies that focus on Latin America's energy consumption-growth nexus, which are Apergis and Payne [9,14] and Zilio and Recalde [15]. In the first and second ones the authors examine energy consumption-economic growth relationship for a panel of six Central American countries and a panel of nine South American countries respectively, and in the third one the authors examine energy consumption-economic growth relationship for twenty-one Latin American countries. To the best of our knowledge, there is no study that examines the causality relationship between crude oil consumption and economic growth for a group of Latin American countries. All the existing studies have considered total energy in Latin America, but there are differences between the results from examining total

energy consumption-economic growth and crude oil consumption-economic growth nexuses.

Another contribution of our study is that we apply an energy consumption side model instead of a growth side model, therefore we use crude oil price as control variable of the model, and this is a fresh contribution. Based on theory, there is a broad consensus that a crude oil price movement impacts economic growth of countries (Brown and Yücel [16], Hamilton [17], He et al. [18]). This impact can be explained by various channels. The most primary channel is the classic supply-side effect (see Rasche and Tatom [19] and Barro [20]). The second channel is an income transformation from net oil importing to net oil exporting countries by a shift in their terms of trend, which is called a demand-side effect (see Fried and Schulze [21], Mork and Hall [22], Dohner [23] and Ferderer [24]). The third key channel is real balance effect (see Pierce and Enzler [25] and Pindyck [26]). And the fourth channel can be explained by the undertaken monetary policy after crude oil price shock (see Bohi [27] and Bernanke et al. [28]). Therefore ignoring the impact of crude oil price on its consumption and economic growth of countries leads to the problem of omitted variable bias in the results, which we avoid in this study by including it to the model.

The rest of this paper has the following organization: Section 2 develops energy consumption-GDP nexus literature; Section 3 provides crude oil price-GDP nexus literature; Section 4 describes the model, methodology and data; Section 5 extends the results and discussion; and Section 6 provides a conclusion.

2. Energy consumption-GDP nexus

According to the results obtained from previous studies, there are four expected types of causality relationships between energy consumption and economic growth. (i) When there is a unidirectional causality relationship running from economic growth to energy consumption (the conservation hypothesis). In this case, changes of economic growth significantly affect energy consumption but changes of energy consumption do not impact on economic growth. Therefore employing energy conservation policies such as increasing energy costs do not adversely affect economic growth. (ii) When energy consumption and economic growth are independent (the neutrality hypothesis). In this case, implementing energy conservation policies do not adversely impact on economic growth and the above-described policies can be applied. (iii) When there is a unidirectional causality relationship running from energy consumption to economic growth (the growth hypothesis). In this situation, energy conservation policies widely affect economic growth. Hence performing an inappropriate energy conservation policy, such as increasing energy costs decreases economic growth. As the result, policy makers need to apply different types of policies to reduce wasting of energy, such as investment on energy efficiency programs and energy saving techniques, improving industrial technologies or allocation of subsidies on clean energy alternatives. (iv) When there is a bidirectional causality relationship between energy consumption and economic growth (the feedback hypothesis). In this case, reduction of energy consumption still negatively affects economic growth, however it is a complementarily effect and the same policies with the growth hypothesis should be applied to avoid the negative impacts on economic growth.

The existing literature use different sources of energies, including total energy, electricity, crude oil, natural gas, coal, nuclear energy and renewable energy, within three main groups of studies: single country, multiple countries and multiple countries under panel framework studies. Below we elaborate a brief literature review:

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[1] In this study, panel of South America includes eight countries that five of them are net oil exporters and two are oil producers (Bolivia and Peru) but they are not net exporters.