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Electricity consumption from renewable and non-renewable sources and economic growth: Evidence from Latin American countries

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ABSTRACT

This study explores the effect of renewable and non-renewable electricity consumption on economic growth in 18 Latin American countries. To achieve the goal of this study a panel Gross Domestic Product (GDP) model was constructed taking the period 1980–2010 into account. From the Pedroni cointegration test results it was found that renewable electricity consumption, non-renewable electricity consumption, labor, gross fixed capital formation, and total trade are cointegrated. Moreover, the panel Dynamic Ordinary Least Squares (DOLS) test results revealed that all above the mentioned variables have a long run positive effect on GDP growth in the investigated countries. The Vector Error-Correction (VEC) Granger causality model results revealed the existence of feedback causality between the variables. The results of the study indicated that renewable electricity consumption is more significant than non-renewable electricity consumption in promoting economic growth in the investigated countries in the long run and the short run. Based on the results of this study, it is recommended that the investigated countries should increase their investment on renewable energy projects to increase the role of electricity consumption from renewable sources. In addition, it is essential that these countries should reduce their non-renewable electricity consumption by increasing their energy efficiency and implementing energy saving projects. By applying these recommendations, these countries would be able to mitigate global warming and reduce their dependency on fossil fuel to increase their energy security.

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1. Introduction

The economic growth in Latin American countries has been increasing substantially in the last three decades which resulted in intensifying their demand on electricity. During the period

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1980–2010 electricity consumption increased more than 73%, this phenomenon encouraged the governments of these countries to increase their investment in power generation to meet their continuously expanding need of electricity. It is fundamental to note that Latin America is an active region in hydropower development. Moreover, there are several projects that were constructed to increase the power capacity of other renewable resources. However these projects are relatively small compared to the projects that have been conducted in other regions [1]. As mentioned above, Latin America is a leading region in hydro-electric power whereby most of its electricity production comes

from hydroelectric sources. These sources represent 52% of the total electricity production, while 39% of the total electricity production comes from fossil fuels and 10% comes from other renewable sources [2]. The large percentage of renewable energy (hydroelectricity, solar and wind) in the total production of electricity and the lack of studies that explore electricity–GDP relationship in Latin American countries motivated this study to examine the impact of electricity consumption from renewable and non-renewable sources on economic growth in 18 Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela. Fig. 1 below reviews the trend of real GDP, renewable electricity from hydro sources (ELH) and other renewable (ELR) sources, and non-renewable electricity consumption (ELF). These variables are progressing together in a positive trend in the last three decades. Based on the World Development Indicators (WDI), the Latin American region had witnessed a substantial increase in economic growth and electricity consumption from both renewable and non-renewable sources. The gross domestic product, electricity consumption from renewable sources, and electricity consumption from nonrenewable sources increased more than 60%, 70%, and 50% respectively.

The following section (Section 2) will review the literature that explored the relationship between electricity consumption and GDP growth. In addition, Section 3 will reveal the empirical model, data source and the panel methodology tests that will be utilized in the analysis. The empirical results and conclusion and discussion will be reviewed in Sections 4 and 5 respectively.

2. Literature review

Due to the importance of electricity in promoting economic growth and development, the electricity–GDP relationship was investigated by many researchers over the last decade. In Hong Kong [3], India [4,5], Portugal [6], Taiwan [7] and Malaysia [8], it was found that electricity consumption and economic growth are cointegrated, furthermore, a one way causal relationship from economic growth to electricity was found. Similarly, causal relationship between electricity consumption and economic growth was found in Bangladesh [9] and Cote d'Ivoire [10]. However, a bi-directional causal relationship between electricity consumption and economic growth was found in Malawi [11] and Poland [12]. A cointegration relationship between electricity consumption and economic growth and a one way causal relationship from electricity consumption to economic growth was also found in former Soviet Republics by Bildirici and Kayıkçı [13], Nigeria by

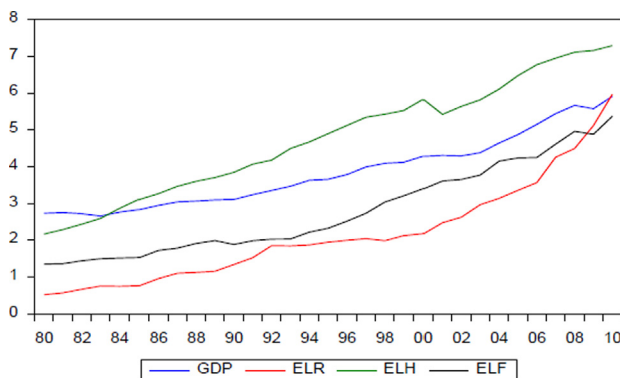


Fig. 1. Trend in GDP growth, electricity consumption from renewable sources and electricity consumption from non-renewable sources 1980–2010. (World Development Indicators (WDI) 2013).

Akinlo [14], Lebanon by Abosedra et al. [15], China by Shiu and Lam [16], Bangladesh by Ahamad and Islam [17], Malaysia by Chandran et al. [18], Fiji Islands by Narayan and Singh [19], China by Shengfng et al. [20], and the Middle East by Narayan and Smyth [21]. The same results were also found in Turkey by Altınay and Karagol [22] and Pakistan by Jamil and Ahmad [23]. However, in Malaysia, Tang [24] found a bi-directional causal relationship, rather than cointegration, between electricity consumption and economic growth. Furthermore, electricity consumption and economic growth were found to be cointegrated and interrelated in a bi-directional causal relationship in South Korea [25]. Similar results were concluded by Ouédraogo [26] in Burkina Faso, in South Africa by Odhiambo [27], in Algeria by Bélaïd and Abderahmani [28], in Malaysia by Tang and Tan [29], and in Pakistan by Shahbaz and Lean [30]. In addition, Narayan et al. [31] found that electricity consumption increased economic growth for all the seven major developed (G-7) countries except for the U.S, thus, electricity conservation policies will definitely result in harming the economic growth of the G-7 countries, excluding the U.S. The relationship between electricity consumption and economic growth varied between the African countries based on Wolde-Rufael [32], he found that electricity consumption and economic growth are cointegrated in a number of African countries. He also found that some African countries have a unidirectional causality from economic growth to electricity consumption while a bi-directional causality relationship between the variables was found in the rest of the African countries. In addition, Squalli [33] also found mixed results between the diverse Organization of the Petroleum Exporting Countries (OPEC). While some countries' economic growth is dependent on electricity, other countries are less dependent or independent on electricity in achieving their economic growth. Yoo and Kwak [34] found that the causal relationship between electricity consumption and economic growth varied across the South American countries whereby the causal relationship was unidirectional from electricity consumption to economic growth in Argentina, Brazil, Chile, Colombia and Ecuador. They also found that the causal relationship between electricity consumption and economic growth was bi-directional in Venezuela. Nonetheless, no causal relationship was found between the two variables in Peru. Likewise, Narayan and Prasad [35] found a mixed causal relationship between electricity consumption and economic growth in the Organization for Economic Co-operation and Development (OECD) countries whereby unidirectional causal relationship from electricity consumption to economic growth was found in a number of OECD countries while the rest of the countries have no causal relationship between them. Different causal relationships were reached in ASEAN countries by Yoo [36], who found a bi-directional causal relationship between electricity consumption and economic growth in Malaysia and Singapore while a unidirectional causal relationship from electricity consumption to economic growth was found in Indonesia and Thailand. In addition, Apergis and Payne [37] concluded that the relationship between electricity consumption and economic growth varied between the countries based on their level of income. The results of the study indicated that a bi-directional causality between electricity consumption and economic growth was found in high, upper and lower middle income countries, while a one way causal relationship was found in low income countries. Furthermore, they also emphasized that the long run relationship between the variables is present in all income level countries. However, Ozturk and Acaravci concluded that there is neither long run relationship nor short run relationship between electricity consumption and economic growth in a number of Middle East and North Africa (MENA) countries [38] and in transition countries [39].

The relationship between electricity consumption from renewable sources and economic growth was examined by few studies.

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