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Economic growth and biomass energy

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ABSTRACT

This paper investigates the short-run and long-run causality analysis between biomass energy consumption and economic growth in the selected 10 developing and emerging countries by using the Autoregressive Distributed Lag bounds testing (ARDL) approach of cointegration and error correction models. It covers annual data from 1980 to 2009. The cointegration test results show that there is cointegration between the biomass energy consumption and the economic growth in nine of the ten countries (Argentina, Bolivia, Cuba, Costa Rica, El Salvador, Jamaica, Nicaragua, Panama, Paraguay, Peru). The cointegration test results show that there is no cointegration between the biomass energy consumption and the economic growth in one of the ten countries (Paraguay).

1. Introduction

Biomass energy may be consumed either directly or indirectly. Direct consumption is the traditional consumption of biomass energy and involves the process of combustion as cooking, space heating, and industrial processes. Indirect consumption and/or modern consumption are the more advanced processes of converting biomass into secondary energy [1]. As the economy progresses, commercial energy consumption and electricity consumption become predominant and traditional biomass energy consumption decreases. During the period of rapid urbanization combined with industrialization and economic development, the energy transition from traditional biomass energy consumption to commercial fossil fuels energy consumption accelerated and a higher penetration of commercial fossil fuels in countries caused a decline in the share of traditional biomass energy consumption [2]. In addition to the effects of industrialization, the 1974 and 1979 oil crises, led to an "energy transition" away from modern fossil fuels toward modern biomass energy. Such modern biomass energy is attracting growing interest around the world [3]. Modern biomass energy is an alternative for reducing foreign oil dependency because it is renewable, abundant and can be produced everywhere [4]. Moreover, biomass energy can be converted to useful thermal energy, electricity and fuels for power by means of transferring [5]. In developing countries, modern biomass energy can provide a basis for rural employment and income. Since biomass production is labor intensive, feedstock production could be an important source of both primary employment and supplemental income in rural areas [1]. Socio-economic benefits of biomass energy consumption can be identified as a significant driving force in increasing the share of bioenergy in the total energy supply.

The economic impacts of biomass energy production and consumption are generally analyzed for three socio-economic indicators: gross output, value-added and employment [6]. In evaluating the economic impacts, input–output (I–O) models are generally used. I–O models developed multipliers that estimate the relationship between the initial effect of a change in demand and the total effects of that change. In

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these models, output is the total value of production and value-added is measured as total output minus variable costs and employment, which includes the number of full- and part-time jobs in the sector [7]. Hjerpe [8], Gan and Smith [6], and Grebner et.al. [9] show that models have demonstrated the multiplicative effects of bioenergy in various regions of the U.S.

The aim of this study is to estimate the relationship between biomass energy consumption and economic growth by ARDL method in the following countries: Argentina, Bolivia, Cuba, Costa Rica, El Salvador, Jamaica, Nicaragua, Panama, Paraguay and Peru. This study can be defined as complementary to the previous papers in the context of energy economics. However, it differs from the existing literature of energy economics in some aspects. First, to distinguish it from the previous works, it employs biomass energy consumption. Second, it is the first study in the literature that analyzes the causal relationship between biomass energy consumption and economic growth for the analyzed countries.

In perspectives of this paper, knowledge of the direction of causality between biomass energy consumption and economic growth is important to determine appropriate energy policies.

In the second section of the study, causality literature will be presented. Econometric theory is identified in the third section. The fourth section consists of the empirical results, while the last section includes conclusions and policy implications.

2. The literature of energy consumption and economic growth

Rasche and Tatom [10], Kraft and Kraft [11], Berndt [12], Akarca and Long [13] and even Proops [14], Yu and Hwang [15], Yu and Choi [16], and Erol and Yu [17] were among the first researchers to examine the relation between GDP and energy consumption in the framework of energy economy. Many papers analyzed the relationship between energy consumption and economic growth in pursuit of these pioneering studies. Depending on developments in econometrics techniques, the Granger causality test and Tado Yamamoto test were applied following Vector Autoregressive (VAR) and cointegration methods: the Johansen–Juselius procedure, the Engle-Granger procedure and the ARDL model. Different results on direction of causality allowed for four hypotheses: 1) the “neutrality hypothesis”; 2) the “conservation hypothesis”; 3) the “growth hypothesis” and 4) the “feedback hypothesis”.

The neutrality hypothesis postulates that causality between GDP and energy consumption does not exist. Energy consumption is a relatively small component of overall output and thus will have little or no impact on economic growth. Second, the conservation hypothesis determines the unidirectional causality running from GDP to energy consumption. Energy conservation policies, such as efficiency improvement measures and demand management policies, designed to reduce energy consumption and waste may not have an adverse impact on economic growth. These hypotheses are supported in cases when an increase in economic growth causes an increase in energy consumption. Third, the growth hypothesis suggests the unidirectional causality running from energy consumption to GDP. The growth hypothesis postulates that energy consumption has played a vital role in economic growth both directly and indirectly. Since an increase in energy consumption has a positive impact on economic growth, energy conservation-oriented policies that reduce energy consumption can impact economic growth. Fourth, the feedback hypothesis accepts the existence of a bi-directional causality between GDP and energy consumption. The feedback hypothesis determines the interdependent relationship between energy consumption and economic growth, whereby each serves as complement to the other [18].

For America, with the exception of the United States, the research on the causal relationship between energy consumption and GDP is relatively sparse. Nachane et al. [19] find support for the growth hypothesis in Guatemala. Murray and Nan [20] identify unidirectional causality from real GDP to electricity consumption for Colombia. Cheng [21] shows evidence of unidirectional causality from energy consumption to real GDP for Brazil and the neutrality hypothesis, absence of causality between energy consumption and real GDP for Venezuela. Huang B.N. et.al. [22], in an 82-country panel that includes Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela, determined for the low-income panel the absence of causality between energy consumption and real GDP, whereas unidirectional causality from real GDP to energy consumption was found for the middle- and high-income panels. Chontanawat et al. [23] found unidirectional causality from energy consumption to real GDP for Chile, Colombia and Uruguay, and unidirectional causality from real GDP to energy consumption for Boliva, Paraguay, Peru and Venezuela. Squalli [24] reveals evidence of unidirectional causality from electricity consumption to real GDP in Venezuela. Apergis and Payne [25] determined both short-run and long-run causality from energy consumption to economic growth in Central America. They found evidence of bi-directional causality between energy consumption and real output. Apergis and Payne [26] examined the relationship between energy consumption and economic growth for a panel of nine South American countries over the period 1980 to 2005 within a multivariate framework. The Granger causality results indicate both short-run and long-run causality from energy consumption to economic growth, which supports the growth hypothesis. Seung-Hoon Y. and So-Yoon K. [27] investigated the causal relationship between electricity consumption and economic growth among seven South American countries, namely Argentina, Brazil, Chile, Columbia, Ecuador, Peru and Venezuela, for the period 1975–2006. Their results indicated that the causal nexus between electricity consumption and economic growth varies across countries. There is a unidirectional, short-run causality from electricity consumption to real GDP for Argentina, Brazil, Chile, Columbia and Ecuador. In Venezuela, there is a bi-directional causality between electricity consumption and economic growth. However, no causal relationships exist in Peru.

In recent years, the causal relationship between renewable energy consumption and economic growth was investigated