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Renewable electricity consumption and economic development: New findings from the Baltic countries

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ABSTRACT

This study employed homogeneous and heterogeneous panel methods to examine the relationship between renewable and non-renewable electricity consumption and economic development in three transition economies in the Baltic region, namely, Estonia, Latvia and Lithuania, for the period of 1992–2011. The study put forward four hypotheses to examine the renewable electricity–development nexus. The findings indicated that there existed a unidirectional causality from the economic development to renewable electricity consumption. Thus, the results obtained from the statistical analyses have provided empirical evidence in support of the conservation hypothesis that postulates that economic development causes the expansion of renewable electricity consumption, but not vice versa.

1. Introduction

Electricity is a flexible form of energy that can be easily transferred from one place to another. Due to its importance in economic production and convenience in consumption, electric power plays a vital role in the process of economic development [1]. Generally, electricity consumption tends to have a statistically significant positive relationship with economic development. At the same time, there is a growing awareness of the importance of clean energy. Concerted efforts are undertaken in various regions of the world to increase renewable and sustainable energy consumption as a means to cope with global climate change [2]. It can be proposed that as a country's income and wealth increase, its consumption of the renewable electricity expands. This is because wealthier countries are able to allocate additional human and financial resources to support their efforts to increase the share of renewable electricity consumption.

Since the mid-1990s, numerous studies have examined the relationship between electricity consumption and economic development [3–27]. Several pioneer studies focused on the relationship between renewable electricity consumption and economic development [2,28–32]. Despite these inquiries, the present state of the art on the electricity–economic development nexus research indicates a lack of agreement concerning the direction of a causal relationship between the two variables. Table 1 offers a summary of the major studies on the electricity–development nexus. As can be seen from the table, the findings of these studies are contradictory. Seven inquiries detected a unidirectional causality from economic development to electricity consumption [7,8,14,16–18,26] while an equal number of studies reported the reverse causality from electricity consumption to economic development [9,12,13,15,17,21,26]. To complicate the issue, ten studies discovered bidirectional causality between the variables [6,16,17,19,20,22–25,27] and one investigation concluded that there was an independent relationship between them [17].

Only six major studies have been done on the relationship between renewable electricity and economic development and Table 2 offers a summary of their findings. As can be seen from the table, the results are contradictory. Two studies discovered a unidirectional causality from economic development to renewable electricity consumption [2,28] while one study reported the reverse causality [29]. Two investigations concluded that there was bidirectional causality between renewable electricity consumption and economic development [30,32] and one study reported that the relationship between these variables was independent [31]. Thus, there is a lack of agreement as to whether renewable electricity consumption is a cause or an effect of economic development.

The main objective of the current study is to examine empirically the relationship between renewable electricity consumption and economic development in three Baltic countries, namely, Estonia, Latvia and Lithuania. To be more specific, this article combines two research strategies: it provides a review of relevant literature and it also conducts an empirical analysis for hypothesis testing. Fig. 1 offers a graphical representation of the share of renewable electricity in total electricity generation in the three Baltic countries for the period of 1995–2012. As the figure demonstrates, there was an upward trend in the production of renewable energy. Until the mid-2000s, the share of renewable energy remained negligible. In 2004, it was only 0.3% in

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Table 1
Summary of findings on the electricity–development nexus.

No	Authors	Countries	Variables	Data source	Methods	Findings
1	Burney [3]	93 countries	GNP per capita electricity consumption per capita price of electricity socio-economic data	Cross-sectional data from UN Statistics Division, World Bank, UNDP	Random coefficient model	Significant relationship between income and electricity consumption
2	Ferguson et al. [4]	G7 countries	GDP per capita GDP/electricity consumption	Annual data (1960–1990) from OECD	Correlation analysis	Significant negative association between the variables
3	Ferguson et al. [5]	114 countries	GDP per capita electricity consumption per capita	Annual data (1960–1995) from World Bank and International Energy Agency	Correlation analysis	Significant positive association between the variables
4	Yang [6]	Taiwan	real GDP electricity consumption	Annual data (1954–1997) from AREMOS	Phillips-Perron (PP) unit root test Phillips-Ouliaris cointegration test Hsiao causality test	GDP is *I(1)* and electricity is *I(1)* No cointegration Bidirectional causality
5	Ghosh [7]	India	GDP per capita electricity consumption per capita	Annual data (1950–1997) from Economic and Political Weekly Foundation, India and Central Electricity Authority, India	PP unit root test Johansen cointegration test Granger causality test	GDP is *I(1)* and electricity is *I(1)* Cointegration between income and electricity Unidirectional causality from income to electricity
6	Jumbe [8]	Malawi	real GDP electricity consumption	Annual data (1970–1999) from National Statistical Office, Malawi	Augmented Dickey-Fuller (ADF) and PP unit root tests Engle-Granger (EG) cointegration test ECM causality test	GDP is *I(1)* and electricity is *I(1)* Cointegration between income and electricity Unidirectional causality from income to electricity
7	Shiu and Lam [9]	China	GDP electricity consumption	Annual data (1971–2000) from National Bureau of Statistics, China, Chinese Social Sciences Press, Chinese Society of Electrical Engineering, and China Electric Power Information Centre.	ADF and PP unit root tests Johansen cointegration test ECM causality test	GDP is *I(1)* and electricity is *I(1)* Cointegration between income and electricity Unidirectional causality from electricity to income
8	Fatai et al. [10]	New Zealand Australia	real GDP electricity consumption	Annual data (1970–1999) from International Energy Agency	ADF unit root test Johansen cointegration test ARDL method	GDP is *I(1)* and electricity is *I(1)* No cointegration between income and electricity
9	Morimoto and Hope [11]	Sri Lanka	real GDP electricity consumption	Annual data (1960–1998) from Ceylon Electricity Board and Central Bank of Sri Lanka	Vector autoregression (VAR) analysis	Significant relationship between electricity and income
10	Wolde-Rufael [12]	Shanghai (China)	real GDP electricity consumption	Annual data (1952–1999) from Shanghai Municipal Statistics Bureau	KPSS and DF-GLS unit root tests Toda-Yamamoto (TY) causality test	GDP is *I(1)* and electricity is *I(1)* Unidirectional causality from electricity to income
11	Yoo [13]	South Korea	real GDP electricity consumption	Annual data (1970–1999) from Korean Ministry of Commerce, Industry and Energy, and Bank of Korea	PP unit root test Johansen cointegration test VECM causality test	GDP is *I(1)* and electricity is *I(1)* Cointegration between income and electricity Unidirectional causality from electricity to income
12	Narayan and Smyth [14]	Australia	real GDP per capita electricity consumption per capita manufacturing employment	Annual data (1966–1999) from International Energy Agency	ADF, PP and Zivot-Andrews (ZA) unit root tests ARDL method VECM causality test	GDP is *I(1)* and electricity is *I(1)* Cointegration between income and electricity Unidirectional causality from income to electricity
13	Altinay and Karagol [15]	Turkey	real GDP electricity consumption	Annual data (1950–2000) from International Energy Agency	ZA unit root test TY causality test	GDP is *I(0)* and electricity is *I(0)* Unidirectional causality from electricity to income
14	Yoo [16]	Indonesia	real GDP per capita	Annual data (1971–2002) from World Bank, BP and ASEAN	PP unit root test	GDP is *I(1)* and electricity is *I(1)*

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