Economic growth and electricity consumption in former Soviet Republics

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ABSTRACT

This study estimates the causal relationship between electricity consumption and economic growth with annual data for the Commonwealth Independent States countries in three groups of income levels. Empirical results reveal that electricity consumption and GDP are cointegrated for all these countries. Furthermore, there is a unidirectional causality from electricity consumption to GDP for all groups in the long run. Effect of electricity consumption on the GDP is negative for the second group of countries which supports the energy conservation policies, whereas it is positive for the first and third group of countries which supports the growth hypothesis.

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1. Introduction

All of the former Soviet Republics except the Baltic countries formed Commonwealth Independent States (CIS) after the breakup process of the Soviet Union. Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Moldova, the Republic of Belarus, the Russian Federation, Turkmenistan, Tajikistan, Ukraine and Uzbekistan are the members of CIS. Some of the members of the CIS have also established the Eurasian Economic Community to create a more efficient and compatible common market.

Some of these countries play major roles in the world energy market as producers of oil and natural gas as well as being energy distribution centers. Nevertheless, energy intensities of these countries are also very high compared to other transition countries in the world. Cornillie and Fankhauser (2004) indicated that energy intensity of most of the CIS countries has increased while some of them were stable in the transition process. In those countries, new and efficient capital inflows to the industrial sectors could not be provided due to delayed privatizations. Extensive use of energy without payment

through subsidies and nonpayment of energy bills also contributed to the intensity problem. Thus, structural change did not provide much improvement in energy intensity. Apergis and Payne (2009) analyzed the relationship of energy and economic development in these countries. This paper investigates the relationship between economic growth and one of the subcomponents of energy; electricity.

The aim of this study is to estimate the relationship between electricity consumption and economic growth, by the Panel Auto Regressive Distributed Lag (ARDL) method and Pedroni (1999) cointegration analysis in CIS countries.

This study can be defined as a complementary to the previous empirical papers. However, it differs from the existing literature for some aspects. First, as being distinguished from the previous works, it employs not only the Pedroni cointegration and Granger causality methods but also the ARDL method in order to clarify the direction of relationship with elasticities of electricity intensities. Second, it is the first study in the literature that analyzes the relationship between electricity consumption and growth for the CIS countries. Another contribution of the paper is the classification of countries according to the income levels to satisfy more homogeneity in the panel.

In the next section of the study, panel studies about energy consumption and growth in the literature will be presented briefly. Econometric theory and methodology are identified in the third section. The fourth section consists of the empirical results while the last section includes conclusions and policy implications.

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2. Causality, electricity demand forecast and elasticity literature

Rasche and Tatom (1977), Kraft and Kraft (1978), Berndt (1978), Akarca and Long (1980), and even Proops (1984), Yu and Hwang (1984), Erol and Yu (1987), among others, first examined the subject within the energy economy framework. Rasche and Tatom's (1977) study was different from the others. They specified a production function for the United States. They exhibited that the increase of energy prices stimulated the decreasing trends on gross national product by using energy, land, labor and capital.

Even though the relationship between energy consumption and growth is widely analyzed in the literature, research for electricity consumption is not enough and research on CIS countries is limited. Reynolds and Kolodzieji (2008) examined the relationship between Gross Domestic Product (GDP) and production of some energy sources like oil, coal and natural gas for the former Soviet Union by Granger Causality and found unidirectional causality from oil production to GDP and unidirectional causality from GDP to coal production and natural gas. Apergis and Payne (2009) examined the relationship of energy consumption and GDP for 11 CIS countries by Pedroni (1999, 2004) cointegration and Granger Causality methods for 1991–2005 period. They found unidirectional causality from energy consumption to economic growth in the short run whereas there is bidirectional causality between energy consumption and economic growth in the long run. Apergis and Payne (2010) found that the short-run dynamics indicate unidirectional causality from energy consumption and real output, respectively, to carbon dioxide emissions along with bidirectional causality between energy consumption and real output. In the long-run there appears to be bidirectional causality between energy consumption and carbon dioxide emissions.

This relationship, whether energy and electricity consumption positively affects and causes GDP, is crucial for electricity conservation policies (Ghosh, 2002; Narayan and Smyth, 2005). The differences in causality results constructed four hypotheses: "neutrality hypothesis," "conservation hypothesis," "growth hypothesis," and "feedback hypothesis." According to the growth hypothesis, energy conservation policies can impede GDP because energy consumption causes economic growth. However, conservation hypothesis argues that GDP growth energy conservation policies can be implemented without deteriorating GDP since the causality is from GDP to energy consumption. Neutrality hypothesis treats the energy as a small component of output and argues that there is no causality between energy consumption and GDP. However, feedback hypothesis claims that energy consumption increases GDP through industrial production and energy use increases as a result of high income. Thus, there is bidirectional causality between energy consumption and GDP (Table 1).

When the studies that used panel data for energy consumption and GDP relation in the literature are examined, results are compatible with one of the hypotheses above. Lee and Chang (2007) analyzed the relationship between energy consumption and GDP for 22 developed and 18 developing countries by the Panel Vector Auto Regression (VAR) method for 1965–2002 period. They found unidirectional causality from GDP growth to energy consumption in developed countries and bidirectional causality in developing countries. Mehrara (2007) analyzed the relationship between per capita energy consumption and per capita GDP for 11 oil exporting countries by the Panel VAR method for the 1965–2002 period and found unidirectional causality from GDP growth to energy consumption. Chontanawat et al. (2008) analyzed the subject for more than 100 countries in two groups as the Organization of Economic Cooperation and Development (OECD) and other countries. Their results for the 1960–2002 and 1971–2001 periods confirm the causality from energy consumption to GDP in most of the OECD countries when compared to other groups. Böhm (2008) specified the direction of causality for 15 European countries in the 1978–2005 period. He reported unidirectional causality which runs from electricity consumption to GDP for 3 countries, runs from GDP to electricity consumption for 5 countries and no causality for 6 countries. Ciarreta and Zarraga (2010) used panel data for the 1970–2004 period for 12 European Union countries. They dedicated no evidence of a short run causal relationship between electricity consumption and economic growth, but there is evidence of cointegration between the series in the long run. Al-Iriani (2006) analyzed the relationship between energy consumption and GDP for some oil exporting countries by the Panel cointegration method for the 1970–2002 period and found unidirectional causality from GDP growth to energy consumption. Narayan

Table 1
Causality literature.

Author(s)	Country	Period	Methodology	Causality
Conservation hypothesis				
Böhm (2008)	5 European	1978–2005	Panel cointegration	Y→EC
Al-Iriani(2006)	GCC	1970–2002	Panel cointegration	Y→EC
Özturk et al. (2010)	51 countries (low income)	1971–2005	Panel cointegration	Y→ENR
Lee and Chang (2007)	18 developing	1971–2002	Panel VAR	Y→EC
Huang et al. (2008)	82 countries (middle and high income groups)	1972–2002	Panel VAR	Y→EC
Mehrara (2007)	11 oil exporting	1965–2002	Panel VAR	Y→ENR
Growth hypothesis				
Böhm (2008)	3 European	1978–2005	Panel cointegration	EC→Y
Narayan and Smyth (2008)	G7	1972–2002	Panel cointegration	EC→Y
Lee (2005)	18 developing	1975–2001	Panel cointegration	EC→Y
Ciarreta and Zarraga (2010)	12 EU	1970–2007	Panel cointegration, panel system GMM	EC→Y
Apergis and Payne (2009)	11 CIS (short run)	1991–2005	Panel cointegration	ENR→Y
Lee and Chang (2008)	16 Asian (long run)	1971–2002	Panel cointegration	ENR→Y
Feedback hypothesis				
Narayan and Smyth (2009)	7 Middle East	1974–2002	Panel cointegration	EC←→Y
Lee and Chang (2007)	22 developed	1965–2002	Panel VAR	EC←→Y
Apergis and Payne (2009)	11 CIS (long run)	1991–2005	Panel cointegration	ENR←→Y
Özturk et al. (2010)	51 countries (middle income)	1971–2005	Panel cointegration	ENR←→Y
Neutrality hypothesis				
Narayan and Prasad (2008)	OECD	1960–2002	Granger-causality	None
Böhm (2008)	6 European	1978–2005	Panel cointegration	None
Özturk and Acaravci (2010)	15 European	1960–2006	Panel cointegration	None

*EC refers to electricity consumption and ENR refers to energy consumption.