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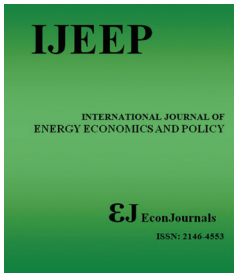

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Analysis of the Relationship between Energy Consumption and Economic Growth in the Commonwealth of Independent States

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ABSTRACT

Since energy is one of the indispensable elements of our lives, it is one of the most studied topics today. Utilization of energy with the highest efficiency capacity is very important for sustaining the growth of the countries. Effects of energy consumption on economic growth differ from country to country depending on economic structure and economic growth process of country. For this reason, there is no exact opinion related to direction of causality relationship between energy consumption and economic growth. In the literature there are four hypotheses (growth, protective, objectivity, feedback) which explain the relationship of the point in the question. In this context, in order to implement a strategically correct energy policy, one of the growth and energy indicators should be tested correctly. This study examines the relationship between energy consumption and economic growth in Commonwealth of Independent States (CIS) for the period of 1992-2018. According to the findings of the study, there is a two-way causality between energy consumption and economic growth in CIS countries. This shows that the feedback hypothesis is valid in these countries.

Keywords: Energy Consumption, Economic Growth, CIS Countries, Panel Co-integration, Panel Causality
JEL Classifications: O40, Q43, Q40

1. INTRODUCTION

The Commonwealth of Independent States (CIS) founded in 1991, is composed of twelve countries of the former Soviet Union (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan). Georgia later joined in 1993, but Georgia's membership to the CIS expired on August 17, 2009. Ukraine left the community after Russia annexed Crimea in March 2014. As of 2019, the member states of the CIS; Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan (World Bank, 2019). With their rich energy resources, CIS countries play an important role in world energy markets both as producers and as transit centers for the distribution of energy (Syzdykova, 2018a).

Today, the most important economic goals of the countries are to achieve economic growth. Numerous studies have been carried out on growth from the past to the present and continue to be done. Energy has been recognized by studies conducted by various economists as an important factor for growth (Syzdykova, 2018b). Understanding the relationship between energy consumption and economic growth is vital for effective energy policies to be implemented. When we look at the example of CIS, it is seen that the member countries of this community are different from each other in terms of natural resource ownership, energy use and development levels. In addition, developing and transition countries operate in energy-intensive areas in order to achieve higher economic growth rates (Dedeoglu and Piskin, 2014. p. 96).

Effects of energy consumption on economic growth differ from country to country depending on economic structure and economic growth process of country. For this reason, there is no exact opinion related to direction of causality relationship between energy consumption and economic growth. In the literature there are four hypotheses (growth, protective, objectivity, feedback) that explain the relationship that the point in the question (Akadiri et al., 2019). The existence of one-way causality from energy consumption to economic growth (growth hypothesis) indicates that economic growth is energy dependent. In this case, energy saving policies may adversely affect economic growth. On the other hand, it shows that energy conservation policies may have little or no impact on economic growth in the case of one-way causality (conservative hypothesis) from economic growth to energy consumption. The presence of a two-way causality (feedback hypothesis) reflecting interdependence and possible complementarity between energy consumption and economic growth is also possible. Finally, the lack of a causal relationship between energy consumption and economic growth (the neutrality hypothesis) means that energy saving policies will have a negligible impact on economic growth (Apergis and Payne, 2010).

This study aims to test the connection between energy consumption and economic growth in CIS countries using panel data analysis. In the second part of the study, a general evaluation is made on the energy production and consumption of CIS member countries and the environmental impact of energy consumption. In the third chapter, empirical studies on the relationship between energy consumption and economic growth are given. In the fourth chapter, empirical results are discussed after explaining the data and methodology. In the conclusion part, various evaluations are made according to the findings obtained by empirical analysis.

2. ENERGY PRODUCTION AND CONSUMPTION IN THE COMMONWEALTH OF INDEPENDENT STATES

According to BP (2019), Russia is the world's largest producer of crude oil and the second largest producer of natural gas. In addition, Russia has the world's largest natural gas reserve with 1680 trillion cubic feet. Furthermore, Russia's revenues from oil and natural gas exports account for more than 40% of federal budget revenues. Among the CIS countries, Russia, Kazakhstan and Azerbaijan are net oil exporters, while other CIS countries are net importers. Besides, Turkmenistan and Uzbekistan follow Russia in terms of natural gas production. Although Turkmenistan and Uzbekistan follow Russia concerning natural gas production, both of these countries have insufficient pipeline infrastructure for natural gas exports. Table 1 provides an overview of energy production and consumption in CIS countries.

Accordingly, the need for energy resources in CIS countries continues to increase every year. Especially in CIS countries, the demand for energy will be more intense in the coming years in parallel with the increase in population after the independence, industrialization, increasing the welfare level of people and technological developments. CIS countries consume approximately 6.7% of the total primary energy consumption in the world. Table 2 shows the sources of primary energy consumption in CIS countries.

53% of the total primary energy consumption in CIS countries is natural gas, 20% is petroleum resources, 21% is coal and nuclear resources. The share of renewable energy (including hydropower) in the first energy sources consumption in these countries is 6%. As can be seen from the Table 2, CIS countries are different from each other in terms of energy sources where energy is provided. While the main source of primary energy consumption in Azerbaijan, Belarus, Russia and Uzbekistan is natural gas, coal is the source of more than half of the energy consumption in Kazakhstan. Energy (electricity) production in the CIS countries Tajikistan stems mainly from hydropower.

On the other hand, carbon dioxide emissions in metric tons per capita, which is a measure of the environmental consequences of energy production and consumption, is an important issue. Regarding the environment, CIS countries face major problems in reducing greenhouse gas emissions. Kazakhstan has the highest carbon dioxide emissions per capita. Tajikistan has the lowest carbon dioxide emission per capita among the CIS countries. Carbon dioxide emissions per capita range from a low of 0.77 MT/capita in Tajikistan to a high of 13.33 MT/capita in Kazakhstan. It is interesting to note that the countries with the lowest carbon dioxide emissions per capita (Tajikistan 0.77, Georgia 0.86, and Kyrgyzstan 1.12) have the highest percentage of electricity production from hydroelectric power (Tajikistan 97.65%, Kyrgyzstan 86.87%, and Georgia 85.81%) (World Bank, 2019).

3. THEORETICAL AND EMPIRICAL LITERATURE

Since energy is an important variable of production function, it is also assumed to be closely related to economic growth (Yildirim et al., 2014. p. 14). Therefore, the focus of energy policies is economic growth. There are many different ideas about how energy affects growth. This is due to the differences in the growth policies of countries (Belke et al., 2011. p. 782). These differences have led to various hypotheses. When the studies in the literature are examined, it is seen that four different hypotheses are proposed for the energy-growth relationship (Wolde-Rufael, 2014. p. 326).

In the literature, the causality relationship between energy consumption and gross domestic product (GDP) has been examined under four hypotheses (Pirlogea and Cicea, 2012; Ozturk, 2010): (1) Growth hypothesis: If causality is from energy expenditures to economic growth, this shows that the country is an energy dependent country. Therefore, the fall in the energy bottleneck will adversely affect economic growth. In addition, it is seen that policies envisaging a reduction in energy expenditures will adversely affect economic growth (Ciarreta and Zarraga, 2010). (2) Conservation hypothesis: If the causality relationship is from economic growth to energy expenditures, then it appears that the country is not dependent on energy to sustain economic growth.

Table 1: Primary energy: Consumption

Million tons oil equivalent	2000	2005	2010	2015	2016	2017	2018	Share (%)
Azerbaijan	11.3	14.3	11.2	14.7	14.6	14.3	14.4	0.1
Belarus	22.0	24.6	26.0	23.2	23.0	23.4	24.6	0.2
Kazakhstan	31.3	45.4	54.9	63.7	64.7	67.6	76.4	0.6
Russia	613.4	640.3	669.3	675.4	690.5	694.3	720.7	5.2
Turkmenistan	10.3	15.2	21.5	28.6	27.5	28.7	31.5	0.2
Uzbekistan	51.1	48.1	44.4	44.9	43.6	45.0	43.9	0.3
Other CIS	13.1	15.3	15.9	17.4	17.5	18.0	19.0	0.1
Total CIS	752.4	803.2	843.2	867.9	881.5	891.2	930.5	6.7

Source: BP, 2019

Table 2: Primary energy: Consumption by fuel, 2018

Million tons oil equivalent	Oil	Natural gas	Coal	Nuclear energy	Hydro electric	Renew- ables	Total
Azerbaijan	4.6	9.3	^	-	0.4	^	14.4
Belarus	6.8	16.6	1.0	-	0.1	0.1	24.6
Kazakhstan	16.4	16.7	40.8	-	2.3	0.1	76.4
Russia	152.3	390.8	88.0	46.3	43.0	0.3	720.7
Turkmenistan	7.1	24.4	-	-	-	^	31.5
Uzbekistan	2.6	36.6	3.1	-	1.6	-	43.9
Other CIS	3.7	4.9	2.0	0.5	8.0	^	19.0
Total CIS	193.5	499.4	134.9	46.7	55.4	0.6	930.5

^Less than 0.05. Source: BP, 2019

This shows that energy conservation policies will not adversely affect economic growth. In addition, as GDP increases, energy consumption will increase. (3) Feedback hypothesis: If there is a two-way causality between energy expenditures and GDP, energy expenditures and GDP affect each other. In a country with such a relationship, increasing GDP means increasing energy consumption, while increasing energy consumption increases GDP. Accordingly, it is of great importance that a country showing a two-way dependence on energy can generate the energy it needs and turn to renewable energy resources in this context (Pirlogea and Cicea, 2012). (4) Neutrality hypothesis: It shows that there is no causal relationship between these two variables.

When the studies examining the causality between energy consumption and economic growth for CIS countries are examined; Dedeoglu and Piskin (2014) examined 15 former Soviet Union countries for the period 1992-2009 and showed that there was a one-way causality relationship from energy consumption to real GDP per capita. Apergis and Payne (2009) found a two-way causal relationship between energy consumption and economic growth in their study based on the period 1991-2005 for 11 CIS countries. Apergis and Payne (2010) examined the relationship between CO_2 emission, economic growth and energy consumption for 11 CIS countries in 1992-2004 and found that there is a one-way causality relationship from energy consumption to economic growth in the short term. In addition, Zhang (2011) examined the relationship between economic growth and energy consumption for Russia in the 1970-2008 period and concluded that there is a two-way causality relationship between energy consumption and economic growth. Syzdykova (2018b) also found similar results in her study for Central Asian countries. Kalyoncu et al. (2013) investigated the relationship between energy consumption and economic growth in Georgia, Azerbaijan and Armenia during the period of 1995-2009. For Georgia and Azerbaijan it is found that these two variables are not cointegrated. In case of Armenia these two variables are cointegrated. Accordingly, causality analysis is conducted for Armenia. The research outcomes reveal that there is unidirectional causality from per capita GDP to per capita energy consumption for Armenia. Table 3 summarizes the empirical studies investigating the relationship between energy consumption and economic growth.

What is important here is the policy implications of the causality aspect between energy consumption and economic growth between countries and country groups. If the growth hypothesis is valid in a country, it indicates that economic growth is energy dependent. In this case, energy saving policies may adversely affect economic growth. It suggests that energy conservation policies may have little or no impact on economic growth in the case of a savings assumption. There is also the case where the feedback hypothesis, which reflects interdependence and possible complementarity between energy consumption and economic growth, is valid. Finally, the neutral hypothesis implies that energy saving policies will have a minor impact on economic growth (Apergis and Payne, 2010. p. 1422-1423).

4. DATA AND METHODOLOGY

In this study, the relationship between primary energy consumption and economic growth of CIS countries (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan) was examined by using panel data analysis. Co-integration and causality analysis was applied to determine whether there is a relationship between these variables.

In this study, data on energy consumption were used as "kg of oil equivalent per capita" for each country. Economic growth refers to GDP per capita in US dollars at market prices. Energy consumption data from the CIS countries, the American Energy Agency and data on economic growth were obtained from the World Bank's

Table 3: Summary of empirical studies

Author	Period	Country and country group	Method	Results
Kraft and Kraft (1978)	1947-1974	USA	Granger causality	EG→EC
Cheng and Lai (1997)	1955-1993	Taiwan	Co-integration, hsiao granger causality	EG→EC
Asafu-Adjaye (2000)	1973-1995 1971-1995	India, Indonesia, Thailand, Philippines	Co-integration, error correction model, granger causality	EC→EG (India, Indonesia) EG↔EC (Thailand, Philippines)
Oh and Lee (2004)	1981-2000	Korea	Co-integration, granger causality	In the short term: EC--EG In the long term:: EG→EC
Ghali and Sakka (2004)	1961-1997	Canada	Co-integration, error correction model, granger causality	EG↔EC
Narayan and Smyth (2008)	1972-2002	G7	Pedroni (1999) and Westerlund (2006) co-integration, error correction model, granger causality	In the long term: EC→EG
Huang et al. (2008)	1971-2002	82 countries	Threshold variables approach	EC→EG (for 48 country)
Ozturk et al. (2010)	1971-2005	Low and middle income countries	Pedroni (1999; 2001) panel co-integration method	EG→EC in low income countries EG↔EC in middle income countries
Herrerias et al. (2013)	1995-2009	Different regions of China	Co-integration, error correction model, granger causality	EG→EC
Alaali et al. (2015)	1981-2009	Oil exporting and developed country groups (130 countries)	Generalized moments method	EC→EG
Alshehry and Belloumi (2015)	1971-2010	Saudi Arabia	Johansen co-integration	EG↔EC
Long et al. (2015)	1952-2012	China	Co-integration analysis	EG↔EC
Shahbaz et al. (2016)	1970-2012	Australia	VECM	EG↔EC
Wang et al. (2016)	1990-2012	China	Granger causality	EG↔EC
Mirza and Kanwal (2017)	1971-2009	Pakistan	ARDL–VECM	EG↔EC
Jebli and Youssef (2017)	1980-2011	Tunisia	VECM	EG↔EC
Riti et al. (2017)	1970-2015	China	ARDL–VECM	EG←EC
Shabestari (2018)	1970-2016	Sweden	ARDL–VECM	EG↔EC
Bekun et al. (2019)	1960-2016	South Africa	Pesaran et al. (2001) bounds test	EG←EC

EG: Economic growth, EC: Energy consumption. →: Represents unidirectional, ↔: Is bidirectional, --: Presents no relationship. Source: Ozturk (2010); Ahmed et al. (2017); Syzdykova (2018b); Waheed et al. (2019)

official website. In order to ensure that the variables are suitable for analysis and to minimize the measurement differences between them, the data was taken by logarithm.

The model equation used in the study is as follows:

$$lngrowth_{it} = \alpha_{it} + \beta_{it} lnenergy_{it} + \varepsilon_{it} \quad (1)$$

In equation (1), i=1,…,10 represents the countries and t=1992,1993…,2018 represents the time period.

The basic hypothesis of the study is as follows:

H_1: There is a positive relationship between economic growth and energy consumption.

In the literature, studies on the relationship between economic growth and energy consumption are discussed in the literature review section. In this section, the H_1 hypothesis will be tested by panel data analysis for CIS countries.

Panel data is generated by combining the time series of economic individuals with the horizontal cross-sectional dimension (Syzdykova et al., 2019). Within the scope of panel data analysis, the existence of horizontal cross-sectional dependence between the units forming the series was first tested by Breush Pagan and Pesaran et al. (2008) LM analyzes. Considering the horizontal cross-section dependence between the series is important in the selection of the tests to be discussed in the next stages. The dependence of the horizontal cross-section means that a shock to one of these will affect the other cross-section. The investigation of cross-sectional dependence is important for considering the high level of globalization in the economic relations between countries.

In the second stage, panel unit root tests were used to test whether the variables contain unit root, and in the next stage the panel co-integration tests were examined to see if there was a long term relationship between the variables. Then, the coefficients of the long-term relationship between the variables were estimated by the AMG (Augmented Mean Group Estimator) method proposed in Eberhardt and Bond (2009). Finally, the causality relationship between the variables was tested by Dumitrescu and Hurlin (2012) panel causality test.

5. RESULTS

5.1. Cross Sectional Analysis

If there is a cross-sectional dependence between the series, the selection of root and co-integration tests of one, regardless of this, can significantly affect the results of the analyzes. The causes of horizontal cross-sectional dependence can be listed as spatial effects, unobserved components, common shocks and globalization of the world economy. If $T>N$ is the number of time size observations in panel data models, Breusch and Pagan (1980)

and Pesaran et al. (2008) tests should be preferred. Otherwise, Friedman (1937), Frees (1995) and Pesaran (2004) horizontal section dependency tests can be used (De Hoyos and Sarafidis, 2006). Since T=27 and N=10, Breusch and Pagan (1980) and Pesaran et al. (2008) tests would be more appropriate. For each test H_0 hypothesis is "no cross-sectional dependence" and for H_1 hypothesis "there is cross-sectional dependence." The results obtained from the cross-section dependency test are presented in Table 4.

As the result of the test, the probability values of the variables are <0.05, H_0 hypothesis can be rejected and it is decided that there is a horizontal cross-section dependence in the series. This result is a realistic approach when one considers that the economies are closely related to each other and that one of the countries constituting the panel is affected.

5.2. Panel Unit Root Tests

Since the panel data has a time series dimension, it is important to conduct a stasis test to reflect the realistic relationship of the results. Misleading results are obtained when experimental analyzes are performed between non-stationary series (Syzdykova et al., 2019a). Since there is a cross-sectional dependence in the series used in the study, we estimate the mean of CADF (Cross Sectional Augmented Dickey Fuller) test developed by Pesaran (2007. p. 265-312), which is a second generation unit root test, in order to obtain more consistent and reliable results. CIPS (Cross-sectional augmented version of IPS) statistics were applied. In the Table 5, Pesaran (2007) panel unit root test results are given. Here, CADF test results are shown for both as well asInterceptand Intercept and trend cases, and critical values are given at $\bar{t}$ (t-bar) statistic value and 95% confidence level.

As a result of the unit root test, it can be seen from the Table 5 that the level values are not stationary even if the series includes the trend of deterministic components. This means that the shock effects on the series do not disappear over time. When the first order difference is taken, the variables become stagnant according to all statistical test values, that is, I (1) carries the process. Co-integration analysis was performed because of the same degree of stability.

5.3. Panel Co-integration Tests

The concept of co-integration reveals the long-term relationship between economic variables. The most important feature of these tests is to express whether two or more variables are integrated. In the study, co-integration analysis developed by Pedroni (2004. p. 597-625) was used (Table 6).

Although the Pedroni co-integration test detects the co-integration relationship in the panel data, the Westerlund ECM panel co-integration test was used for a more consistent analysis based on the assumption that the series forming the panel were equally stable and in the first difference, taking into account the horizontal cross-section dependence and heterogeneity between the data. Westerlund (2007. p. 709-748) developed four panel co-integration tests based on the error correction model. Two of these tests are called group average statistics and the other two are called panel statistics (Table 7).

Table 4: Cross-sectional dependence test

Variables	Breusch and Pagan (1980) LM test		Pesaran et al. (2008) LM test	
	t-statistics	Probability	t-statistics	Probability
ngrowth	763.9	0.003	351.7	0.000
lnenergy	274.3	0.000	119.3	0.000

Table 5: Pesaran panel unit root test results

Variables	Level		1st difference	
	$\bar{t}$	5%	$\bar{t}$	5%
lngrowth				
Intercept	−0.961	−2.330	−2.682*	−2.330
Intercept and trend	−0.650	−2.830	−3.360*	−2.830
lnenergy				
Intercept	−1.580	−2.330	−4.742*	−2.330
Intercept and trend	−1.750	−2.830	−4.389*	−2.830

Table 6: Pedroni co-integration test results

	t statistics	P-value
Panel v-statistic	3.251	0.000*
Panel rho-statistic	0.429	0.768
Panel PP-statistic	−0.958	0.201
Panel ADF-statistic	−1.744	0.05**
Group rho-statistic	1.931	0.654
Group PP statistic	−2.855	0.001*
Group ADF statistic	−3.809	0.000*

*and **represent significance levels of 1% and 5%, respectively

Table 7: Westerlund (2007) panel co-integration test results

Test	Test statistical value	z-value	P-value	Robust P-value
G_t	−2.269	1.768	0.872	0.659
G_a	−18.598	−3.485	0.000*	0.011**
P_t	−4.523	2.251	0.887	0.899
P_a	−15.150	−3.084	0.001*	0.102

*and **represent significance levels of 1% and 5%, respectively

When the co-integration test results are examined, it can be concluded that there is a co-integration relationship between the series. In other words, tests with original values will not include false regression. According to the results of the co-integration test, when the strong probability values of the test statistics considering the cross-sectional dependence in CIS countries, it is concluded that there is a long-term relationship between energy consumption and economic growth at 5% significance level in the long run.

5.4. Estimation of Long-term Co-integration Coefficients

After determining the co-integration relationship between the series, long-term individual co-integration coefficients analyzed by AMG (Augmented Mean Group Estimator) which taking into account the horizontal cross-sectional dependency, different coefficients of the cross-sectional equations (Eberhardt and Bond, 2009. p. 1-26). In the Panel AMG method, the result weighted average group effect of the overall panel is calculated (Table 8). The panel AMG estimation results are as follows:

When the panel is examined, it is seen that economic growth in CIS countries has a statistically significant and positive effect on energy consumption in the long term. According to the test results,

Table 8: Long-term co-integration coefficients

	Coefficient	P-value
Armenia	0.0734	0.000*
Azerbaijan	0.1927	0.000*
Belarus	0.1456	0.000*
Kazakhstan	0.1687	0.1203
Kyrgyz Republic	0.0980	0.077***
Moldova	−0.1236	0.100
Russia	0.3896	0.001*
Tajikistan	0.0289	0.000*
Turkmenistan	0.2398	0.028**
Uzbekistan	0.1963	0.000*
Panel	0.1567	0.000*

*, ** and ***represent significance levels of 1% and 5%, respectively

Table 9: Dumitrescu and Hurlin (2012) test results

Null hypothesis	Test	Statistics	P-value
Growth is not the Granger cause of energy consumption	Z-bar	4.7978	0.0000
	Z-bar tilde	3.5763	0.0001
Energy consumption is not the Granger cause of growth	Z-bar	4.1371	0.0000
	Z-bar tilde	2.9813	0.0025

a 10% increase in energy consumption in these countries leads to an increase of 1.15% on economic growth. The most significant effect of energy consumption on growth by countries; Russia and Turkmenistan.

5.5. Panel Causality Test

The results of the causality test developed by Dumitrescu and Hurlin (2012) for the panel data model with heterogeneous and cross-sectional dependence are presented in Table 9. In the causality analysis, the series were used as stationary. The lag length was selected according to the AIC. For the causality test developed by Dumitrescu and Hurlin (2012), it is recommended to use $\bar{Z}_{N,T}$ test statistic with asymptotic distribution when $T>N$ and $\tilde{Z}_{N}^{Hnc}$ test statistic with semi-asymptotic distribution when $T<N$ (Syzdykova et al., 2019b). In the study, since $T>N$, $\bar{Z}_{N,T}$ (Z-bar) test statistics were considered.

According to the results in Table 9, there is a two-way causality relationship between economic growth and energy consumption in CIS countries concerning to 1% significance level. This result shows that the feedback hypothesis developed from the hypotheses related to the relationship between energy consumption and economic growth in CIS countries is valid.

6. CONCLUSION

Energy is an important input of economic growth that shapes the policies of the world and countries. Continuity of energy is necessary for the growth of the economy with the increase of the production of the countries and the decrease of the unemployment. The focus on energy consumption and economic growth is the direction and extent of the impact of energy consumption on economic growth.

There is still no consensus in the literature on the direction of causality between energy consumption and economic growth variables. The results of the studies vary according to the method used, the period under consideration, country groups and the places where the data were taken. This has led to different results for the same country.

In this study, the relationship between energy consumption and economic growth with the data of 1992-2018 period for CIS countries (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan) was examined with panel data analysis. Panel co-integration tests reveal a long-term equilibrium relationship between energy consumption and economic growth. The increase in energy consumption in CIS countries positively and significantly affects economic growth and the 10% increase in energy consumption increases economic growth by 1.1567%.

According to Dumitrescu and Hurlin (2012) panel causality test results, energy consumption and economic growth bi-directional causality relationship was found in CIS countries. This result is proof that the feedback hypothesis is valid in the CIS countries. According to this hypothesis, the increase in the energy use resulting from growth needs to be well studied and correct saving policies should be implemented. Otherwise, energy saving policies may damage economic growth.

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