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ENERGY CONSUMPTION AND ECONOMIC GROWTH RELATIONSHIP IN THE EURASIAN ECONOMIC UNION: PANEL ARDL ANALYSIS

Avrasya Ekonomik Birliğinde Enerji Tüketimi Ve Ekonomik Büyüme İlişkisi: Panel ARDL Analizi

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ABSTRACT

Today, energy consumption is an important indicator of welfare. Especially when looking at developed countries, it is seen that energy consumption is high. The ever-increasing importance of energy also increases the dependence of economies on energy. However, it is also seen in the economic literature that there is no consensus in the relationship between energy consumption and economic growth.

In this study, the relationship between energy consumption and economic growth between the years 1995-2017 in the Eurasian Economic Union countries consisting of Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia was examined with the help of panel ARDL analysis. According to the results of PMG model, error correction coefficient was negative and statistically significant. Outside Kazakhstan, error correction coefficient was found to be negative and statistically significant on a country basis. It can be said that Armenia, Belarus, Kyrgyzstan, Russian Federation have a long-term relationship. Among these countries, the error correction coefficient was estimated relatively high, especially for Armenia. Therefore, it can be said that the reaching equilibrium rate of Armenia in the long term is relatively high. In the model, it can be said that the energy variable has a positive and statistically significant effect in the short term. According to the results of PMG model, economic growth increases by 6.02 unit when energy consumption increases by 1 unit in the long run.

Key Words: Eurasian Economic Union, Energy, Economic Growth, Panel Ardl

ÖZET

Günümüzde enerji tüketimi refahın önemli bir göstergesi durumundadır. Özellikle gelişmiş ülkelere bakıldığı zaman enerji tüketimlerinin de yüksek olduğu görülmektedir. Enerjinin sürekli olarak artan önemi ekonomilerin enerjiye olan bağımlılıklarını da arttırmaktadır. Ancak iktisat literatüründe enerji tüketimi ile ekonomik büyüme arasındaki ilişkide bir uzlaşı olmadığı da görülmektedir.

Bu çalışmada Ermenistan, Belarus, Kazakistan, Kırgızistan ve Rusya'dan oluşan Avrasya Ekonomik Birliği ülkelerinde 1995-2017 yılları verileri ile enerji tüketimi ile ekonomik büyüme arasındaki ilişki panel ARDL analizi yardımıyla incelenmiştir. PMG modeli sonuçlarına göre hata düzeltme katsayısı negatif ve istatistiksel olarak anlamlı tahmin edilmiştir. Ülke bazında Kazakistan dışında hata düzeltme katsayısı negatif ve istatistiksel olarak anlamlı bulunmuştur. Ermenistan, Belarus, Kırgızistan, Rusya Federasyonu, için uzun dönemli bir ilişkin varlığı söylenebilir. Bu ülkeler arasında özellikle Ermenistan için hata düzeltme katsayısı görece olarak yüksek tahmin edilmiştir. Dolayısıyla Ermenistan'ın uzun dönemde dengeye gelme hızı görece olarak yüksek olduğu söylenebilir. Modelde kısa dönemde eneji değişkeninin pozitif ve istatistiksel olarak anlamlı bir etkisinin olduğu söylenebilir. PMG modeli sonuçlarına göre uzun dönemde enerji tüketimi 1 birim arttığında ekonomik büyüme 6,02 birim artmaktadır.

Anahtar Kelimeler: Avrasya Ekonomik Birliği, Enerji, Ekonomik Büyüme, Panel Ardl

1. INTRODUCTION

Along with the Industrial Revolution, with the transition to mass production, the demand for energy has increased rapidly (Aydın, 2018, 3). The impact of energy use, which is one of the most important inputs of the production process, on economic growth, is one of the main topics investigated in the economic literature. Energy has become a commodity needed in all areas of life with the increase of population, urbanization and industrialization. However, it is seen that not all countries are equally lucky in having energy resources. It is known that especially oil and natural gas resources are higher in certain countries compared to other countries. Due to the inhomogeneous distribution of energy

resources in the world, countries have to develop policies to reach the energy resources they use in production.

Developed countries have to ensure the continuity of the supply of inputs used in production in order to ensure the continuity of their economic growth. This also applies to energy, as one of the inputs used in production. It is observed that developed countries are able to exert power and pressure especially on underdeveloped and developing countries that have energy resources but have not completed their industrialization.

The Eurasian Economic Union, launched in January 2015, is an economic integration form covering Belarus, Kazakhstan, Russia, Armenia and Kyrgyzstan (Karaman, 2019, 120). The Eurasian Economic Union countries, which Russia and Kazakhstan are among the most important energy exports of the world, aim to increase their welfare levels by increasing their production levels in order to increase their economic growth and ensure their continuity.

In the literature, the causality relationship between energy consumption and GDP is examined under four hypotheses. According to the growth hypothesis, the increase in energy consumption increases the GDP. According to the savings hypothesis, the increase in real GDP causes an increase in energy consumption. According to the neutral hypothesis, there is no causal relationship between energy consumption and real GDP. In the feedback hypothesis, energy consumption and real GDP are complementary to each other (Usta & Berber, 2017, 174). For example, according to the savings hypothesis, growth rates will not be adversely affected if energy saving policies are followed. According to the growth hypothesis, saving energy may decrease growth rates. According to the neutral hypothesis, saving energy will not affect growth (Asafu-Adjaye, 2000, 617).

In this study is aimed to contribute to the empirical literature by examining the effect of energy consumption on economic growth in the Eurasian Economic Union with Panel ARDL limit test. In the second part of the study, the related literature examining the studies between energy consumption and economic growth is given. Then, in the third section, econometric method and empirical results are discussed. Evaluations are also made in the fourth section, the conclusion.

2. LITERATURE REWIEW

It was detemirned that Hondroyiannis a.o. In 2002, with the help of granger causality test with the data of 1960-1996, they determined a long-term relationship between energy consumption and economic growth in their studies for the Greek economy.

Oh, Lee could not detect a causal relationship between energy consumption and economic growth in the short run in 2004, with their quarterly data in Korea between 1981 and 2000, with the help of Granger causality and VECM. However, they concluded there is causality from economic growth to energy consumption in the long term.

In 2005, Lee and Chang found energy consumption positively affected economic growth in their studies in Taiwan, with the help of structural breakage and granger causality tests for the period 1954-2003. They also stated that energy saving policies could harm economic growth.

In 2008, Lee and Chang concluded there was causal relationship from energy consumption to economic growth in their work with the help of panel causality and panel co-growth tests for 16 Asian countries 1971-2002.

Mucuk and Uysal in 2009 and the years 1960 to 2006 for the period from energy consumption and energy consumption in Turkey with the help of Granger causality tests with real GDP data have determined that the causality economic growth.

Apergis and Payne, studied on 17 countries who were the members of Commonwealth using panel co-integration test depending on data in 1991-2005. In their studies they found out that while there was a one-way causality relationship from energy consumption to economic growth in the short term, they found a two-way causality relationship between energy consumption and economic growth in the long term. Overall, the results support the existence of the feedback hypothesis.

Eggoh a.o. In 2011, for the period 1970-2006, they reached the conclusion that energy consumption increased real GDP in their studies covering 21 African countries with the help of panel co-integration model.

Çetin and Şeker with the help of co-integration test, they concluded energy consumption has a positive and strong effect on economic growth based on data from 1970 to 2009 for Turkey.

In his study conducted in 2012 with the help of panel data analysis with data from 1987-2007 for OECD countries, Ersoy concluded that primary energy consumption and GDP are co-integrated.

In his study conducted in 15 African countries with the data of 1980-2008 in 2013, with the help of panel co-integration and granger causality test, Ouedraogo determined that there was a causality relationship from real energy consumption to real GDP in the long run.

İsmiç analyzed 8 developing countries in 2015 with the data from 1990-2012 with the help of random coefficients model and seemingly unrelated regression models. As a result, economic growth has positive effect on electricity conspumtion.

In 2015, Dineri and Bazarova determined a two-way causality between natural gas consumption and economic growth, and one-way causality from primary energy consumption to economic growth, with the data of the period between 1985 and 2014 in Turkmenistan, with the help of cointegration, VECM and Granger causality tests.

In her study, which covers 34 OECD countries in 2016, Lotz identified a positive and significant relationship from renewable energy consumption to economic growth with the help of panel data analysis with the data for the period 1990-2010.

Alper and Oguz determined that renewable energy consumption positively affected economic growth in their studies based on countries who are the new members of the EU with the data of 1990-2009 in 2016.A statistically significant relationship was found only in Bulgaria, Estonia, Poland and Slovenia. They concluded that the neutral hypothesis was valid in Cyprus, Estonia, Hungary, Poland, Slovenia and Czechia. Only in Bulgaria, causality has been determined from energy consumption to economic growth, so existence of a growth hypothesis has been determined.

Tang a.o. In 2016, with the data of 1971-2011, in their studies carried out with the help of cointegration and granger causality tests in Vietnam, they detected one-way granger causality from energy consumption to economic growth.

In 2017, Tunalı and Ulubaş reached the conclusion that the consumption of electrical energy positively and significantly affected economic growth in their studies carried out with the data of the G7 countries for the period 1970-2015, using the pooled least squares (pooled OLS) method.

Boz a.o. In 2017, they found causality relationship from economic growth to energy consumption in their studies conducted by panel data analysis with data from 1985-2013 for Asean countries.

Kesbiç and Salkım Er found causality relationship from economic growth to renewable energy consumption in their study in 2007 for the 2004-2014 period including Turkey and 28 EU member countries.

Gozgor a.o. In 2018, in their work with the help of panel ARDL model for the period of 1990-2013 in 29 OECD countries, they concluded that the consumption of energy sources positively affected economic growth.

Using the data from 1971-2013 for low and middle income countries in 2018, Aydın concluded that the neutral hypothesis was mostly valid in his study with the help of Konya panel causality test. He found that the feedback hypothesis exists only for Kenya.

Akdağ and İskenderoğlu have determined that energy consumption has a positive and significant effect on GDP in their studies with help of Panel data analysis of 14 countries that are members and candidates of the European Union in 2018 with data from 2007-2016.

Table 1. Literature Summary

Growth Hypothesis	Lee and Chang (2005), Lee and Chang (2008), Mucuk and Uysal (2009), Eggoh (2011), Çetin and Şeker (2012), Ouedraogo (2013), Dineri and Bazarova (2015), Lotz (2016), Alper and Oğuz (2016), Tang (2016), Tunalı and Ulubaş (2017), Gozgor a.o. (2018), Akdağ and İskenderoğlu (2018)
Savings Hypothesis	Oh and Lee (2004), İsmiç (2015), Boz a.o. (2017), Kesbiç and Salkım Er (2017)
Neutral Hypothesis	Alper and Oğuz (2016), Aydın (2018)
Feedback	Hondroviannis v.d. (2002), Apergis and Payne (2009), Ersoy (2012), Dineri and Bazarova (2015), Aydın (2018)

As a result, although the studies that determine that the increase in energy consumption increases economic growth in the literature according to Table 1, there are many studies that determine that this is the opposite, there is no relation between them, and that energy consumption and economic growth are complementary to each other. This situation, which varies from country to country and from period to period, reveals that there is no compromise between the relationship between energy consumption and economic growth in the literature.

3. ANALYSIS

In this study, the effect of energy consumption on economic growth was investigated in Eurasian economic union. For the countries listed below;

- ✓ Armenia
- ✓ Belarus
- ✓ Kyrghyzstan
- ✓ Kazakhstan
- ✓ Russian Federation

for the period 1995-2017, according to data availability;

- ✓ Gross domestic product in USD terms in fixed prices in 2010 (million USD), (GDP)
- ✓ Energy consumption (kilo tonnes of oil equivalent), (ENERGY)

variables were taken. The data were provided by the World Bank and International energy agency.

In the study, the relationship between energy consumption and economic growth was investigated by panel delay distributed autoregressive model (ARDL) method. Panel data model has been used due to its advantages of providing wider data set compared to time series and horizontal section models, giving more reliable estimations in this context and controlling individual heterogeneity.

The panel data model discussed is as follows.

$$yit=\gamma 0i+\gamma 1ixit+\mu i+\varepsilon it \quad (1)$$

This on display notation y_{it} shows the value of the country's gross domestic product at the time and this notation x_{it} shows the energy consumption of the country at the time. The ARDL model (for example ARDL (1,1) model) to be used when these variables are first degree integrated and cointegration relations for countries are specified below.

$$y_{it} = \alpha_{10i}x_{it} + \alpha_{11i}x_{it-1} + \lambda_i y_{it-1} + \mu_i + \varepsilon_{it} \quad (2)$$

Error correction equation for the model,

$$\Delta y_{it} = \phi_i(y_{it-1} - \gamma_{0i} - \gamma_{1i}x_{it}) - \alpha_{11i}\Delta x_{it-1} + \varepsilon_{it} \quad (3)$$

Here,

$$\phi_i = -(1-\lambda_i)$$
$$\gamma_{0i} = \frac{\mu_i}{1-\lambda_i}$$
$$\gamma_{1i} = \frac{\alpha_{10i} + \alpha_{11i}}{1-\lambda_i} \quad (4)$$

can be specified as this. It shows error correction speed among these parameters. Therefore, this parameter is expected to be significant and negative for the variables to reach long-term equilibrium.

Table 2. Summary Statistics

	GDP	ENERGY
Average	295566.07	97429.94
Standard Deviation	527905.94	167850.44
Flatness	1.49	0.36
Skewness	1.75	1.51
Min.	2440.01	717.00
Max.	1690779.22	487945.00

GDP variable was realized as 295566.07 million dollars on average in the period under consideration. When this series is taken into consideration in all countries, the highest reached $ 1690779.22 million in 2014, belonging to the Russian Federation, and the lowest was determined as $ 2440.01 billion in Kyrgyzstan in 1995. When the panel structure of the series is ignored, it can be said that the series exhibits right-sided structure due to the skewness coefficient of 1.75, while it is observed that the course follows a steep course from the normal distribution with 1.49 kurtosis value.

The ENERGY variable was realized as an average period of 97429.94 kilograms of oil equivalent. Considering all countries, this series reached the highest value of 487945 kilograms of oil belonging to the Russian Federation in 2017, while the lowest was observed as 717 kilograms of oil equivalent in Armenia in 1996. When the panel structure of the series is ignored, it can be said that series exhibits right skewed structure due to the skewness coefficient of 1.51 while it is observed that the series follows a steep course from the normal distribution with 0.36 kurtosis value.

To determine whether the series to be used in the study are stationary or not, a panel unit root test was performed. Panel unit root tests to be performed for this purpose differ depending on whehter there is horizontal cross-section dependence in the model. There is a horizontal cross-section dependence in the model, Friedman, Breusch Pagan, Pesaran 2004 and Pesaran a.o.tests used with 2008 tests.

Table 3. Cross Sectional Dependency Test

Test	**Test stasics**	**p-value**
Friedman Cross Sectional Dependency Test	18.7130	0.0009
Breush Pagan 1980 Cross Sectional Dependency	56.6000	0.0000
Pesaran 2004 Cross Sectional Dependency	6.8130	0.0000
Pesaran 2008 Cross Sectional Dependency	27.0500	0.0000

Result of the Friedman test, coefficient was calculated as 18.7130 and the p-value was calculated as 0.0009. While the Breush Pagan horizontal cross-section dependency test coefficient is calculated as 56.6000 and the p-value for this coefficient is approximately 0, Pesaran 2004 test coefficient is calculated as 6.8130 and p-value for this coefficient is calculated as approximately 0. Finally, the Pesaran 2008 test coefficient was calculated as 27.0500 and the p-value for this coefficient was approximately 0. In the panel data structure, the time dimension, T, is 23, and since this time dimension is greater than the number of panel units, N is 5, T>N condition is met. In this case, Breush Pagan cross section dependency test gives more consistent results. As a result, since the p value is less than 0.01, there is no cross-sectional dependency.

H_0: No horizontal cross section dependence

The null hypothesis was rejected in 99% confidence interval, it was concluded that the model had horizontal cross-section dependence.

Pesaran 2007 panel unit root test, which is one of second generation tests that take into account the horizontal cross-section dependency, was applied to the variables in model due to the horizontal cross-section dependence in the model.

Table 4. Pesaran 2007 Panel Unit Root Test

Variable	Constant		Constant and Trend
	t stats	p-value	t stats
GDP	-1.777	0.484	-1.892
D_GDP	-3.128	0.001	-3.385
ENERGY	-2.137	0.192	-2.063
D_ENERGY	-4.386	0.000	-4.359

Accordingly, the variables used in the model GDP and ENERGY was found as first row integrated. Therefore, the first row differences of these variables are taken (d_GDP and d_ENERGY respectively).

In order to determine a long-term relationship between variables, Wasterlund panel co-integration test was applied. According to the test results, test statistics with a p value of 0.0526 found as 1.6197. Accordingly,

H_0: No co-integration

Null hypothesis was rejected within the 90% confidence interval.

3 different models were used in order to calculate a short and long term relationship between variables.

- ✓ Average groups (MG)
- ✓ Pooled average groups (PMG)
- ✓ Dynamic fixed groups (DFE)

Estimates for each country to determine the appropriate number of delays for the models to be installed were made here and the most repeated delay lenght was found as (1.1).

Hausman tests were applied to choose between PMG, MG and DFE models mentioned in Table 5.

Table 5. Hausman Test

		Coefficient		Difference	Std Error
		MG	PMG		
MG-PMG	ENERGY	6.50	6.02	0.48	2.13
DFE-PMG	ENERGY	2.56	6.02	-3.46	83481.78

Table 5 shows the parameters of Hausman test performed for PMG models against MG model and PMG models against DFE model. Empty hypothesis created for PMG model versus MG model

H0: PMG model is valid

Since the relevant test statistic was calculated as 0.05 with a value of 0.82 p, it was not rejected. Therefore, PMG model was preferred to MG model. Empty hypothesis in comparison between DFE model and PMG model

H0: PMG model is valid

Here, the test statistic was calculated as approximately 0 with a value of about 1 p. Here, PMG model was preferred to DFE model.

As a result, the model results created with the PMG model are given in Table 6.

Table 6. PMG Model Results

	Coefficient	Std Error	z	p value
Long Term				
ENERGY	6.02	0.64	9.47	0.00
Short Term				
ECT	-0.07	0.05	-1.36	0.01
ENERGY	1.08	0.50	2.15	0.03
Constant	-9214.82	11518.27	-0.80	0.42
Error Correction Coefficient for Countries				
Armenia	-0.26	0.15	-1.77	0.08
Belarus	-0.05	0.03	-1.74	0.08
Kazakhstan	0.05	0.02	2.00	0.05
Kyrgyzstan	-0.02	0.01	-2.33	0.02
Russian Federation	-0.07	0.04	-1.53	0.01

Results of PMG model, error correction coefficient was negative and statistically significant. In this case, it can be said that the deviations occurring in the short term have disappeared and the series converged to the long term equilibrium value again. In other words, the error correction mechanism of the model works and the long term analysis performed is reliable. On the country basis, outside of Kazakhstan, error correction coefficient was found to be negative and statistically significant.

- ✓ Armenia
- ✓ Belarus
- ✓ Kyrgyzystan
- ✓ Russian Federation

A long-term relationship can be said. Among these countries, the error correction coefficient was estimated relatively high, especially for Armenia. Therefore, it can be said that the rate of Armenia reaching equilibrium in the long term is relatively high. In the model, it can be said that the ENERGY variable has a positive and statistically significant effect in short term. According to the results of PMG model, economic growth increases by 6.02 unit when energy consumption increases by 1 unit in the long run.

4. RESULT

The demand for energy, an important input of the production process, is constantly increasing. Due to this dependence on energy, problems that may occur in energy supply disrupt the production process and cause the possibility of adversely affecting economic growth.

Results of the PMG model, the error correction coefficient was estimated negative and statistically significant. Outside Kazakhstan, error correction coefficient was found to be negative and statistically significant on a country basis. It can be said that Armenia, Belarus, Kyrgyzstan, Russian Federation have a long-term relationship. Among these countries, the error correction coefficient was estimated relatively high, especially for Armenia. Therefore, it can be said that the rate of Armenia reaching equilibrium in the long term is relatively high. In the model, it can be said that the ENERGY variable has a positive and statistically significant effect in short term. According to the results of PMG model, economic growth increases by 6.02 unit when energy consumption increases by 1 unit in the long run.

As of 2015, Eurasian Economic Union was established with the participation of Armenia, Kazakhstan, Kyrgyzstan, Belarus and Russia (Ganiev et al., 2018, 269). One of the Union countries, especially Russia and Kazakhstan, has an important place in the world in terms of energy resources. The energy needed by the industry sector is provided by the union countries from Kazakhstan and Russia. This situation creates a dependency on Russia, which is the most important power of the Union, and reveals a risk for energy security. However, it is also observed that the energy trade is less affected by the risks in the world energy market due to the fact that the energy trade takes place in unity. In addition, it should be kept in mind that the long-term damage to environment caused by the union countries to provide the energy they need in the industry sector from fossil fuels, and that it is very important for the society to implement the environmental norms as soon as possible.

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