Econometric Analysis of Renewable Energy Consumption and Economic Growth: The Case of Kazakhstan and Kyrgyzstan

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ABSTRACT

Finding renewable resources against depleted resources has become very important in almost every field. Especially in the energy sector, the availability of renewable energy sources is of great importance. The aim of this study is to measure the effect of the renewable energy sector of Kazakhstan and Kyrgyzstan, which are selected Turkish states, on the growth of the economy. The data included in the analysis cover the period from 1996 to 2018. The variables included in the analysis as economic growth and renewable energy consumption were subjected to a series of assumption tests. As a final step, a conclusion was reached by applying regression analysis. It has been determined that there is a positive relationship between the economic growth in both countries and the renewable energy consumed in this country.

Keywords: GDP, Renewable Energy, Economic Growth, Energy
JEL Classifications: Q40, Q20, E24, A10

1. INTRODUCTION

The increase in human needs also affects the increase in the amount of production. Energy resources are needed for production to meet human needs. For a long time, people were exhausted, that is, they depended on traditional energy sources. Today, states are doing a series of studies in terms of access to renewable energy and they use renewable energy in their energy consumption. Renewable energy sources are very important, especially for countries that do not have access to traditional energy sources. Energy is a Greek word and it is used as interior, work and ergon in meaning. Energy can be defined as the ability to do work and produce heat. In the process from antiquity to the present, energy has made progress starting from human labor, depending on the diversification of people's needs and technological developments (Demirbaş, 2002; Çinar and Öz, 2017; Tutar et al., 2022).

The realization of economic growth is among the main goals that almost every country wants to achieve. For this reason,

economic growth is affected by many positive or negative factors (Huseynli, 2022a). There are many studies in the literature on economic development (Gong et al., 2012; Huseynli, 2022b; Pomi et al., 2021).

We can examine energy sources in two parts. These can be considered as primary and secondary energy sources. Primary energy sources are fossil energy sources (coal, oil, natural gas). Secondary energy sources are renewable energy (hydroelectric energy, geothermal, wind, etc.) sources. The fact that primary energy resources are scarce in the world and that they are not distributed unequally, their consumption is increasing due to the increasing population and industrialization of the countries, which directs investors to renewable energy sources. Recently, energy scarcity in the world and consuming more energy than produced energy has become a problem for countries. Biomass, solar, geothermal, wind, alternative or renewable energy sources that can be used instead of fossil fuels in order to reduce the use of fossil fuels in order to eliminate the problems experienced

with the increasing demand for the use of oil and natural gas and especially the increase in the prices of fossil fuels with the continuous oil crises. The importance of energy resources such as hydroelectricity is increasing day by day. In general, renewable energy sources can be considered as a common feature that they can renew themselves, exist in almost every country, are easy to supply and have less damage to the environment than fossil fuels (Çinar and Öz, 2017; Alibabalu and Sarkhanov, 2022).

The use of energy consumption as such an important input for countries and the relationship between economic growth and energy consumption have also increased in studies that deal with economic analysis. The aim of the studies on this subject is to reveal the effect of energy consumption on economic growth and to reveal how it affects the policies and investments to be implemented together with the relations found. Putting the results of the researches forward as a policy proposal and increasing the investments to be made in renewable energy resources and their implementation together with the provision of their use will provide economic growth for Kazakhstan and Kyrgyzstan.

In our study, the effect of renewable energy sources, which are handled annually between 1996 and 2018, on economic growth is investigated. The effect of renewable energy resources on the economy of Kazakhstan and Kyrgyzstan is analyzed by the regression method. According to the hypothesis of the research, there is a relationship between renewable energy consumption and economic growth.

2. THEORETICAL BACKGROUND

Whether there is a relationship between economic growth and energy consumption, and if so, the direction of this relationship is of great importance in energy policy decision-making in countries where the state plays an active role in energy markets. If there is a relationship from energy to growth, protectionist policies such as energy taxes, energy savings and energy prices will have a negative impact on growth (Aytaç, 2010; Durğun and Durğun, 2018). In studies on the relationship between energy consumption and economic growth, some studies have found causality between economic growth and energy consumption, while some studies have not found causality. The work done can be briefly summarized as follows:

The first study for energy consumption and economic growth was in 1978 Kraft and Kraft (1978) investigated economic growth and energy consumption using the Sims causality method in their study in the USA for the 1947-1974 period. As a result of the research, it was revealed that there is a unidirectional causality running from economic growth to energy consumption.

Akarca and Long (1980) found no causality between economic growth and energy consumption with Granger causality for the 1973-1978 periods in the USA in their study. After these studies, there is a rapid increase in the number of similar studies. Hamilton (1983), in his study, used the Granger causality test by considering the 1948-1972 periods in the USA and revealed

that energy prices are the cause of economic growth, not energy consumption.

Burbridge and Harrison (1984) found that the energy price had an effect on economic growth for the USA, Japan, Germany, England and Canada using the Sims technique for the 1961-1982 period Yu and Hwang (1984) used the 1947-1979 period data for the USA in his study, using the Sims technique for economic growth, in addition to the employment variable. No causality was found between growth. Stern (1993) concluded that energy use is a cause of economic growth in the study she conducted in the USA between 1947 and 1990 using the Granger causality test.

In Masih and Masih (1996) studies, for India, Pakistan, Indonesia, Malaysia, Singapore and the Philippines, between 1955 and 1990 and using cointegration and Granger causality, between energy consumption and economic growth India, Pakistan and Indonesia cointegrated but Malaysia There is no cointegration in Singapore and the Philippines, causality is from energy to economic growth in India, and from economic growth to energy consumption in Pakistan and Indonesia. Aqell and Butt (2001) in their study, took the 1955-1996 periods for Pakistan and concluded that the Granger causality was from economic growth to energy consumption with the Hsiao method. Paul and Bhattacharya (2004) found bidirectional causality between energy consumption and economic growth using cointegration and Granger causality for India.

In the research conducted by Syzdykova (2020) on Kazakhstan, the importance of renewable energy resources in the development and development of the region's renewable energy potential was emphasized. Koç and Saidmurodov's (2018) research on Central Asian countries, including Kazakhstan and Kyrgyzstan, concluded that there is no causality between economic growth and electrical energy consumption. Akyol and Ağırkaya (2021), as a result of their study on OECD countries, concluded that the implementation of policies that will encourage renewable energy consumption will contribute to economic growth. As a result of another study on Central Asia by Syzdykova (2018), it was determined that there is a bidirectional causality between energy consumption and economic growth in these countries.

Similarly, studies on Kyrgyzstan are present, albeit a little. Ravanoğlu and Bostan (2019) determined that there is a long-term relationship from energy consumption to growth as a result of their study on Kyrgyzstan. Pırımbaev et al. (2020), it was found that only oil consumption positively affects GDP per capita in the long run. It has been concluded that if the share of renewable energy sources in total energy consumption can be increased, Kyrgyzstan can reduce its foreign trade deficits and use its resources more efficiently.

In a study conducted by Huseynli and Huseynli (2022), the relationship between Azerbaijan's traditional energy production, renewable energy production and unemployment rates between the years 2005-2015 was examined. As a result of the study, a causal relationship was found between unemployment and renewable energy production, renewable energy production and traditional energy production in Azerbaijan.

3. RESEARCH METHODOLOGY

3.1. Purpose
Today, where renewable energy is important, its contribution to economic growth is also important. The aim of this study is to determine the share of renewable energy in the economic growth of Kazakhstan and Kyrgyzstan. The data series used in the analysis part of the study includes the years 1996-2018.

3.2. Data Set
The data required for the analysis were obtained from the World Bank database. The data set covers the period from 1996 to 2018 and is included in the analysis annually. Before proceeding to the regression analysis, a series of assumption tests were applied to measure the reliability of the data.

3.3. Analysis Method
In the analysis part of the study, a series of assumption tests were applied before the regression analysis. Since there are two data sets, the simple regression method was preferred in the study. Stata program was preferred for analysis. The purpose of using the regression method is the assumption that one of the variables among the data sets included in the analysis will affect the other (Crouch et al., 1992; Anghelance and Anghel, 2014).

Literally, regression is the work and way of connecting one thing to another. Scientific regression; It is the job of establishing a relationship between a variable and another (or more than one) variable and the type of relationship. Statistical regression; It is defined as the dependency that emerges as a result of the relationship between two variables and the interaction of their values. If a single independent variable is used, they are called univariate regression analysis, and if more than one independent variable is used, they are called multivariate regression analysis.

The method that reveals the cause and effect relationship between two variables, Y dependent and X independent variable, with a linear model is called simple linear regression. If the number of independent variables is more than one, multiple linear regression is in question (Doğan and Yilmaz, 2017).

If we set up an equation for a simple Regression Model;

$$y = \beta_0 + \beta_1 X + \varepsilon \qquad (1)$$

we get the result. There;
Y; The dependent variable is X Independent variable.
β_0; It is a constant value and is the value of Y when X = 0.
β_1; It is the regression coefficient. It expresses the change that will occur in the dependent variable in response to 1 unit change in the independent variable.
ε; It is the random error term. It is assumed that the dependent variable contains a certain error. There is no error in the argument.

4. ANALYSES AND RESULTS

If we set up an equation for the multiple regression model;

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_k X_{ik} + \varepsilon i_j \; i = 1,2,\dots n \; j = 1,2, \quad (2)$$

In this study, a simple regression model was created to measure the factors affecting economic growth as follows.

$$\text{Growth (y)} = \beta_0 + \beta_1 \text{ renewable energy consumption (x)} + \varepsilon \quad (3)$$

4.1. Multicolliearity Test
The Variance inflation factors for the independent variables (VIF) test is used to measure the connectivity problem between the variables used in the application. It is envisaged that the obtained values will generally take a value up to 5. As can be seen from Table 1, there is no multicollinearity problem between our data set.

4.2. Fixed Variance Test
The autocorrelation problem is important for the data set to be analyzed. With the help of the Breusch-Godfrey LM test, it is measured whether there is autocorrelation between the data. As can be seen from Table 2, there is no autocorrelation problem between these series. That is, the probability values of the data showed a result greater than 0.05. In short, it is understood from the table and probability values that there is no problem of variance changing between the values.

4.3. Normality Test
Another important test during the required tests is the Shapiro-Wilk W test. The Shapiro-Wilk W test measures the normal distribution between error terms. Again, as can be seen from Table 3, our probability value is greater than 0.05. This indicates that there is a normal distribution between the error terms.

After the necessary assumption tests were applied, it was observed that there was no problem for the analysis, and the last step was regression analysis.

Based on the data in Table 4, it is seen that there is a significant relationship between these series. The fact that the R^2 coefficient takes a value of 0.3658 indicates that the model has the power to explain the change in economic growth by 0.3658. It can be said

Table 1: VIF test results

Kazakhstan			Kyrgyzstan		
Variable	VIF	1/VIF	Variable	VIF	1/VIF
renewable energy consumption	1.00	1.00000	renewable energy consumption	1.00	1.00000
Mean VIF	1.00		Mean VIF	1.00	

Table 2: Breusch-Pegan/Cook-Weisberg Test Results

Kazakhstan	Kyrgyzstan
H$_O$: Constant Variance	
Variables: Fitted Values of GSYİH	
Chi 2 (1) = 1.07	Chi 2 (1) = 0.40
Prob = 0.3012	Prob = 0.5662

Table 3: Shapiro-Wilk W test results

Variable	Obs	W	V	z	Prob > z
Error term					
Kazakhstan	23	0.93499	1.700	1.080	0.14017
Kyrgyzstan	23	0.96988	0.785	−0.491	0.68845

Table 4: Linear regression analysis result

R squared	Adjtused R squared	Prob>F
Kazakhstan		
0.3658	0.3356	0.0022
GDP	Standart error	Coeff.
RE	0.302010	−0.105011
Kyrgyzstan		
0.5475	0.5475	0.0001
GDP	Standart error	Coeff.
RE	0.906007	−0.456018

that the model gives significant results at the 95% confidence level. We can say that the H_1 hypothesis is accepted for this country and there is a significant relationship between economic growth and renewable energy consumption in this country.

When we look at it from the perspective of Kyrgyzstan, we can see that the model gives significant results like the previous country. R^2 value of 0.5475 shows that the model explains the variability in economic growth at a rate of 0.5475. Again in this model, it can be said that the series gave significant results at the 95% confidence level. We can state that the H_1 hypothesis is accepted for this country as well, and that there is a significant relationship between economic growth and renewable energy consumption.

5. CONCLUSION

Renewable energy consumption, which is constantly growing exponentially, has become an important issue for almost every country. The development of the renewable energy sector is especially important for the countries that depend on foreign energy to be self-sufficient. In this study, the relationship between renewable energy consumption and economic growth in Kazakhstan and Kyrgyzstan was tried to be measured by regression analysis. Annual data from 1996 to 2018 were used as the data set. Before the regression analysis, a series of assumption tests were applied. As a result of the latest regression analysis, it has been determined that there is a linear positive relationship between the dependent and independent variables of both countries. In other words, it was concluded that the increase in renewable energy consumption in both countries triggered economic growth positively. The reason why the study was limited to 2018 was the inability to reach the data in recent years for these countries. In general, it is recommended to study by choosing more countries and increasing the number of variables in order to make future studies more comprehensive.

REFERENCES

Akarca, A.T., Long, T.V. (1980), On the relationship between energy and GNP: A reexamiation. The Journal of Energy and Devolpment, 1980, 326-331.

Akyol, H., Ağirkaya, M.B. (2021), İş çevrimlerinin uluslararası enerji piyasalarına duyarlılığının incelenmesi: Türkiye örneği. The Journal of International Scientific Researches, 6(3), 382-396.

Alibabalu, S.S., Sarkhanov, T. (2022), Geopolitics and geoeconomics of the eastern mediterranean gas conflict: Analysis of turkey's policy. Geopolitics Quarterly, 18(4), 94-115.

Anghelance, C., Anghel, M.G. (2014), Using the regression model for the portfolios analysis and management. Theoretical and Applied Economics, 21(4), 53-66.

Aqell, A., Butt, M.S. (2001), The relationship between energy comsuption and economic growth in Pakistan. Asia Pasific Development Journal, 8(2), 101-110.

Aytaç, D. (2010), Enerji ve ekonomik büyüme ilişkisinin çok değişkenli VAR yaklaşimi ile tahmini. Maliye Dergisi, 158, 482-495.

Burbridge, J., Harrison, A. (1984), Testing for the effect of oil-price rises using vector autoregressions. International Economic Review, 25(2), 459-484.

Çinar, M., Öz, R. (2017), Enerji Tüketimi ve ekonomik büyüme ilişkisine yenilenebilir enerji bağlaminda bir öneri. International Journal of Academic Value Studies, 3(13), 40-54.

Crouch, G.I., Schultz, L., Valerio, P. (1992), Marketing international tourism to Australia: A regression analysis. Tourism Management, 13(2), 196-208.

Demirbaş, L. (2002), Türkiye'de Enerji Sektörü, Sektörün Problemleri, Avrupa Birliği ve Türkiye'de Enerji Politikaları. Isparta: Süleyman Demirel Üniversitesi, Sosyal Bilimler Enstitüsü.

Doğan, V., Yılmaz, C. (2017), Çoklu doğrusal regresyon modellerinde bağimsiz değişkenlerin karşilaştirilmasi ve bastirici etki tespiti. Uluslararası Yönetim İktisat ve İşletme Dergisi, 13(2), 385-406.

Durğun, B., Durğun, F. (2018), Yenilenebilir enerji tüketimi ile ekonomik büyüme arasinda nedensellik ilişkisi: Türkiye örneği. International Review of Economics and Management, 6(1), 1-27.

Gong, L., Li, H., Wang, D. (2012), Health investment, physical capital accumulation, and economic growth. China Economic Review, 23(4), 1104-1119.

Hamilton, J. (1983), Oil and the macroeconomy since world War II. The Journal of Political Economy, 91(2), 228-248.

Huseynli, B. (2022a), Examining the relationship between brand value, energy production and economic growth. International Journal of Energy Economics and Policy, 12(3), 298-304.

Huseynli, B. (2022b), The contribution of the number of tourists to the economic growth of Egypt: An econometric analysis. African Journal of Hospitality Tourism and Leisure, 11(4):1350-1361.

Huseynli, B., Huseynli, N. (2022), Econometric analysis of the relationship between renewable energy production, traditional energy production and unemployment: The case of Azerbaijan. International Journal of Energy Economics and Policy, 12(4), 379-384.

Koç, S., Saidmurodov, S. (2018), The relationship between electricity, foreign direct investment and economic growth in central Asian countries. Ege Academic Review, 18(2), 321-328.

Kraft, J., Kraft, A. (1978), On the relationship between energy and GNP. Journal of Energy and Development, 3(2), 401-403.

Masih, A., Masih, R. (1996), Energy consumption, real income and temporal causality: Results from a multi-country study based on cointegration and error-correction modelling techniques. Energy Economics, 18(3), 165-183.

Paul, S., Bhattacharya, R.N. (2004), Casuality between energy comsuption and economic growth in India: A note on conflicting result. Energy Economics, 26, 977-983.

Pırımbaev, J., Ravanoglu, G.A., Sulaımanova, B. (2020), Enerjinin ekonomik büyümeye etkisi: Kırgızistan ekonomisi için ARDL sınır testi. Reforma, 3(87), 48-63.

Pomi, S.S., Sarkar, S.M., Dhar, B.K. (2021), Human or physical capital, which influences sustainable economic growth most? A study on Bangladesh. Canadian Journal of Business and Information Studies, 3(5), 101-108.

Ravanoğlu, G.A., Bostan, A. (2019), Türkiye'de enerji tüketimi ve cari açiğin büyüme üzerindeki etkisinin incelenmesi. MANAS Sosyal

Araştırmalar Dergisi, 8(2), 1713-1726.

Stern, D. (1993), Energy use and economics growth in the USA. A multivariate approach. Energy Economics, 15(2), 137-150.

Syzdykova, A. (2018), Orta asya ülkelerinde enerji tüketimi ve ekonomik büyüme ilişkisi: Panel veri analizi. Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 20(1), 87-99.

Syzdykova, A. (2020), Kazakistanın yenilenebilir enerji potansiyeli.

Ekonomi İşletme ve Maliye Araştırmaları Dergisi, 2(1), 79-88.

Tutar, H., Sarkhanov, T., Guliyeva, N. (2022), Eastern mediterranean area in energy security of the European Union: From sea border issues to economic conflicts of interest. International Journal of Energy Economics and Policy, 12(1), 332-341.

Yu, E., Hwang, D. (1984), The relationship between energy and GNP. Energy Economics, 6(3), 186-190.