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Article

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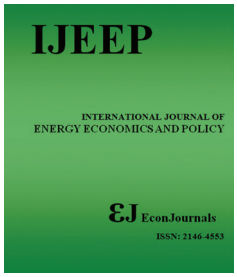

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The Effect of Renewable Energy and Traditional Energy Production on Economic Growth: The Case of Turkey and Azerbaijan

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ABSTRACT

The aim of this study is to determine the relationship between traditional energy and renewable energy in the economic growth of Turkey and Azerbaijan. Multiple Linear Regression Model was used to measure whether there is a significant or insignificant relationship between dependent and independent variables and how these variables affect economic growth. Data for the years 2005–2015 were used in the study. In order to reveal the importance of the model in the analysis process, a series of assumption tests were conducted. The VIF test was used to measure whether the independent variables were related to each other, the Breusch-Godfrey LM test to examine whether there was autocorrelation between the error terms, and the Shapiro-Wilk W test, which is another assumption, was used to measure the normal distribution of the error terms. As a result of the multiple linear regression analysis performed at the end, no relationship was found between renewable energy and economic growth for Azerbaijan, but a significant result was obtained between traditional energy production and economic growth. When we examine the analysis in terms of Turkey, there is no relationship between renewable energy or traditional energy production and economic growth in this country.

Keywords: GDP, Economic Growth, Renewable Energy, Region
JEL Classifications: Q40, Q20, R10, A10

1. INTRODUCTION

Increases in the world population increase the demand for goods and services. Continuous production is carried out in order to meet the endless human needs. Today, energy demand has become a necessity for the realization of production. That is why, politically and economically, countries are constantly working to obtain more energy. Traditional energy is the most preferred method historically and is still used today. However, the scarcity of resources and the decrease in world reserves have led countries to find alternative energy. Renewable energy has become a necessity for states that do not have access to traditional energy or have difficulty accessing it. Today, states are in competition for the discovery of renewable energy by leaving the traditional method. Renewable energy is very important in terms of the convenience it offers, environmental cleanliness and the absence of a threat that can be exhausted. Many countries are now meeting the energy demand within the country by benefiting from the blessings of renewable energy. Since it affects the output level of either traditional energy or renewable energy, it also contributes significantly to the growth of the country's economy.

In this study, two Turkish states with an output to renewable energy and traditional energy; It is analyzed by taking Azerbaijan and Turkey as an example. The place of the energy types used in both countries in the economic growth of the countries has been tried to be analyzed. When we consider the issue in terms of Turkey, although there are a number of studies made as a contribution of renewable energy to economic growth, there is no such study in the literature for Azerbaijan. By making the same analysis for each country with a similar structure, it is investigated whether there is a causality between the variables taken as a basis.

Kumbur et al. (2005) in their study on Turkey concluded that the harms of a large part of renewable energy to the environment outweigh the benefits. Erdal (2012) analyzed the relationship between renewable energy and employment in Turkey. According to the results of the analysis, it was concluded that renewable energy can be a source of employment. As a result of another similar study conducted by Güllü and Kartal (2021), it was concluded that there is a linear relationship between employment and renewable energy sources. The study by Erdoğan et al. (2018) was also conducted to analyze the relationship between renewable energy and economic growth in Turkey. According to the results obtained, renewable energy causes economic growth in the long run. Apaydın et al. (2019) concluded that there is a relationship between economic growth and renewable energy sources as a result of their study. Alper (2018) found in her study that there is a unilateral causality relationship between renewable energy and economic growth.

2. THEORETICAL BACKGROUND

As a result of the study conducted by Kraft and Kraft (1978), it was concluded that there is a relationship between economic growth and the energy sector. In their study on developed and developing countries, Apergis and Danuletiu (2014) revealed that there is a one-way relationship between economic growth and energy consumption. In another study by Apergis and Payne (2010) for Eurasia, a bidirectional relationship was found between economic growth and energy consumption. Salim et al. (2014) concluded that there is a bidirectional causality relationship between these two variables as a result of their study on OECD countries. Inglesi-Lotz (2016) found a causal relationship between renewable energy consumption and economic growth as a result of their study on OECD countries. Bhattacharya et al. (2016) found that there is a positive relationship between economic growth and renewable energy in their study on the countries that prefer renewable energy the most. Likewise, as a result of the study conducted by Shahbaz et al., on Pakistan in 2015, it was concluded that there is a bidirectional causality relationship between economic growth and renewable energy. Kahia et al. (2017) observed that there is a significant relationship between these variables in the long run as a result of their study on both renewable energy and non-renewable energy consuming countries.

Sadorsky (2009) reached a meaningful conclusion by examining the relationship between renewable energy consumption and economic growth for 18 developing countries. Rafindadi and Ozturk (2017) in their study on Germany, concluded that renewable energy positively affects economic growth in this country. Lin and Moubarak (2014) found in their study on China that there is a bilateral causality relationship between renewable energy consumption and economic growth for this country. Akinlo (2008), as a result of her study on the African continent, concluded that there is a causality between economic growth and energy consumption in the countries taken as an example. As a result of her study for Tanzania, Odhiambo (2009) determined that there is a one-sided relationship from energy consumption to economic growth in this country.

Although there is a causal relationship between economic growth and energy consumption, a number of studies in the literature have not found any relationship between these two variables. For example, Marques and Fuinhas (2012) found no relationship between energy consumption and economic growth in their study. Menegaki (2011) found no relationship between energy consumption and economic growth in her study on European countries.

3. RESEARCH METHODOLOGY

The aim of this study is to determine the relationship between the economic growth of Azerbaijan and Turkey and the use of traditional energy and renewable energy between the years 2005–2015. In the analysis made in this direction, it is measured whether there is a significant relationship between dependent and independent variables and how the variables affect economic growth, and a series of suggestions are made according to the results obtained.

3.1. Data Set

The data used in the study were obtained from the World Bank. The data set includes the years 2005–2015. All data are included in the analysis annually. Since the renewable energy data could not be reached after 2015, the analysis was limited to 11 years. In order to eliminate problems such as changing variance and normal distribution, the logarithm of the dependent variable was taken and included in the analysis.

3.2. Analysis Method

In this part of the study, data collection and analysis methods are included. By defining the Simple Linear Regression Model, a number of assumptions of the model are listed. STATA statistics/econometrics program was used for analysis. The data used in the study were obtained from the World Bank. The data set includes the years 2005–2015. All data are included in the analysis annually. In order to eliminate problems such as changing variance and normal distribution, the logarithm of the dependent variable was taken and included in the analysis.

The regression method used in the analysis; It is carried out to examine the numerical relationship between dependent and independent variables. In regression analysis, it is assumed that the dependent variable is affected by the independent variable or that the independent variable affects the dependent variable. In this method, if the number of dependent and independent variables is one, Simple Regression Analysis, if the dependent variable is one, Multiple Regression Analysis, if there is more than one dependent variable, Multivariate Regression Analysis Regression analysis methods are applied.

A Simple Regression Model (Lichtenberg and Şimşek, 2017);

$$y = \beta_0+\beta_1X+\varepsilon \quad (1)$$

is established as. In this equation;
Y: dependent variable X is the 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 a 1-unit change in the independent variable.
e: It is a random error term. It is assumed that the dependent variable contains a certain error. There is no error in the argument.

Our error terms, ε, are normally distributed, have a mean of zero, and have a constant spread. If the number of independent variables is more than one, a multiple linear regression model is established. That is, if a new term, X_{i2}, is added to the simple regression model, the model turns into a multiple linear regression model Anghelache et al. (2015).

$$y_i = \beta_0+\beta_1 X_i+\beta_2 X_{2i}+\varepsilon_i \quad (2)$$

β_0, β_1 ve β_2 a three-parameter multivariate model was established. If the number of independent variables is not clear in the analysis, a multiple linear regression model is established:

$$y_i = \beta_0+\beta_1 X_i+\beta_2 X_{2i}+\ldots+\beta_p X_{pi}+\varepsilon_i \quad (3)$$

The dependent variable y_i in the equation; β_0 its constant value; $X_{1i,pi}$, its arguments; ε_i represents the error term and β_p regression coefficients. In order to apply the linear regression method, a number of assumptions must be valid (Grajales and Kurkiewicz, 2013).

- The sample used is assumed to be a random sample or largely representative of the population.
- It is assumed that the dependent variable has random error and the mean error is zero.
- According to the constant variance assumption, the errors are independent of each other.
- According to the autocorrelation assumption, the error variance is constan
- Errors should show a normal distribution.
- Since there is no multicollinearity; There should be no relationship between the independent variables.

4. ANALYSIS AND RESULTS

The Multiple Regression Model we established for the analysis;

$$\text{Growth (y)} = \beta_0+\beta_1 \text{ traditional energy (x)}+\beta_2 \text{ renewable energy}+\varepsilon \quad (4)$$

is established as. Since the logarithm of the dependent variable is taken, the model is

$$\text{Loggrowth (y)} = \beta_0+\beta_1 \text{ traditional energy (x)}+\beta_2 \text{ renewable energy}+\varepsilon \quad (5)$$

is displayed as.

Our hypotheses for analysis;
H_0: There is no relationship between growth and conventional energy and renewable energy,
H_1: It has been determined that there is a relationship between growth and traditional energy and renewable energy. The tests performed for some basic assumptions in order to apply the model and their results are shown below;

4.1. Multicollinearity Test

The Variance inflation factors (VIF) for the independent variables test was used to measure whether the independent variables were related to each other (Table 1).

If the VIF value is above 5, it indicates that there is a multicollinearity problem in the model. Since the value we get is below 5, it means that there is no multi-connection problem in our model.

4.2. Constant Variance Test

Breusch-Pagan/Cook Weisberg test was applied to find out whether the model satisfies the homoscedasticity assumption (Table 2). Our hypotheses for analysis are as follows;
H_0: There is no varying variance between the Error Terms
H_1: There is varying variance between the Error Terms

According to the test results, our probability values are greater than 0.05, so our H_0 hypothesis is accepted. There is no problem of varying variance in the model.

4.3. Autocorrelation Test

In this test, the Breusch-Godfrey LM test was used to examine whether there was autocorrelation between the error terms (Table 3). Our hypotheses;
H_0: It means that there is no autocorrelation between the error terms
H_1: It means there is autocorrelation between the Error Terms

According to the autocorrelation test results, it was concluded that the probability value was greater than 0.05. In this case, there is no autocorrelation in our model. H_0 hypothesis is accepted.

4.4. Normality Test

Another assumption, the Shapiro-Wilk W test, was applied to measure the normal distribution of error terms (Table 4). Our hypotheses;

Table 1: VIF test results

Azerbaijan			Turkey	
Variable	VIF	1/VIF	VIF	1/VIF
traditional energy	1.16	0.865534	1.14	0.877160
renewable energy	1.16	0.865534	1.14	0.877160
Mean VIF	1.16		1.14	

Table 2: Breusch-Pegan/Cook-Weisberg test results

Azerbaijan	Turkey
H_0: Constant Variance Variables: Fitted Values of GSYİH	
Chi-square (1)=1.08	Chi-square (1)=0.08
Prob>Chi-square=0.2994	Prob>Chi-square=0.7763

Table 3: Breusch-Godfrey LM test results

	Lags(p)	Chi-square	df	Prob>Chi-square
Azerbaijan	1	0.774	1	0.3791
Turkey	1	3.332	1	0.0679

Table 4: Shapiro-Wilk W test results

Variable	Obs	W	V	z	Prob>z
Error Term					
Azerbaijan	11	0.94858	0.833	−0.321	0.62585
Turkey	11	0.86993	2.106	1.423	0.07736

Table 5: Multiple regression analysis result

Azerbaijan		
R Squared	**Adjtused R Squared**	**Prob>F**
0.9506	0.9382	0.0000
GDP	Standart Error	Coeff.
RE	0.086121	−0.1362041
TE	0.022344	0.2687659
Turkey		
R Squared	**Adjtused R Squared**	**Prob>F**
0.5615	0.4519	0.0370
GDP	Standart Error	Coeff.
RE	0.2226479	0.4862368
TE	0.2754829	0.392879

H_0: Error terms are normally distributed
H_1: Error terms are not normally distributed

As the probability value is >0.05 according to the result of the test, the H_0 hypothesis is accepted for both countries. Error terms in the model show normal distribution characteristics.

According to the test results, the basic assumptions were tested in order to apply the model and it was concluded that the model was applicable. The results of the regression analysis obtained are as follows (Table 5):

According to the analysis results; The coefficient of determination in Azerbaijan is $R^2 = 0.9506$. In other words, the model has the power to explain the variability in economic growth at a rate of 0.9506. Since the P value is less than α in the model ($P = 0.000 < 0.05$), it can be said that the model is significant at the 95% confidence level. In the explanatory variables, it is seen that there is a significant relationship between traditional energy production and economic growth. In this case, our H_1 alternative hypothesis is accepted. Due to the fact that the country has not developed much in this regard in terms of renewable energy and that it cannot be used much in the general production and consumption sector, a meaningful relationship between economic growth and economic growth has not been obtained.

Considering our analysis for Turkey, the coefficient of determination is $R^2 = 0.5615$. The new model has the power to explain the variability in economic growth by 0.5615. Since the p value is smaller than α in the model ($P = 0.000 < 0.05$), it can be said that the model is significant at the 95% confidence level if we consider it in the general framework. From the point of view of the explanatory variable, there is no significant relationship between traditional and renewable energy and economic growth. The reason for this is that the country's energy sector generally has a structure based on imports. Although the use of energy indirectly triggers economic growth, it does not give a meaningful result when considered separately. In this case, our alternative hypothesis H_1 is rejected.

5. DISCUSSION AND CONCLUSION

The aim of this study is to determine the relationship between traditional energy production and renewable energy production and economic growth of Azerbaijan and Turkey between 2005 and 2015. Multiple Linear Regression Model was used to measure whether there is a significant relationship between these variables or the effect of the relationship. Data for analysis were obtained annually from the World Bank. Variance inflation factor test, Breusch-Pegan/Cook Weisberg test, Breusch-Godfrey LM test and Shapiro-Wilk W test were applied for independent variables (VIF) during the study phase. As a result of the multiple linear regression analysis performed at the end, no relationship was found between renewable energy and economic growth for Azerbaijan, but a significant result was obtained between traditional energy production and economic growth. The fact that the country has natural resources and exports energy also supports our hypothesis. When we examine the analysis in terms of Turkey, there is no relationship between renewable energy or traditional energy production and economic growth in this country. The main reason for this is that the country is an energy importing country.

It is assumed that the development of these countries in renewable energy sources and their use of more renewable energy as an alternative to traditional energy use in the process, in terms of both Azerbaijan and Turkey, will have their own effect on the development of these countries and indirectly on the increase in employment rates.

Some of the previous similar studies in the literature include studies that give meaningful and meaningless results, especially for Turkey. Considering the small number of such studies conducted in Azerbaijan, it is hoped that this study will fill the gap in the literature in this context, albeit a little.

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