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Research Article

The effects of globalization on energy consumption: Evidence from EAGLEs

Küreselleşmenin enerji tüketimi üzerindeki etkisi: EAGLEs ülkelerinden kanıtlar

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Abstract

Energy is seen as one of the critical inputs of the production process to ensure countries' economic and social development. Due to the increasing economic integration between countries in recent years, the relationship between globalization and energy consumption is frequently discussed. To contribute to the discussions on this subject, the effect of the globalization process on energy consumption was investigated in this study. In addition to globalization, economic growth, urbanization, and changes in public expenditures on energy consumption are also examined. In this context, panel data analysis was made for the period 1990-2019 by using annual data of 9 countries called EAGLEs (Emerging and Growth-leading Economies). The analysis framework applied cross-section dependency and Pesaran's (2007) CADF (Cross Sectional Dickey-Fuller) unit root tests. Then, coefficient estimates were made with the random-effects model. The findings show that the increase in globalization increases energy consumption. In addition, it has been determined that economic growth, included in the model as a control variable, has an increasing effect on energy consumption. In addition, it has been observed that the increase in urbanization has reduced effects on energy consumption, but the change in public expenditures has no effect.

Keywords: Economic Growth, Energy Consumption, Globalization, Panel Data Analysis

Jel Codes: O47, O13, F62, C23

Öz

Enerji, ülkelerin ekonomik ve sosyal gelişmelerini sağlamaları bakımından üretim sürecinin önemli girdilerinden biri olarak görülmektedir. Son yıllarda ülkeler arasında artan ekonomik entegrasyona bağlı olarak küreselleşme ile enerji tüketimi arasındaki ilişki sıklıkla tartışılmaktadır. Bu konudaki tartışmalara katkı sağlamak amacıyla bu çalışmada küreselleşme sürecinin enerji tüketimine olan etkisi araştırılmıştır. Küreselleşmenin yanında ekonomik büyüme, kentleşme ve kamu harcamalarındaki değişimin de enerji tüketimi üzerindeki etkisi belirlenmeye çalışılmıştır. Bu kapsamda EAGLEs (Yükselen ve Büyümede Öncü Ekonomiler) olarak adlandırılan 9 ülkeye ait yıllık veriler kullanılarak 1990-2019 dönemi için panel veri analizi yapılmıştır. Analiz çerçevesinde, ilk olarak yatay kesit bağımlılığı ve Pesaran (2007)'nin CADF (Cross Sectional Dickey-Fuller) birim kök testleri uygulanmıştır. Daha sonra tesadüfi etkiler modeliyle katsayı tahminleri yapılmıştır. Elde edilen bulgular küreselleşme düzeyindeki artışın enerji tüketimini arttırdığını göstermiştir. Ayrıca kontrol değişken niteliğinde modele dahil edilen ekonomik büyümenin de enerji tüketimini arttırıcı etkilerde bulunduğu tespit edilmiştir. Ayrıca enerji tüketiminde kentleşmedeki artışın azaltıcı etkilerinin olduğu fakat kamu harcamalarındaki değişimin bir etkisinin olmadığı görülmüştür.

Anahtar Kelimeler: Ekonomik Büyüme, Enerji Tüketimi, Küreselleşme, Panel Veri Analizi

Jel Kodları: O47, O13, F62, C23

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Introduction

Historical developments following the Second World War have also introduced a new dimension to the functioning of the world economy. The conflict of interest among the states has divided the world economy into two poles: economic and social terms. While the United States and the countries on its axis have tried to achieve dominance through the capitalist system, the Soviet Union and the countries under its influence have established the socialist order as another superpower. International trade has been liberalised in the new world order established during this period. The attempt to achieve economic development in many regions of the world has brought about severe increases in production. These production increases have also increased the need for sources. In many countries, the increase in energy demand caused by enhancing welfare has considerably boosted the interest in energy. Moreover, increases in energy prices over time have affected energy consumption in many countries. In this respect, the fact that the energy notion has gained vital importance during the globalization process and has become one of the essential components of the world economy and policy has increased the number of scientific studies on this subject.

The concept of continuous consumption that has emerged for the sustainability of economic growth with globalization has put energy production and consumption in a significant position. Globalization affects almost all sectors and is of great importance for energy consumption. Energy, a significant input for developed and developing countries, is directly or indirectly used to produce many goods and services. For most countries, a safe and secure energy supply is vital for future economic development. The needs for future energy supply depend on the expectations about future energy consumption (Shahbaz, Shahzad, Mahalik and Sadorsky, 2018, p. 1479). Recently, energy demand and supply problems have made world nations much more dependent on each other for their welfare and safety. Countries consuming energy always need more fuel, gas, and coal from abroad. In contrast, countries producing energy always need increasing amounts of foreign capital to develop the necessary facilities for more sources (Ahmad and Babar, 2013, p. 267). Accordingly, it can be said that energy also assumes an essential role in the globalization process and is making countries increasingly dependent on each other in social, economic, cultural, and political terms (Badea, Angheluță and Partal, 2017, p. 44; Danish, Saud, Baloch and Lodhi, 2018, p. 18651, Shahbaz et al., 2018a, p. 1479).

The development of markets, infrastructure integration between countries, and the development of trade flows bring some regions to the forefront as energy basins and enable increases in the incomes of these regions. This situation also increases the risk of political and military conflicts over new energy basins. The routeing security of the energy transferred from these regions to the main consumption points constitutes another problem. The political popularity of the region's countries that possess these energy sources also increases. In this matter, energy observers state that the increasing popularity in these regions will pose a significant threat to the future of energy security and energy production (Ahmad and Babar, 2013, p. 270). Another negative expectation is that military and political conflicts may occur in these regions, resulting in an affected energy supply. On the other hand, energy consumption, which is expected to rise as a result of an increase in income levels through trade and production, may exceed the supply. Both cases can lead to increases in energy prices in many countries. Since extreme increases in prices will cause decreases in the welfare level, it can be expected that many developing countries facing energy shortages to struggle with social and political turmoil in the future. In the process of globalization, the interdependence between the countries of the world economy may lead to the spread of instability in various regions to all countries. It is impossible to mention that countries' struggle with these instabilities alone will be enough to protect their welfare. Thus, a world system that will meet the increasing energy demand in the globalization process and ensure adequate energy production is required. In this context, it can be stated that it is increasingly essential for all global components, especially developed countries, to cooperate.

Furthermore, with globalization, energy production and energy sources have been diversified, and some of these sources have undergone proportional changes. In this context, power production has decreased in thermoelectric plants but increased in wind and solar power plants (Badea et al., 2017, p. 44). The increase in the prices of some energy types due to the increased demands of countries for energy also increases the usability of new energy sources, which have not been considered economical. The increase in the efficiency of new energy sources with technological developments is elevating the share of these sources in total production compared to classical energy sources. This situation also creates a global market for the technology, machinery, equipment, and other inputs used to produce these resources. It also expands technology and machinery-equipment trade between countries previously traded in energy. Hence, it is possible to say that energy has introduced a new dimension to globalization and affected energy production and consumption.

When energy consumption is mentioned, explaining how the link between economic growth and energy consumption comes to mind first, the first hypothesis is the growth hypothesis stating that increasing energy consumption will increase economic growth. The second hypothesis is the conservative hypothesis. It suggests that the increase in economic growth will increase energy consumption. Third, the feedback hypothesis explains the bidirectional causality between economic growth and energy consumption. Finally, the neutrality hypothesis argues that the relationship between energy consumption and economic growth is independent (Acheampong, Boateng, Amponsah and Dzator, 2021, p. 2). This study aims more than to explain the pure relationships between energy consumption and energy consumption growth. Therefore, studies focusing on the link between energy consumption and growth are not addressed. However, as in economic growth-energy consumption, an imprecise link is observed between globalization and energy consumption. For example, is the increase in energy consumption an achievement of globalization? Or, is energy consumption decreasing with the technological development spread due to globalization? The literature indicates that the relationship between energy consumption and globalization is a potential research topic. From this point of view, it aims to explain the complex relationship between energy consumption and globalization.

After this section provides general information, the article is organized as follows. In section 2, the literature is summarized. In section 3, an empirical approach is presented. Section 4 reports the analysis conducted using the panel random effects model. Finally, section 5 discusses the results, and the article is finalized with political suggestions.

Literature review

The effect of globalization on energy consumption and the size and direction of this effect is still discussed, and the findings of empirical analyses differ from each other. The first idea is that globalization expands economic activities and increases energy consumption (Huang, Zhang and Duan, 2020, p.2). Shahbaz et al. (2018a) examined the relationship between energy consumption and globalization in 25 developed countries from 1970-2014 by using panel data and time-series methods. The results of the cointegration test indicated a long-term relationship between the variables. In many countries, globalization was observed to increase energy consumption. Shahbaz, Lahiani, Abosedra and Hammoudeh (2018) investigated the relationship between globalization and energy consumption in the Netherlands and Ireland for 1970Q1-2015Q4 using the quantile autoregressive distributed lag-QARDL. The results showed that globalization affected energy consumption positively in these two countries. Another study providing evidence for the increase caused by globalization in energy consumption belongs to Gozgor, Mahalik, Demir and Padhan (2020). The authors examined the relationship between renewable energy consumption and economic globalization in 30 OECD countries from 1970 to 2015. With economic globalisation, they revealed that per capita carbon dioxide emission, per capita income, and fuel prices increased renewable energy consumption. Godil, Sharif, Ali, Ozturk and Usman (2021), on the other hand, analysed the relationship between globalization, corporate quality, research-development expenditures, financial development, and energy consumption in India with three-month data for the period of 1995-2018 QARDL method. As a result, they determined that corporate quality and research-development expenditures affected energy consumption negatively, and financial development and globalization affected energy consumption positively, similar to other studies. Rashed and Eren (2021) examined the relationship between economic, social and political globalization and energy consumption in Turkey from 1970 to 2017. Time series analyses showed a causal relationship between political and social globalization and energy consumption.

The second idea in energy consumption-globalization is that globalization reduces energy consumption because globalization promotes information and innovative transfer at the international level. Thus, technologies develop in the energy field. In addition, an increase in energy efficiency reduces energy consumption (Huang et al., 2020, p. 2). Saud, Danish and Chen (2018) examined the link between the variables of energy consumption, globalization, financial development, urbanization, and growth from 1980-2016 using the autoregressive distributed lag (ARDL) method. The findings indicated a negative relationship between energy consumption and globalization. Shahbaz, Mahalik, Shahzad and Hammoudeh (2018) focused on the relationship between energy consumption and globalization within the scope of the environmental Kuznets hypothesis in 86 low-, middle- and high-income countries from 1970-2015. The findings indicated that the hypothesis was valid, and globalization decreased energy consumption. Padhan, Padhang, Tiwari, Ahmed and Hammoudeh (2020) examined the link between renewable energy consumption and globalization in 30 OECD countries between 1970 and 2015 through Machado and Silva's panel quantile regression method. In the analysis, carbon emission, per capita income, social, economic and political globalization, as well as overall globalization indices, were used. Globalization was seen to reduce renewable energy consumption. Lu, Imran, Haseeb, Saud, Wu, Siddiqui and Khan (2021) analysed the relationship between energy consumption and globalization and foreign direct investments (FDI) variables, financial development and economic growth in Belt and Road Initiative-BRI countries from 1990-2016. The Westerlund cointegration, Dynamic Seemingly Unrelated Regression-DSUR panel estimation and Dumitrescu-Hurlin panel causality tests were applied. The findings showed that the variables were cointegrated. A 1% increase in globalization resulted in a 0.621-unit decrease in energy consumption.

Some of the studies that obtained heterogeneous findings other than the main two ideas on energy consumption-globalization are as follows: Danish et al. (2018) investigated the role of globalization in energy consumption in Next-11 countries for the period of 1990-2014 using the panel data and time-series analyses. The results indicated that globalization increased energy consumption, and the results were heterogeneous in single-country analyses. Fahimi, Olasehinde-Williams and Akadiri (2019) studied the causal relationship between globalization and energy consumption, considering the economic growth variable in Mexico, Indonesia, Nigeria, and Turkey (MINT) from 1970 to 2015. According to Emirmahmutoglu and Kose's (2011) panel causality test, globalization-energy consumption exhibited a bidirectional causality in Indonesia, Turkey, and Nigeria. In contrast, there was a unidirectional causality from globalization to energy consumption in Mexico. Finally, Hossain, Mustafa and Rayhan (2019) examined the link between globalization and energy consumption in Bangladesh from 1972 to 2014 with the Johansen cointegration and VECM Granger causality tests. The results showed that the series was cointegrated, with a unidirectional causality from globalization toward energy consumption.

Huang et al. (2020) investigated the link between energy consumption and globalization with the control variables of economic growth, financial development, and urbanization in 98 countries between 1980 and 2016. Kao's and Pedroni's cointegration tests and panel Granger causality results indicated an inverted U-shaped relationship between energy consumption and globalization in the long term. In other words, energy consumption follows a trend that increases before reaching particular globalization and decreases. Ajmi and Akadiri (2021) researched the relationship between globalization and energy consumption in OECD countries from 1970-2015 with the symbolic transfer entropy causality method. In addition to energy consumption and globalization, economic growth and FDI were also among the variables used. The findings revealed a bidirectional causality relationship between energy consumption and globalization. Shahbaz, Balcilar, Mahalik and Akadiri (2021) studied the causality between globalization and energy consumption in 20 economies using the data of quarterly periods from 1970-2017 using the time-varying Granger causality test. The findings confirmed the time-varying causality between globalization and energy consumption. Causality was seen to be bidirectional for many countries. Urom, Abid, Guesmi and Ndubuisi (2022) investigated the relationship between energy consumption, globalization and growth in G7 countries. Nonlinear Cointegrating Auto-Regressive Distributed Lag (NARDL) results showed that results vary by country.

Apart from the studies summarized above, there are also studies suggesting no relationship between energy consumption and globalization. For example, Dogan and Deger (2016) investigated the cointegration and causality relationship between energy consumption and globalization in BRIC from 2000-2012. The economic growth data were used as the control variable in the research. Pedroni's and Kao's cointegration tests showed that the series was cointegrated in the long term. Moreover, the Granger causality results indicated no causality relationship between energy consumption and globalization. Akadiri and Ajmi (2020), on the other hand, revealed no causality relationship between energy consumption and globalization in Sub-Saharan African countries from 1970-2014 through the symbolic transfer entropy causality method.

Data set and econometric method

BBVA Bank named some of the emerging market economies EAGLEs[1] (Emerging and Growth-Leading Economies) in 2010 due to their contributions to the world economy (Narin and Kutluay, 2013, p. 37). These countries, which have been affected by globalization, have exhibited a high level of growth performance and used substantial amounts of energy in recent years. Consequently, they need high energy to maintain their high growth rates. Hence, this country group was selected to investigate the effects of globalization on energy consumption. To research the relationships between the variables, data from 1990-2019 were used. Explanations related to the variables used in the empirical analysis are stated in Table 1.

[1] EAGLEs = China, India, Brazil, Indonesia, South Korea, Russia, Mexico, Egypt, and Turkey.

Table 1: Variable Explanations

Variable	Explanation	Source
	The Dependent Variable	
ENERGY	Primary Energy Consumption (Exajoules)	BP (British Petroleum)
	Independent Variables	
GLOBAL	General Globalization Index	KOF Swiss Economic Institue
PCGDP	Per Capita Real GDP (Constant 2015 $)	World Bank
GOVEXP	General government final consumption expenditure (% of GDP)	World Bank
URBAN	Urban population growth (%)	World Bank

The econometric model created based on this information is as follows.

$$\mathrm{ENERGY_{it}} = \beta_{it} + \beta_1 \mathrm{GLOBAL_{it}} + \beta_2 PC\mathrm{GDP_{it}} + \beta_3 \mathrm{GOVEXP_{it}} + \beta_4 \mathrm{URBAN_{it}} + \varepsilon_{it} \tag{1}$$

The empirical analysis consists of three stages. In the first stage, cross-sectional dependence (CSD) in the variables and model was investigated with Breusch and Pagan (1980)'s CDLM1, which provides effective results when the time dimension (T) is greater than the cross-sectional dimension (N). In addition, Pesaran (2004)'s CDLM2, which provides effective results when T and N go to infinity, and Pesaran, Ullah and Yamagata (2008)'s CDLMadj, which provide effective results when T>N and T<N. Nowadays, a shock experienced by a country also affects others. Therefore, investigating the relationship between the cross-section units will prevent obtaining deviated and inconsistent results in analyses.

In the second stage, Pesaran's (2007)'s CADF (Cross-Sectional Augmented Dickey-Fuller), one of the second-generation unit root tests, considers the presence of a CSD relationship between the series, was applied. This test is the expanded version of the lag levels and 1st difference values with the cross-sectional averages in standard ADF regression for each series. The main equation used in the CADF test is:

$$y_{it} = (1 - \emptyset_i)\mu_i + \emptyset_i y_{i,t-1} + u_{it}, \qquad i = 1, \dots, N;\ t = 1, \dots, T \tag{2}$$

In Equation (2), the initial value y_{i0} has a density function with finite mean and variance, and the error term u_{it} has a single-factor structure:

$$u_{it} = \gamma_i f_t + \varepsilon_{it} \tag{3}$$

Here, f_t is the unobservable common effect and ε_{it} is the individual-specific error. Thus, equations (2) and (3) can be expressed as follows:

$$\Delta y_{it} = \propto_i + \beta_i y_{i,t-1} + \gamma_i f_t + \varepsilon_{it} \tag{4}$$

$\propto_i = (1 - \emptyset_i)\mu_i$, $\beta_i = -(1 - \emptyset_i)$ and $\Delta y_{it} = y_{it} - y_{i,t-1}$. Accordingly, the unit root hypothesis $\emptyset_i = 1$ can be expressed as follows:

$$H_0: \beta_i = 0 \text{ (for all } i) \tag{5}$$

$$H_1: \beta_i < 0, i = 1,2, \dots N_1, \beta_i = 0, i = N_1 + 1, N_1 + 2, \dots, N \tag{6}$$

Here, H_0 hypothesis was established as "not each of units is stationary" and H_1 hypothesis as "some of cross-sectional units are stationary".

The CIPS (Cross-Sectionally Augmented IPS) statistics, which are valid for the whole panel, can be obtained by calculating the arithmetic mean of the statistics of each cross-section with the CADF test. CIPS statistics is calculated as follows:

$$CIPS\ (N,T) = t - bar = N^{-1} \sum_{i=1}^{N} t_i\ (N,T) \tag{7}$$

$t_i(N,T)$ is the CADF statistic of i^{th} cross-section unit. This way, stationarity analysis can be conducted for cross-sections and the whole panel. When the calculated CADF and CIPS statistics are more significant than the critical table values as absolute values, the series is said to have a stationary structure. The series has a unit root if these statistics are smaller than the critical values. At the final stage, depending on the results of the preliminary tests, static panel data analysis was carried out to obtain estimation results. In this context, the fixed-effects model was used.

Results of econometric analysis

Results of the cross-sectional dependence tests are shown in Table 2.

Table 2: Cross-sectional Dependence Test Results

Variables	$CDLM_1$	$CDLM_2$	$CDLM_{adj}$
ENERGY	803.549*** (0.000)	90.457*** (0.000)	90.301*** (0.000)
GLOBAL	999.255*** (0.000)	113.521*** (0.000)	113.365*** (0.000)
PCGDP	913.328*** (0.000)	103.394*** (0.000)	103.239*** (0.000)
GOVEXP	169.133*** (0.000)	15.690*** (0.000)	15.535*** (0.000)
URBAN	450.364*** (0.000)	48.833*** (0.000)	48.678*** (0.000)
Model	394.871*** (0.000)	42.293*** (0.000)	29.775*** (0.000)

Note: The symbols ***,** and * indicate 1%, 5% and 10% significance levels, respectively. Values in parentheses indicate probability.

The obtained results proved that all variables and the model have cross-sectional dependence. The CIPS statistical values obtained from the CADF test, which was applied to reveal the stationarity degrees of the variables, are given in Table 3.

Table 3: Unit Root Test Results

Variables	CIPS Statistics
	Level
ENERGY	-2.544**
GLOBAL	-2.605***
PCGDP	-2.709***
GOVEXP	-2.539**
URBAN	-2.383**

Note: Table critical values for 1%, 5% and 10% significance level are -2.57, -2.33 and -2.21, respectively. The symbols ***,** and * indicate 1%, 5% and 10% significance levels.

The unit root test results showed that all variables were stationary at level values. The variables GLOBAL and PCGDP were stationary at level values at a 1% significance level, and other variables were static at a 5% significance level. As a result, all variables were found to have I(0). Accordingly, coefficient estimations were made at the next stage within the static panel data analysis scope. First, the F and LR tests were used to test the validity of the fixed- and random-effects models against the classical model. Results are given in Table 4.

Table 4: F and LR Tests Results

	Model 1			
	F Test		LR Test	
	F Statistic	Probability	X^2 Statistic	Probability
Unit Effect	98.67***	0.000	323.03***	0.000
Time Effect	0.79	0.778	0.00	1.000

Note: The symbols ***,** and * indicate 1%, 5% and 10% significance levels.

According to the results of the F test, only unit effects were observed in the model. According to the results of the LR test, similarly, only unit effects were seen. In this respect, it was considered appropriate to use one-way random effects or one-way fixed-effects models, instead of the classical model, in coefficient estimation. The model used was decided with Hausman's (1978) specification test, which is presented in Table 5.

Table 5: Hausman Test Results

	Coefficients			
Model (Variable)	**Fixed Effects (b)**	**Random Effects (B)**	**Difference (b-B)**	**Standard Error**
GLOBAL	0.457	0.481	-0.024	0.018
PCGDP	0.001	0.001	0.000	0.000
GOVEXP	-1.205	-0.908	-0.297	0.180
URBAN	-4.960	-4.508	-0.452	0.339

Note: Hausman χ2 = 6.20, p-value (χ2) = 0.102

According to the test results, hypothesis H_0 was accepted, and no systematic difference was determined between the coefficients. Therefore, the random-effects model was decided to be used in model estimation. Before proceeding with the coefficient estimation, the presence of autocorrelation and heteroscedasticity problems, which might pose an obstacle to adequate estimations, was investigated. The results are given in Table 6.

Table 6: Diagnostic Test Results

	Heteroscedasticity		Autocorrelation	
	Lagrange Multiplier (LM) Test	**Prob.**	**Durbin-Watson Test**	**Baltagi- Wu (LBI) Test**
Model	1492.88	0.000	0.274	0.187

Note: According to Durbin-Watson and Baltagi-Wu LBI tests, the threshold value is accepted as "2".

According to the Breusch-Pagan Lagrange Multiplier test results, the model observed the heteroscedasticity problem. Furthermore, the presence of an autocorrelation problem was also revealed since the results of Modified Bhargava et al. (1982) Durbin-Watson and Baltagi-Wu (1999) Locally Best Invariant (LBI) tests were smaller than 2, the threshold value. In light of these results, coefficients were estimated with the robust Driscoll-Kraay estimator, which allows effective and consistent estimations in the case of cross-sectional dependence, heteroscedasticity, and autocorrelation problems in the model. The results are stated in Table 7.

Tablo 7: Coefficient Estimation Results

The Dependent Variable: ENERGY				
Explanatory Variables	**Coef.**	**Driscoll-Kraay Standard Error**	**t stat.**	**Prob.**
GLOBAL	0.482***	0.219	3.29	0.000
PCGDP	0.001***	0.001	3.04	0.005
GOVEXP	-0.908	0.573	-1.58	0.124
URBAN	-4.508**	2.018	-2.23	0.033
χ2	104.65	**Prob.**	0.000	

Note: The symbols ***,** and * indicate 1%, 5% and 10% significance levels, respectively.

The results revealed that variables other than GOVEXP had significant effects on energy consumption, and the most influential variable was URBAN. A 1% increase in URBAN causes a decrease of 4.508 units in energy consumption. Globalization, which forms the basis of the study and is represented by GLOBAL, was seen to have positive effects on energy consumption. Accordingly, a 1-unit increase in the GLOBAL variable causes a 0.482-unit increase in energy consumption. The increase in the control variable PCGDP was found to increase energy consumption. A 1-unit increase in the PCGDP variable and a slight 0.001-unit increase occur in globalization. Moreover, as previously stated, the change in GOVEXP did not affect energy consumption.

Conclusion

The overall effects of globalization on different aspects of life have aroused great interest in recent years. Especially with the opening up of developing countries, studies on globalization and its different effects have increased. The efforts of developing countries to achieve economic development have also necessitated the increase and sustainability of production. In this context, the topic of energy, which has become one of the essential components of production, has started to attract attention as a vital subheading of studies on the globalization concept. Due to this importance, the effect of globalization on energy consumption was researched in EAGLE countries in this study. To this end, panel data analysis was conducted using 1990-2019. Coefficient estimations were made using the random-effects model. According to the results, globalization was found to affect energy consumption positively. This result coincides with the idea widely adopted in the literature that "globalization increases energy consumption by expanding economic activities." Thus, the obtained results are consistent with the results of the studies conducted by Shahbaz et al. (2018), Gozgor et al. (2020), and Godil et al. (2021). Regarding the effects of the control variables, it was determined that the increase in per capita real GDP, representing economic growth, decreased the total energy consumption, and the increase in the urbanization rate decreased the total energy consumption. Considering that energy is an important input in production, the increase in economic growth also increases energy use in these countries, exhibiting high growth rates. Furthermore, the increase in the urbanization growth rate can help raise the awareness of individuals who have gotten used to living together, protecting the environment and less energy consumption over time. Hence, they can gravitate toward consuming energy-saving and environment-friendly goods and services. In conclusion, it can be said that the increase in the urbanization rate can decrease energy consumption.

Since EAGLEs mainly consist of developing countries with high economic performance, the scale effect in production can be mentioned in this country group. This is because the increase in globalization leads to an increase in the market size and scale of production. This increases energy consumption. Moreover, deepening in the globalization process increases energy consumption by causing an increase in tourism activities. On the other hand, considering that energy use affects economic growth, in parallel with the effects of globalization, policies need to be followed on energy supply and demand to be made to guarantee the security of energy supply. In this sense, energy promotion policies should increase energy production. Furthermore, increasing investment in energy-saving policies will decrease energy consumption during globalization. In this way, international trade deficits resulting from energy import and external dependence will be decreased, and important developments will be achieved in reaching sustainable growth targets. Finally, the study has some limitations regarding the period under review. Therefore, obtaining longer-term data and analysing it will be better in terms of the effectiveness of the results of future studies.

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