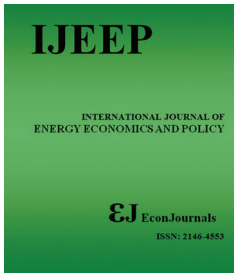

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Determinants of Energy Consumption in Central Asian Countries: Panel Data Analysis

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ABSTRACT

Central Asian countries (Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan) have been witnessing important developments in the field of economic development since gaining their independence. The increase in energy consumption, in particular, plays an important role in the development of the country's economy by triggering the development of many factors. The main purpose of this study is to empirically analyze the determinants of energy consumption in Central Asian countries. Panel data analysis covering the years 1992-2021 was used in the study. Since there are many determinants of energy consumption, the factors of economic growth, foreign direct investments and energy prices are considered appropriate in this study and it is aimed to examine the interaction of these factors with each other. The test technique used to detect the cointegration relationship in the study confirmed the cointegration relationship between the series. In other words, there is a long-term relationship between the series considered in Central Asian countries. When the estimation results are evaluated, it is seen that the results differ for each country group. It is seen that the economic growth variable, as a determinant of energy consumption, is significant in Kazakhstan, Uzbekistan and Tajikistan, the foreign direct investments series is significant in Uzbekistan and Kazakhstan, and is insignificant in Tajikistan and the Kyrgyz Republic. The results obtained for the Kyrgyz Republic were found to be insignificant for all three series.

Keywords: Energy Consumption, Central Asian Countries, Energy Prices
JEL Classifications: Q43, Q40, Q53, C33

1. INTRODUCTION

The need for energy dates back to prehistoric times. Mankind has benefited from energy as much as technological possibilities allow, within the knowledge of the period in order to meet their needs and increase their living standards in every period. Increasing dependence on energy causes countries with energy resources to form alliances, conflicts of interest and wars, energy-related crises, an increase in energy-based agreements and many other issues. In this context, the development of new theories and policies based on energy gains importance in terms of national economies (Syzdykova et al., 2022). According to the 2022 report published by BP, approximately 29% of the total energy demand consists of coal, 33% oil and 24% natural gas, respectively (BP, 2022). Therefore, the majority of global energy demand consists of non-renewable energy sources called fossil fuels. According to the energy scenarios made by the IEA, even if the share of fossil fuels in energy resources is predicted to decrease relatively in the 2040s, fossil fuels will remain the dominant source among energy resources. On the other hand, the share of renewable energy sources is expected to be approximately 16.1% in the 2040s and the share of these energy sources in energy is expected to increase (IEA, 2022).

Population growth rate, increase in the welfare level of countries, rapidly increasing world trade with the effect of globalization,

urbanization etc. It seems very likely that there will be an increase in heat and power demand every year with the effect of many factors. By 2030, the world population is expected to increase by 2 billion people and the number of vehicles in traffic in non-OECD countries is expected to increase to approximately 550 million. In addition, it is predicted that world energy demand will be approximately 60% more than today by the 2030s, mostly from developing countries. According to the scenarios made by the IEA, residential and commercial energy demand is expected to increase by about 20% in the 2040s. For this reason, it would not be wrong to expect energy consumption in the world to increase every year with the effect of all these factors.

The amount of energy consumption, which increases every year in the world, is seen as a factor that can directly affect many macroeconomic factors in both developing and developed countries. For this reason, it is important to determine the factors that directly affect many factors from inflation to unemployment, from exports to imports and from production to consumption. In this context, there are many studies in the literature that directly or indirectly examine energy consumption. Iheanacho (2018), Shahbaz et al. (2013), Kumar et al. (2015), Shahbaz et al. (2014), Lean and Smyth (2010), Sadorsky (2012), Farhani et al. (2014), Kyophilavang et al. (2015), Ahmed (2017), Kurniawan and Managi (2018), Iheanacho (2018), Lau et al (2018) etc. In the studies carried out, the factors that determine the energy consumption are investigated. This study aims to examine the determinants of energy consumption, which is an indispensable element for human beings both in the industrial sense and in normal life and will increase each year compared to the previous year. In this direction, the effects of energy prices, economic growth and foreign direct investments on energy consumption, selected as the determinants of energy consumption, are analyzed econometrically on a panel data set covering the years 1992-2021 for Central Asian countries (Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan).

2. LITERATURE REVIEW

With the importance of the energy factor in economic development, the issue of energy consumption has found a place in the literature, especially in recent years. Reaching different results as a result of the studies conducted for various places and periods led to the inability to reach a common judgment about the determinants of energy demand. For this reason, many theories have been developed to determine the energy demand (Syzdykova et al., 2020). On the other hand, there are many studies that empirically investigate the determinants of energy consumption. In this part, a literature review was carried out by taking into account some time series and panel data studies. Table 1 summarizes some of these studies.

Iheanacho (2018) investigates the effects of urbanization, population, economic growth, financial development and trade openness on energy consumption for Nigeria in the period 1971-2013. Unit root tests of variables are carried out with ADF and PP tests. After examining the cointegration relationship between the series with the ARDL bounds test, long and short term coefficient estimates of the series are made. Accordingly, trade openness affects energy consumption positively and significantly in the short and long term. Finally, the existence and direction of causality between the series is determined with the VECM Granger causality test. The results show that in the long run, trade openness increases energy consumption, while economic growth and financial development factors reduce energy consumption. In addition, unidirectional causality from economic growth and financial development to energy consumption, and bidirectional causality between trade openness and energy consumption is determined.

Shahbaz et al. (2013) examines the relationship between energy consumption, foreign trade, economic growth, financial development and capital variables for China in the 1971-2011 period. The stationarity levels of the series are investigated with traditional unit root tests such as ADF and PP, as well as structural break unit root tests such as Zivot-Andrews and Clemente-Montanes-Reyes. Then, besides the Johansen cointegration test, the existence of a long-term relationship between the series is tested with the ARDL bounds test. Then, by taking the economic growth as the dependent variable, long and short term coefficient estimates of the series are made with the ARDL approach, and the existence of causality between the series is tested with the vector error correction model (VECM) Granger causality test. Empirical findings show the existence of bidirectional causality between trade openness, economic growth, capital and financial development and energy consumption in the long run.

Kumar et al. (2015) investigated the role of energy consumption, trade openness and financial development in explaining economic growth in South Africa for the period 1971-2011. In order to determine whether the series contain a unit root, Perron's structural break unit root test was used together with traditional unit root tests such as ADF, PP and KPSS. Whether the variables move in the long run is investigated by ARDL bounds test and Bayer-Hanck multiple cointegration test. The long- and short-term coefficient estimates of the series with cointegration relationships were also determined by the ARDL bounds test. Finally, the existence and direction of causality between the series was examined with the Toda-Yamamoto causality test, and the results proved that there is only one-way causality from energy consumption to economic growth among macroeconomic variables.

Shahbaz et al. (2014) examines the relationship between trade openness and energy consumption for 91 high, middle and low income countries in the 1980-2010 period. In the study, the stability analyzes of the variables were performed with Panel Levin, Lin, Chu (LLC), Im, Pesaran, Shin (IPS) and Maddala-Wu (MW) tests. The long-term relationship between the series is investigated with the Panel Likelihood cointegration test. Finally, the causality relationship between the series is determined by the Panel Hurlin-Venet granger causality test. The results show that there is a "U" shaped relationship between trade openness and energy consumption in high-income countries, while it is "∩" in low- and

Table 1: Summary of some econometric studies on the relationship between energy consumption and its key determinants

Authors	Period	Country	Methodology	Long term effect	Causality
Lean and Smyth (2010)	1971-2006	Malaysia	Lee-Strazich unit root test, Johansen cointegration test, ARDL bounds test, Toda-Yamamoto causality test, VECM Granger causality test	Not researched	TR→EN GDP↔EN CAP↔EN
Sadorsky (2012)	1980-2007	7 South American Countries	Pesaran and Shin panel unit root tests with CADF, Fisher ADF and PP, Pedroni panel cointegration test, Panel VECM Granger causality test, Panel FMOLS coefficient estimation	Not researched	TR↔EN GDP×EN CAP×EN
Shahbaz et al. 2013)	1971-2011		ADF, PP, Zivot-Andrews and Clemente-Montanes-Reyes unit root test, Johansen cointegration test, ARDL bounds test, VECM Granger causality test	Not researched	TR↔EN GDP↔EN CAP↔EN FIN↔EN
Farhani et al. 2014)	1980-2010	China	ADF and PP unit root test, ARDL bounds test, Toda-Yamamoto causality test	Not researched	TR→EN GDP↔EN CAP→EN
Shahbaz et al. 2014)	1980-2010	Tunisia	Panel LLC, IPS, MW unit root test, Panel Likelihood cointegration test, Panel ARDL estimator, Panel Hurlin-Venet Granger causality test	Negative	TR↔EN
Kumar et al. 2015)	1971-2011	91 countries	ADF, PP, KPSS, Perron unit root test, Bayer-Hanck cointegration test, ARDL bounds test, Toda-Yamamoto causality test	Not researched	TR×EN GDP×EN CAP×EN FIN×EN
Kyophilavang et al. (2015)	1971-2012	South Africa	Ng Perron unit root test, Bayer-Hanck multiple cointegration test, Variance decomposition method, VECM Granger causality test	Not researched	TR↔EN GDP↔EN
Ahmed (2017)	1991-2013	Thailand	Panel LLC and CADF unit root tests, Panel Johansen Fisher cointegration test, Panel Bayer-Hanck cointegration test, Panel VECM Granger causality test	Not researched	TR→EN GDP→EN FIN↔EN CAP↔EN
Kurniawan and Managi (2018)	1970-2015	BRICS	Perron structural break unit root test, ARDL bounds test	TR positively affects EN GDP positively affects EN IND negatively affects EN	Not Researched
Iheanacho (2018)	1971-2013	Indonesia	ADF and PP unit root test, ARDL bounds test, VECM Granger causality test	TR positively affects EN	TR→EN
Lau et al. (2018)	1980-2015	Malaysia	Cointegration analysis, ARDL, granger causality test based on VECM	It has been determined that economic growth and FDI are the main components of renewable electricity consumption. In addition, it has been determined that the renewable electricity consumption negatively affects the trade openness in the long run.	
Ergun et al. (2019)	1990-2013	21 African countries	Panel data analysis	While renewable energy sources have a positive relationship with FDI in the energy mix, they have a negative relationship with GDP and HDI.	

"EN, TR, GDP, FIN, CAP, IND" symbols shown in the table represent energy consumption, trade openness, economic growth, financial development, capital and industrialization factors, respectively. Note: The signs "↔, → and "" in the table indicate bidirectional and unidirectional causality, respectively, while the sign "x" indicates the absence of causality

Source: Created by the author as a result of the literature review, HDI: Human development index, FDI: Foreign direct investment

middle-income countries. Considering the causality relationship, there is bidirectional causality between trade openness and energy consumption.

Lean and Smyth (2010) the dynamics of growth; analyzes electricity consumption, exports, labor and capital variables for Malaysia based on the 1971-2006 period. In the study, the analysis of stationarity is performed with the single and double structural break LeeStrazich unit root test. Then, the cointegration relationship between the variables is searched with the Johansen and ARDL bounds test. At the same time, short- and long-term coefficient estimates of the variables are made with the ARDL test. Finally, the existence and direction of causality between variables is determined by Toda-Yamamto and Granger causality tests based on VECM. According to the causality results based on VECM, it proves a bidirectional causality between economic growth and capital and energy consumption, and a unidirectional causality from trade openness to energy consumption. While the results of the Toda-Yamamoto causality test show bidirectional causality between economic growth and energy consumption, there is no causal relationship between capital and trade openness and energy consumption.

3. DATA SET, MODEL AND ECONOMETRIC METHOD

3.1. Data Set and Model

In the analysis part of the study, Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan from Central Asian countries were included in the sample group. Since statistical data could not be reached for Turkmenistan, one of the Central Asian countries, it was excluded from the analysis. While analyzing the determinants of energy consumption in the study, the energy consumption function was formulated as follows, taking into account the compatibility with the literature: $ECON=f(GDP,FDI,EP)$

In this function, while *econ* forms the energy consumption function, *gdp* shows the total gross domestic product, *fdi* shows the total foreign direct investment, and the *ep* variable shows oil prices. In order to obtain reliable results from empirical analysis, it would be more useful to make the function logarithmic. The logarithm of the model is as follows:

$$lnecon_{it}=\alpha_0+\alpha_1 lngdp_{it}+\alpha_2 lnfdi_{it}+\alpha_3 lnep_{it}$$

In this model;
i=1,2.,n is the number of cross sections and t=1,2.,t is the time dimension.

The World Bank, UNCTAD database and BP statistical reports were used while compiling the data covering the period 1992-2021 of the variables used in the analysis. Detailed data of the variables are presented in Table 2. The energy consumption used as the dependent variable in the study; represents million tons of oil consumption for the countries in the sample. The related energy consumption variable was obtained from the World Bank database. GDP data from the independent variables are obtained from the World Bank and are expressed in US dollars. The data set of the foreign direct investments variable was obtained from the UNCTAD database in US dollars. The energy prices variable was taken from the International Energy Agency database as the price of a barrel of Brent oil.

3.2. Econometric Method

In this part of the study, the econometric method to be applied in the analysis phase was determined. For this purpose, it was first investigated whether the variables and the established model have cross-sectional dependence. In the next sections, the stationarity of the series and a long-term relationship between the variables related to the model are tested. Then, the long-term cointegration coefficients were estimated.

Although there are many methods measuring cointegration analysis in the literature, the Westerlund (2008) test is seen as a newer and more advantageous test compared to other test techniques. Westerlund (2008) developed four different cointegration tests based on structural tests and considering the error correction model. Two of these test techniques show group average statistics, while the other two tests show panel statistics. In addition, this test, which was introduced to the literature by Westerlund (2008), accepts the assumption that the series forming the panel will be stationary in the case of level and first difference I (1) (Westerlund, 2008).

In the Westerlund (2008) test, first of all, the test statistics that make up the panel should be calculated. In order to make this calculation, the models given in the equations below should be estimated directly by the least squares method.

$$\Delta Y_{it}=\delta_i d_t+\lambda X_{it-1}+\sum_{j=1}^{pi}\alpha_{ij}\Delta Y_{it-1}+\sum_{j=0}^{pi}\lambda X_{it-j}+e_t$$

$$\Delta Y_{it-1}=\delta_i d_t\lambda X_{it-1}+\sum_{j=1}^{pi}\alpha_{ij}\Delta Y_{it-1}+\sum_{j=0}^{pi}\lambda X_{it-j}+\varepsilon_t$$

After calculating the test statistics of the models given above with the direct least squares method, the error correction coefficient of the panel and the standard deviation appearing here are calculated respectively.

$$\alpha_i=\left[\sum_{i=1}^{N}\sum_{t=1}^{N}\left(\tilde{Y}_{it-1}\right)^2\right]^{-1}\sum_{i=1}^{N}\sum_{t=2}^{T}\frac{1}{\alpha_{i(1)}}\tilde{Y}_{it-1}\widetilde{\Delta Y}_{it}$$

$$S.E(\alpha_i)=\left[\left(\tilde{S}_N\right)^2\sum_{i=1}^{N}\sum_{t=2}^{N}\left(\tilde{Y}_{it-1}\right)^2\right]^{-\frac{1}{2}}$$

In Westerlund (2008) panel cointegration analysis, test statistics are found as a result of the calculation of the equations in the following equations as the last step.

$$P_t=\frac{\alpha}{S.E(a)}\sim N(0,1)$$

$$P_a=T_a\sim N(0,1)$$

Finally, in Westerlund (2008) cointegration analysis technique, which was calculated in three stages, the H_0 hypothesis indicates that there is no cointegration relationship between the series (α_i=0), while the H_1 hypothesis indicates the existence of a cointegration relationship ($\alpha_i=\alpha<0$).

4. ANALYSIS OF FINDINGS

4.1. Cross-Section Dependency Tests

Various tests have been developed in the literature to analyze the presence of cross-section dependence. In this study, CD_{LM} test

Table 2: Data set and sources used in analysis

Data	Definition	Abbreviation	Period	Source
Energy consumption	Total oil consumption (million tons)	*econ*	1992-2021	World Bank
Gross domestic product	Total gross domestic product (million dollars)	*gdp*		
Foreign direct ınvestment	Total foreign direct capital ınflows (million dollars)	*fdi*		UNCTAD
Energy prices	World oil prices (barrel price)	*ep*		IEA

analysis developed by Breusch and Pagan (1980) and *CD* and CD_{LM2} tests developed by Pesaran (2004) were used in order to test the cross-section dependence. In addition to these tests, the LM_{adj} (bias corrected LM test) test developed by Pesaran et al. (2008) was used. The results of the cross-section dependency tests are given in Table 3. According to the test results, the H_0 hypothesis is rejected at 99% confidence level in the CD_{LM}, *CD* and LM_{adj} tests, and it is concluded that there is a cross-sectional dependence between the series.

4.2. Unit Root Test Results

The CADF unit root test analysis results of the variables in the model are shown in Table 4. In the fixed forum for the variables, it is concluded that the energy consumption is not stable except for Kazakhstan, the economic growth is not stable for the whole country group, the foreign direct investments variable is stable only in Tajikistan, and the energy price variable is stable in Uzbekistan and the Kyrgyz Republic. On the other hand, in fixed and trended forms, while energy consumption is stationary in Kazakhstan, the economic growth variable is not stationary in any country group. Besides, the variable of foreign direct investments is not stable except for Tajikistan. Finally, the energy price variable is not stationary in a constant and trend form for Uzbekistan and the Kyrgyz Republic. According to the CIPS statistical values of the level variables, there is no stationarity in the variables. Therefore, taking the first difference of the series makes the analysis results more reliable.

Table 3: Results of cross-section dependency tests

Cross-section dependency tests	Statistic	*P*-value
CD_{LM} (BP, 1980)	49.093	0.000***
CD (Pesaran, 2004)	8.391	0.000***
CD_{LM2} (Pesaran, 2004)	2.002	0.502
LM_{adj} (PUY, 2008)	3.998	0.000***

***indicates the significance level at 1%.

4.3. Cointegration Test Results

Since there is a cross-sectional dependence between the series in this study, it is important to apply test techniques that are suitable for this situation. In this sense, the "Error Correction Method (ECM)" test analysis, which was introduced to the literature by Westerland (2008), was used. The ECM test results show that according to G_t and G_a statistics with both constant and constant and trend, the hypothesis H_0 (there is no cointegration relationship between the series) should be rejected, and the hypothesis H_1 (there is a cointegration relationship between the series) should be accepted (Table 5). From this point of view, it is revealed that there is a long-term relationship between energy consumption and other variables of the study.

4.4. Estimating Long-Run Cointegration Coefficients

After determining the cointegration relationship between the variables, the long-term cointegration coefficient was estimated with the Common Correlated Effects Mean Group (CCEMG) Estimator suggested by Pesaran (2006). Table 6 shows the results for the overall panel of the CCEMG estimator. According to these findings, while the GDP and foreign direct investments variables representing economic growth were found to be significant at 10% and 5% levels, respectively, the coefficient of the energy prices variable was insignificant.

Table 4: Panel unit root analysis results for variables

Variables	Level		1st difference	
	CADF statistics		CADF statistics	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
lnecon				
Kazakhstan	−3.988**	−3.113*	−5.988***	−4.658**
Kyrgyz Republic	−1.624	−1.838	−2.309	−3.814**
Tajikistan	−2.584	−1.615	−3.064*	−4.990**
Uzbekistan	−1.064	−1.285	−3.256*	−4.849*
CIPS/Panel	−2.645	−1.908	−3.342*	−3.865**
lngdp				
Kazakhstan	−2.230	−1.862	−4.624**	−8.382***
Kyrgyz Republic	−0.463	−1.896	−2.584	−4.585**
Tajikistan	−1.218	−0.086	−3.513*	−4.844**
Uzbekistan	−1.682	−1.240	−3.252	−4.168**
CIPS/Panel	−2.532	0.695	-3.540*	−4.913**
lnfdi				
Kazakhstan	−1.058	−2.018	−8.656*	−3.523**
Kyrgyz Republic	−1.691	−1.961	−3.928**	−1.158
Tajikistan	−4.098**	−3.988**	−4.828**	−6.189***
Uzbekistan	−1.220	−1.186	−4.808**	−3.463**
CIPS/Panel	−2.112	−2.621	−6.365***	−3.936***
lnep				
Kazakhstan	−1.030	−1.915	−3.901**	−8.510***
Kyrgyz Republic	−3.621*	−1.583	−9.131***	−3.901**
Tajikistan	−3.929**	−2.058	−6.386***	−5.985***
Uzbekistan	−1.908	−2.645	−4.189***	−3.844**
CIPS/Panel	−1.896	−1.583	−5.913***	−4.168***

The maximum lag length is taken as 4, and the optimal lag lengths are based on Schwarz determined by the information criterion. *,** and *** indicate significance level at 10%, 5% and 1%, respectively

Table 5: Westerlund (2008) ECM panel cointegration test results

ECM	None		Intercept		Intercept and trend	
H_0: no cointegration	Statistics	Boostrap P value	Statistics	Boostrap P value	Statistics	Boostrap P-value
Gt	4.438	0.031	1.320	0.000	2.775	0.085
Ga	2.735	0.008	1.120	0.001	2.013	0.038
Pt	2.034	0.805	1.120	0.058	3.453	0.007
Pa	2.034	0.153	-4.313	0.034	3.453	0.103

Table 6: Pesaran (2006) CCEMG estimator panel overall results

Variable	Coefficient	P-value
lnfdi	0.0178	0.029**
lngdp	0.4681	0.059*
lnep	0.2591	0.930

*,**indicate 10%, 5% significance levels, respectively.

Table 7: Pesaran (2006) CCEMG estimator ındividual country results

Uzbekistan	Coefficient	P-value
lnfdi	0.0407	0.000***
lngdp	0.3871	0.000***
lnep	−0.1828	0.117
Kazakhstan		
lnfdi	0.0174	0.048**
lngdp	0.1904	0.024**
lnep	−0.2413	0.834
Tajikistan		
lnfdi	−0.0071	0.244
lngdp	0.0900	0.001***
lnep	0.1084	0.914
Kyrgyz Republic		
lnfdi	0.0118	0.137
lngdp	−0.0447	0.342
lnep	0.0402	0.421

Table 8: CCE estimation method significance by country groups

Countries/Variables	lnfdi	lngdp	lnep
Uzbekistan	✓	✓	×
Kazakhstan	✓	✓	×
Tajikistan	×	×	×
Kyrgyz Republic	×	×	×

After determining the cointegration coefficients for the whole panel with the CCEMG estimator, it is important to estimate the individual cointegration coefficients for each of the countries with the same estimator. The results are presented in Table 7. Considering the results of the analysis for Uzbekistan, the coefficient of the economic growth and foreign direct investments variables is significant at the 1% significance level, while the coefficient of the energy prices variable is insignificant. While a 1% increase in foreign direct investments increases the amount of energy consumption by 0.04%, a 1% increase in economic growth causes an increase of 0.38% in energy consumption. The analyzes for Kazakhstan show that, similar to Uzbekistan, the economic growth and direct investments series are significant at 5%, while the energy prices series are meaningless. While a 1% increase in foreign direct investments increases the amount of energy consumption by 0.017%, a 1% increase in economic growth increases energy consumption by 0.19%. In this case, while the effect of direct investments and economic growth series on energy consumption in Uzbekistan and Kazakhstan is proven, the effect of energy prices on energy consumption contradicts the theory. In Tajikistan, only the economic growth series is significant at 1%, while the other two variables are insignificant. A 1% increase in economic growth in Tajikistan increases energy consumption by 0.09%. Finally, the results obtained for the Kyrgyz Republic were found to be insignificant for all three series.

As a result, when the CCE estimator analysis results are evaluated, it is seen that the variable of economic growth as a determinant of energy consumption is significant in Kazakhstan, Uzbekistan and Tajikistan, the series of foreign direct investments is significant in Uzbekistan and Kazakhstan, and it is meaningless in Tajikistan and the Kyrgyz Republic. The results obtained for the Kyrgyz Republic were found to be insignificant for all three series. A brief summary of the results is presented in Table 8.

5. CONCLUSION

This study aims to examine the factors that determine the rapidly increasing amount of energy consumption in the world. In this direction, energy prices, foreign direct investments and economic growth variables were chosen as the determinants of energy consumption in Central Asian (Uzbekistan, Kazakhstan, Tajikistan and Kyrgyz Republic) countries. Data covering the period 1992-2021 were analyzed within the framework of various approaches used in the literature.

The test technique used to determine the cointegration relationship confirmed the cointegration relationship between the series. In other words, there is a long-term relationship between the series discussed in Central Asian countries. After determining the existence of a long-term relationship between the series of the study, the long-term cointegration coefficients were estimated with the Common Correlated Effects Mean Group (CCEMG) Estimator suggested by Pesaran (2006). When the estimation results are evaluated, it is seen that the results differ for each country group. It is seen that the variable of economic growth as a determinant of energy consumption is significant in Kazakhstan, Uzbekistan and Tajikistan, the series of foreign direct investments is significant in Uzbekistan and Kazakhstan, and insignificant in Tajikistan and the Kyrgyz Republic. The results obtained for the Kyrgyz Republic were found to be insignificant for all three series.

Considering all the analyzes made in the study, it is expected that the series of economic growth and foreign direct investment inflows will increase energy consumption, in line with the literature on the subject of the study. In the coming periods, energy will

continue to be an important factor and energy consumption will continue to increase rapidly, especially in developing countries. In this direction, it will be important for countries to determine their renewable energy capacity, to produce policies that increase energy efficiency and energy density, to increase R and D activities in the field of energy, and to encourage the use of domestic resources.

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