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The Effect of Energy Production and Foreign Trade on the Economic Growth of Turkic Republics: A Study Using Panel Data Analysis Method

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ABSTRACT

This study analyzes the impact of energy production and foreign trade on the economic growth of the Turkic Republics using the Panel Data method for the period 2000-2020. Previous scientific studies have shown that many different variables impact economic growth. This study, unlike others, focuses on the effect of energy production and foreign trade volume on economic growth. The findings showed that energy production affects the economic growth of Turkic Republics. Another important finding is that the effect of foreign trade volume on economic growth is not significant when exports and imports are considered together. This is noteworthy as it shows that energy production invariably has a significant impact on the economic growth of a country. In other words, it would be a beneficial approach for a country to give importance to energy production to increase economic growth.

Keywords: Panel Regression Analysis, Turkic Republics, Economic Growth, Foreign Trade, Energy Production
JEL Classifications: C13, C20, C22

1. INTRODUCTION

Kazakhstan, Azerbaijan, Kyrgyzstan, Uzbekistan, and Turkmenistan gained their independence in 1991 after the dissolution of the USSR and entered a new era of political and economic life. Following the independence, each country initiated restructuring its economy and trade to adapt to global markets. They considered their internal dynamics and their overall aim was to ensure prosperity and development. This economic restructuring process is called the "transitional period/transitional economy" in the literature (Niyetalina et al., 2023). Even though they followed different strategies, their common denominator was that all of their economic development strategies were concentrated on exporting essential products such as natural resources and raw materials. Oil and natural gas for Kazakhstan and Azerbaijan, natural gas for Turkmenistan, and gold, oil, and natural gas resources for Uzbekistan have a critical place in foreign trade. Kyrgyzstan was unlucky in natural resources such as oil, natural gas, gold, and other minerals. Hence remittances sent by workers working in foreign countries, especially in Russia, have gained importance for national income and economic growth. The difficulties brought by the 32-year restructuring period were followed by global economic crises (1998 Asian crisis; 2007-2008 global crisis; Covid-19). Despite all the negativities, these five Turkish Republics are in a much better situation in terms of welfare level, national income, economic growth, foreign trade, development, and so on compared to 30 years ago. The positive results of economic restructuring began to be seen by the early 2000s and these countries have

achieved rapid economic growth (Kasım, 2022; Syzdykova, 2019). However, since the revenues of these countries generally depend heavily on oil and natural gas exports, their economies are directly affected by fluctuations in oil and natural gas prices.

1.1. Kazakhstan

Kazakhstan declared its independence on December 16, 1991, and, like other former Soviet countries, made major structural reforms to transition to a free market economy (Taibek et al., 2023; Bekzhanova et al., 2023). Kazakhstan's natural resources eased this painful transition process (Kazakhstan has approximately 3% of the world's total oil reserves, approximately 1.1% of natural gas reserves, and approximately 3.3% of coal reserves, and ranks second in the world in terms of uranium reserves.) (Mudarissov and Lee, 2014; Xiong et al., 2015; Bolganbayev et al., 2021; Kelesbayev et al., 2022a; Mashirova et al., 2023; Sartbayeva et al., 2023; Husnain et al., 2024). Kazakhstan's rich natural energy resources make it an attractive country for foreign direct investments. Kazakhstan has a remarkable position among other developing countries with the economic growth it has achieved thanks to the reforms and investments it has made in the 32 years since its independence (Sabenova et al., 2023; Dyussembekova et al., 2023; Issayeva et al., 2023; Mukhtarov et al., 2020; Kelesbayev et al., 2022b). Kazakhstan has the highest GDP in the CIS after Russia (Syzdykova, 2022).

1.2. Azerbaijan

Azerbaijan declared its independence on October 18, 1991, and, like Kazakhstan, made major structural reforms to transition to a free market economy (Rzali, 2022). The problems brought by these reforms were exacerbated by the major social and economic problems caused by the occupation of Nagorno-Karabakh by Armenia. Azerbaijan has the richest oil and natural gas resources among the Turkic Republics after Kazakhstan. Azerbaijan has 7 billion barrels of oil reserves (17.5 billion according to SOCAR), corresponding to 0.6% of the global reserves, and 2.5 trillion cubic meters of natural gas reserves. Oil provides great commercial income and plays an important role in the performance of both the country and the regional economy, therefore it contributes significantly to the development of Azerbaijan (Süleymanov and Hasanov, 2013; Şahin and Konak 2019).

1.3. Kyrgyzstan

Kyrgyzstan, which gained its independence on August 31, 1991, is the smallest country in Central Asia and lacks natural resources such as oil and natural gas. It is the first among the Turkic Republics to issue its national currency and to join the World Trade Organization as a member. Like other former Soviet countries, Kyrgyzstan has implemented major structural reforms to overcome economic instability and ensure economic growth. Since it does not have natural resources such as oil and natural gas, the country is in a worse economic situation than other Turkic Republics (Syzdykova, 2022). 90% of Kyrgyzstan's energy production is based on hydroelectricity and is sensitive to the negative effects of seasonal weather changes. It is the country with the lowest GDP rate among the Turkic Republics (Köse, 2020).

1.4. Uzbekistan

Uzbekistan declared its independence on 31 August 1991 and, like other Turkic republics, launched a radical reform program to overcome economic instability and expand its economy. Although Uzbekistan does not have rich natural gas and oil deposits like Kazakhstan, Azerbaijan, and Turkmenistan, it has much more natural resources than Kyrgyzstan (Putz, 2017). Uzbekistan, which has significant potential in terms of oil, natural gas, and coal, also has an important position in gold and uranium production (Köse, 2020). The economic difficulties experienced after independence began to ease in the 2000s with the structural reforms. Uzbekistan's cooperation with international organizations such as the IMF, the World Bank, and the European Bank for Reconstruction in recent years has relieved the country financially (Syzdykova, 2022).

1.5. Turkmenistan

Turkmenistan gained its independence on October 27, 1991, following the collapse of the Soviet Union, and, like other Turkic Republics, initiated structural economic reforms to overcome instability (Turan and Dinç, 2015) and ensure economic growth. Moving towards a free market economy, Turkmenistan, on the one hand, removed price controls on some goods and allowed the establishment of private farms, and on the other hand, tried to restructure the financial system. Furthermore, it took steps for monetary policy and privatization to attract foreign capital (Syzdykova, 2022). Turkmenistan's rich natural gas (4th in the world) and oil deposits have helped the country achieve the desired economic growth targets (Halbayev, 2019; Köse, 2020).

Although there are different definitions and the subject of intense debate, economic growth is generally used to mean an increase in the level of production and an increase in national income per capita (Nafziger, 2006). Economic growth is affected by many factors, including government policies, political instability, domestic capital structure, human capital, banking and financial infrastructure, foreign trade policy, foreign direct investment, energy production, and consumption (Sandalcilar, 2012). Therefore, this study analyzed the impact of energy production and foreign trade on the economic growth of five Turkic Republics (Kazakhstan, Azerbaijan, Kyrgyzstan, Uzbekistan, and Turkmenistan) that gained independence after the collapse of the USSR. The Panel Data method was used for the period 2000-2020. The electric energy generation was used as a proxy for energy production data. Research data was retrieved from https://www.imf.org/, https://ourworldindata.org/and https://datacatalog.worldbank.org/.

2. LITERATURE REVIEW

Many studies have focused on the different dimensions of the economies of Kazakhstan, Azerbaijan, Kyrgyzstan, Uzbekistan, and Turkmenistan, which are economically and culturally similar. Here, we will only touch upon the main ones relevant to our subject.

Bolganbayev et al. (2021) published a study titled "The Effect of Oil Prices on the Economic Growth of Oil Exporting Countries Bordering the Caspian Sea: Panel Data Analysis". They analyzed

the effect of Brent crude oil price changes on the economic growths and energy securities of Russia, Iran, Kazakhstan, and Azerbaijan with panel data analysis using the quarterly data from the 2007-2020 period. The research concluded that variability in oil prices affects economic growth.

Durucan and Kutval (2017) published a study titled "The Effects of Energy Production and Export Increase in the Caspian Region on Growth: The Example of Azerbaijan, Turkmenistan, and Kazakhstan". They studied the energy production and export development of Azerbaijan, Kazakhstan, and Turkmenistan, which are all located in the Caspian region and are important countries of the Turkic World, between 1996 and 2015; and they analyzed the energy sector, as one of the determinants of economic growth, using the Panel Data Analysis method. While the analysis found that an increase in oil production increased GDP by 28%, it found no relationship between an increase in natural gas production and GDP. They explained this with the fact that although there has been no stable increase in natural gas production over the years, GDP is constantly increasing.

Freidin and Burakov (2018) published an article titled "Economic Growth, Electricity Consumption, and Internet Usage Nexus: Evidence from a Panel of Commonwealth of Independent States. To determine the effects of economic growth and internet usage on electricity consumption, they used panel data of the members of the Commonwealth of Independent States for the period between 1991 and 2017. Using the panel unit root test, panel cointegration test, pooled mean group regression technique, and Dumitrescu-Hurlin panel Granger causality test, they analyzed the long and short-term effects on consumption. They found that internet usage affects electricity consumption in the long term, while economic growth affects electricity consumption both in the short and long term. Panel causality test results proved the effect of internet usage and economic growth on electricity consumption.

Koç and Saidmurodov (2018) published an article titled "The Relationship between Electric Energy, Foreign Direct Investment and Economic Growth in Central Asian Countries." They analyzed the relationship between electric energy generation, foreign direct investment, and economic growth of the Central Asian Republics (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) using the panel data method and data for the period 1992-2014. They found a one-way causality relationship heading from FDI to economic growth and energy consumption, but no causality heading from economic growth and electric energy consumption to FDI.

Syzdykova (2019) published an article titled "The Relationship between Human Capital and Economic Growth in Central Asian Turkic Republics." The author analyzed the relationship between human capital and economic growth using panel Pedroni cointegration and panel FMOLS tests specifically for Central Asian countries for the period 1991-2016. The study found a significant relationship between human capital and economic growth variables in Central Asian countries.

Bayraç and Çemrek (2019) published an article titled "Causal Relationship between Energy Production and Economic Growth in the Caspian Region and Dutch Disease: The Case of Azerbaijan, Kazakhstan, and Turkmenistan." They analyzed the causal relationship between oil production (kg) per capita and GDP per capita using annual data between 1990 and 2016. For Azerbaijan, they found a one-way causality relationship heading from GDP to oil and that economic growth will lead to oil production. For Kazakhstan, they found that economic growth will lead to oil production, and economic growth will cause oil production. For Turkmenistan, they found a one-way causality heading from oil to GDP and that oil production would lead to economic growth.

Şahin and Konak (2019) published an article titled "Dynamics of Growth, Energy and Foreign Trade in the Sample of Turkey and Azerbaijan." They analyzed the impact of energy imports/exports and foreign trade on growth in the sample of Turkey and Azerbaijan in the 1995-2016 period, using cointegration, the Vector Error Correction Model, and causality methods. They found, in both countries, long- and short-term interactions between variables, unidirectional and/or bidirectional causal relationships, and all variables act together. They concluded that the growth dynamics in the Turkish economy are based on exports, while in Azerbaijan they are based on imports.

In 2023, Mashirova et al. published an article titled "Analysis of the Relationship between the Highest Price and Trading Volume of Energy Company Shares in Kazakhstan with Frequency Analysis." The study examined the correlation between the highest price formation and transaction volume of energy company stocks traded in the Kazakhstan Stock Exchange (KASE), which is an important economic and natural resource hub among the Turkic Republics. The study used the Granger Causality Analysis method and data between January 01, 2021 and January 31, 2023. They observed three different situations in terms of causality between the highest price formation and transaction volume and detected a two-way causality relationship for KEGC and only a one-way causality relationship for KZTO. They didn't detect any causal relationship for KZAP.

Sari et al. (2017) published a study titled "The Effects of Exports and Imports on Economic Growth: The Case of Central Asian Economies." They analyzed the impact of international trade on growth in Kazakhstan, Kyrgyzstan, Turkmenistan, Uzbekistan, and Azerbaijan using the panel data method. They found that exports and capital accumulation have a positive effect on growth.

Osintseva (2022) analyzed the effect of oil prices on economic growth in oil-exporting countries in the 2005-2019 period using statistical regression methods in an article titled "Influence of Oil Factor on Economic Growth in Oil-exporting Countries." Their sample consisted of major oil-exporting countries, including OPEC members (Iraq, Iran, Libya, Saudi Arabia, and Nigeria), and others (Russia, Kazakhstan, Azerbaijan, and Norway). The research found that the correlation between oil price fluctuations and economic growth increases with the scale.

Yet again Niyetalina et al. (2023) analyzed the relationship between energy production from renewable resources and inflation using the VAR method within the framework of the Taylor rule

for Kazakhstan and in the period 2000-2021 in an article titled "The relationship of energy generation from fossil fuels, low carbon resources, and renewable resources and inflation within the framework of Taylor's rule: The case of Kazakhstan." According to the research, interest levels impact inflation and follow Taylor's Fundamental Rule. There is a noticeable correlation between energy production and inflation in Kazakhstan, where energy production from fossil fuels increases inflation, while energy production from renewable and low-carbon sources decreases it. They also observed that the relationship between inflation and energy production is not causal.

Bekzhanova et al. (2023) analyzed the relationship between gold and oil prices, and the stock market returns of Kazakhstan energy companies during the COVID-19 pandemic period (January 01, 2020 to December 31, 2021) and the post-pandemic period (January 01, 2022 to March 31, 2023). They used Granger causality analysis and reported their findings in the article named "The Relationship between Gold and Oil Prices and the Stock Market Returns of Kazakh Energy Companies: Comparison of the Pre-COVID-19 and Post-COVID-19 Periods," published in 2023. They found that the gold returns in international markets have a causal effect on KZAP both during the pandemic period and in the post-pandemic period, while the oil returns have a causal effect on KZAP only during the pandemic period. They also found no causal effect of the international market on KEGC and KZTO returns.

Rasoulinezhad and Saboori (2018) analyzed the long-term and causal relationships between economic growth, CO_2 emissions, renewable and non-renewable (fossil fuels) energy consumption, Composite Trade Intensity (CTI), which is a measure of trade openness, and the Chinn-Ito index, which represents financial openness, using the Panel Data Analysis. Their analysis covers the Commonwealth of Independent States (CIS) region that consists of Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan and the period 1992-2015. They found evidence of a bidirectional long-term relationship between all variables in 12 CIS countries, but this was not the case for the relationship between economic growth and renewable energy usage. They found a unidirectional short-term panel causality moving from economic growth, financial openness, and trade openness to CO_2 emissions and from renewable energy use to fossil fuel energy consumption.

Sartbayeva et al. (2023) published an article called "The Relationship between Energy Consumption (Renewable Energy), Economic Growth and Agro-industrial Complex in Kazakhstan." They analyzed the relationship between energy consumption (renewable energy), economic growth, and developments in the agricultural industrial complex (agricultural and livestock output) and the interaction of these factors for Kazakhstan from 1991 to 2021. The research examined the impact of agricultural industry assets and developments in the agricultural industry on energy consumption using a hierarchical regression analysis approach. They found that developments in the agricultural industry impact energy consumption, especially renewable energy consumption.

Singh et al. (2019) conducted a study on the relationship between renewable energy production and economic growth in 20 developed and developing countries from 1995 to 2016. The researchers used the Panel Data Analysis method to examine the factors that affect both variables. They presented their findings in the article titled "Renewable Energy Development as a Driver of Economic Growth: Evidence from Multivariate Panel Data Analysis." They found that renewable energy production has a positive and statistically significant impact on economic growth in both developed and developing countries and that this impact is higher in developing economies than in developed economies.

In their article titled "The Linkage between Economic Growth, Renewable Energy, Tourism, CO_2 Emissions, and International Trade: The Evidence for the European Union," Leitão and Lorente (2020) conducted a Panel Data Analysis to examine the relationship between economic growth, renewable energy, tourism arrivals, trade openness, and carbon dioxide emissions in the European Union (EU-28). They found that trade openness and renewable energy reduce climate change and environmental degradation, economic growth impacts carbon dioxide emissions positively, and tourist arrivals correlate negatively with carbon dioxide emissions.

3. METHODS

Panel data consists of N units, called cross-sections, and time series data consisting of t periods for each unit. A balanced panel data set contains a total of N×T observation units in a panel data set where T is the time-period (t= 1, 2., T) and N is the number of units (i = 1, 2., N). Since the panel data method uses both time series and cross-sectional data, it provides the opportunity to benefit from more extensive data. It delivers the possibility to analyze the effect of both variables observed as time series and units as cross-sectional data on the dependent variable. Since analyses conducted with only cross-sectional data or time series cannot control heterogeneity, estimates harbor a bias risk. Panel regression analysis, on the other hand, gives more reliable results by reducing the linearity between variables (Baltagi, 2008).

There are two methods in panel regression analysis: the fixed effect model and the random effect model. If the regression coefficients are assumed to vary according to units or units and time, the preferred model is the fixed effect model; if it is assumed that there are different trends for each cross-sectional unit and that the trends remain constant throughout the analysis period, the preferred model is the random effects model. In its general form, the fixed effects model is expressed with the following equation (Judge, 1985):

$$y_{it} = \overline{\beta} + \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + ... + \beta_k X_{kit} + \varepsilon_{it} \left(t = 1,2,...,T; i = 1,2,...,N\right) \quad (1)$$

while the random effects model is expressed with the following equation (Wooldridge, 2009):

$$y_{it} = \beta_0 + \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + ... + \beta_k X_{kit} + \varepsilon_{it} \left(t = 1,2,...,T; i = 1,2,...,N\right) \quad (2)$$

In panel data regression, the Hausman Test is used to decide the method. Hausman test is one of the methods employed to choose between a random-effect model and a fixed-effect model (Green, 2003). The null hypothesis is that the random effects model is appropriate. The Hausman test statistic shows the chi-square distribution with k degrees of freedom under the null hypothesis of "Random effects estimator is correct" (Baltagi, 2008).

Panel data analysis examines the cross-sectional dependence in the first step for the stationarity of the series. Depending on the result, either the first-generation or second-generation unit root test method is selected. The first step is cross-section dependence: when the number of time series periods (T) is greater than the number of cross-section units (N) (T>N), it is examined with Berusch and Pagan (1980) LM test and Peseran, Ullah and Yamagata (2008) $LMadj$ tests, when it is small (T<N) is examined with Pesaran (2004) $CDLM$ test (T<N) and Peseran (2004) CD test. Common to all of these methods is that the null hypothesis is "$H0$: There is no cross-section dependence". In the second step, first-generation panel unit root tests are applied and if there is a cross-sectional dependence, second-generation panel unit root tests are applied (Baltagi, 2008).

Among the first-generation unit root tests used in the absence of cross-section dependence, the most commonly used ones are Levin, Lin and Chu (2002), Breitung (2005), Hadri (2000), Maddala and Wu (1999), Im et al., (IPS, 2003), and Choi (2001). Common second-generation unit root tests are Bai and Ng (2004), Taylor and Sarno (MADF, 1998), Breuer et al., (SURADF, 2002), Pesaran (CADF; 2006, 2007) and Carrion-i Silvestre et al. (PANKPSS, 2005).

4. FINDINGS

Turkic republics can be considered similar in terms of being in the same geography and achieving independence through similar processes, and socioeconomic structures. Therefore it is a prospective area for future studies to investigate the impact of energy production and foreign trade volumes on economic growth in the Turkish republics. The study used electricity production as the proxy for energy production and foreign trade is expressed as a percentage of the economic size. Economic growth is expressed as increases in it. The variables used in the research, their descriptions, and country codes are given in Table 1. The expressions in parentheses show the first difference of the variables.

Table 1: Research variables and descriptions

Code	Country	Variable	Description
AZE	Azerbaijan	X161 (d×161)	Electricity generation (TWh)
KAZ	Kazakhstan	X162 (d×162)	Foreign trade (% of GDP)
KGZ	Kyrgyzstan	Y161 (dy161)	Gross domestic product; constant prices - Percent change
TKM	Turkmenistan		
UZB	Uzbekistan		

Country codes are written following international notation used in the World Bank database. Research data are retrieved from https://www.imf.org/ (Accessed on 10.07.2023), https://ourworldindata.org/ (Accessed on 12.07.2023) and https://datacatalog.worldbank.org/ (Accessed on 14.07.2023). The selected period is 2000–2020 and the data is annual.

This study first provides individual and general descriptive statistics and graphs of each variable by country. In the second step, the stationarity of the data was examined by applying panel unit root tests. In the last step, the effect of energy production and foreign trade on economic growth in the Turkish republics was examined using a panel regression model, and finally, the findings were interpreted.

Table 2 provides descriptive statistics regarding electricity production in the Turkish republics. As can be seen in the table, according to both average and median values, the highest production is in Kazakhstan and Uzbekistan, and the lowest production is in Kyrgyzstan and Turkmenistan. In addition, skewness and kurtosis coefficients show that the data for each country comply with normal distribution.

Graph 1 shows the time path chart for energy production in the Turkish republics. The graph shows an increasing change for Kazakhstan, unlike other countries.

Table 3 provides descriptive statistics regarding foreign trade in the Turkic republics. As can be seen in the table, the highest foreign trade volume is in Kyrgyzstan and the lowest is in Uzbekistan, according to both average and median values. Additionally, skewness and kurtosis coefficients show that each country's data is distributed under a normal distribution.

The time-path chart of the foreign trade data of the Turkic Republics is given in Graph 2. It is noteworthy that the foreign trade volume was high in Turkmenistan and Kyrgyzstan between 2008 and 2014, while there was a downward trend in Uzbekistan in the same period. There is a downward movement in Kazakhstan, albeit weak.

Graph 1: Time path graph for X161

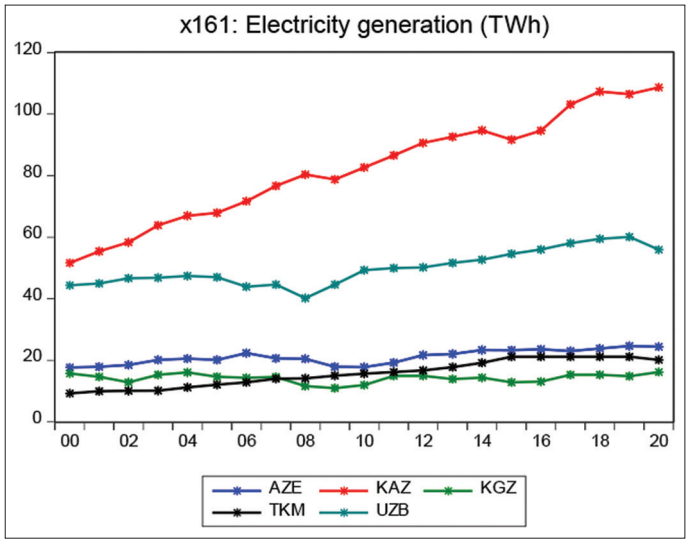


Table 2: Descriptive statistics for X161

Code	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
AZE	21.0786	20.6500	24.6000	17.6500	2.3410	−0.0871	1.6830
KAZ	82.3967	82.6500	108.6400	51.6400	17.4709	−0.1426	1.9399
KGZ	14.1952	14.6400	16.1700	10.9200	1.4719	−0.7769	2.6148
TKM	15.7191	15.6600	21.1800	9.2500	4.3117	−0.0259	1.5942
UZB	49.9148	49.2700	60.1100	40.2000	5.6780	0.3347	2.0371
ALL	36.6609	21.1800	108.6400	9.25000	27.7000	1.0753	3.0106

Table 3: Descriptive statistics for X162

Code	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis
AZE	87.6895	85.8182	121.5071	69.4832	14.8098	0.8326	2.7536
KAZ	78.0405	74.1383	105.6997	53.0497	16.4296	0.0512	1.5528
KGZ	110.6471	105.8236	146.1061	73.7469	22.6743	0.0495	1.5831
TKM	74.7517	63.7047	111.0628	35.1597	23.9009	0.1272	1.5806
UZB	57.2698	58.9545	79.7480	29.1923	15.6700	-0.2994	1.8235
ALL	81.67971	78.81519	146.1061	29.19230	25.67967	0.341227	2.782628

Table 4: Descriptive statistics for Y161

Code	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis
AZE	7.6880	5.8430	34.4660	−4.1990	10.1130	1.3906	4.1795
KAZ	6.0762	5.8990	13.4990	−2.6000	4.0400	−0.2529	2.3866
KGZ	3.7837	4.3360	10.9150	−8.6170	4.1173	−1.1357	5.1552
TKM	8.6873	10.9670	20.3910	−3.3890	7.5287	−0.1532	1.6824
UZB	6.2855	7.0000	9.5000	1.9960	1.8944	−0.4785	2.5914
ALL	6.5041	5.9320	34.4660	−8.6170	6.3595	1.3578	7.0187

Table 5: Correlation coefficient findings for research variables

	X161	X162	Y161
X161	1	−0.397**	−0.132
X162	−0.397**	1	0.163
Y161	−0.132	0.163	1

**Correlation is significant at the 0.01 level (2-tailed)

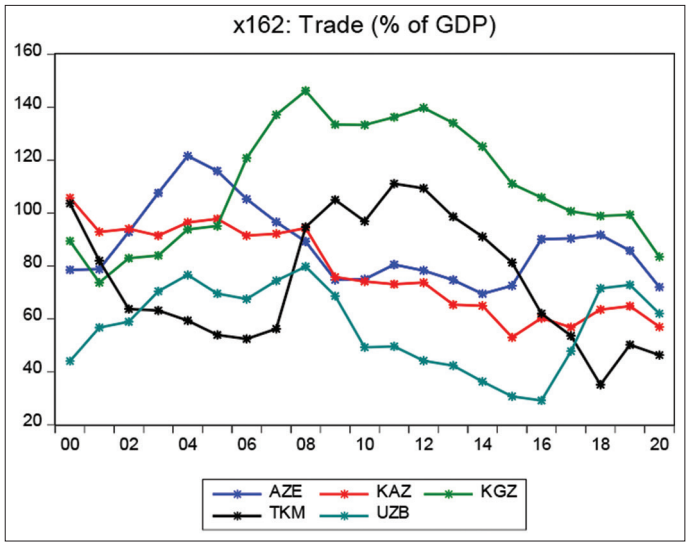
Table 6: Cross-sectional dependence and unit root test findings of research data

Variable	Cross-section dependence		Level		1st difference	
	Statistic	Prob,	Statistic	Prob,	Statistic	Prob,
X161	92.1978	0.0000	12.7899	0.2357	25.1959	0.0050
X162	38.1927	0.0000	11.2510	0.3383	24.0541	0.0075
Y161	35.4962	0.0001	21.4493	0.0182	41.8842	0.0000

Descriptive statistics regarding the changes in GDP in the Turkic republics are given in Table 4. During the analysis period, the highest average change occurred in Turkmenistan and the lowest change occurred in Kyrgyzstan. The average annual increase in Kazakhstan was 6.08%. Furthermore, although the kurtosis coefficient is high in Azerbaijan and Kyrgyzstan, the skewness coefficients show that each country's data comply with normal distribution.

The time path chart of annual GPD change in the Turkic republics is given in Graph 3. The graph shows a significant increase for Azerbaijan between 2005 and 2007. The graph also shows that the general outlook follows a positive and stable path, but there is a decreasing outlook for Turkmenistan.

Graph 2: Time path graph for X162



The correlation coefficient findings for the research variables are given in Table 5. When the data from the five countries are taken together, there is a statistically significant and negative relationship between energy production and foreign trade volume. There was no statistically significant relationship between energy production and economic growth, or between foreign trade and economic growth.

Cross-sectional dependency and unit root test findings for the research data are given in Table 6. Cross-sectional dependence was examined using the Breusch-Pagan LM test and there was cross-sectional dependence in all three variables. For this reason,

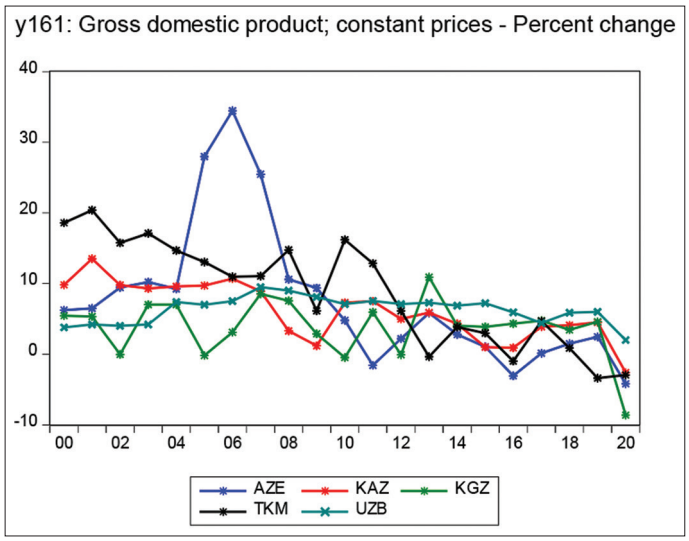
Table 7: Analysis findings of the research model

Variable	Coefficient	Standard Error	t-Statistic	Prob,
Fixed	−0.791677	0.450547	−1.757147	0.082
d×161	0.281562	0.098658	2.853936	0.005
d×162	0.054228	0.043298	1.25244	0.213
Hausman test: Chi-square (2) =0.3304; P=0.8477				
R-squared	0.2366		F-statistics	3.3801
Adjusted R-squared	0.0592		Probability (F-sta.)	0.0375
D.W. Statistics	2.3130			

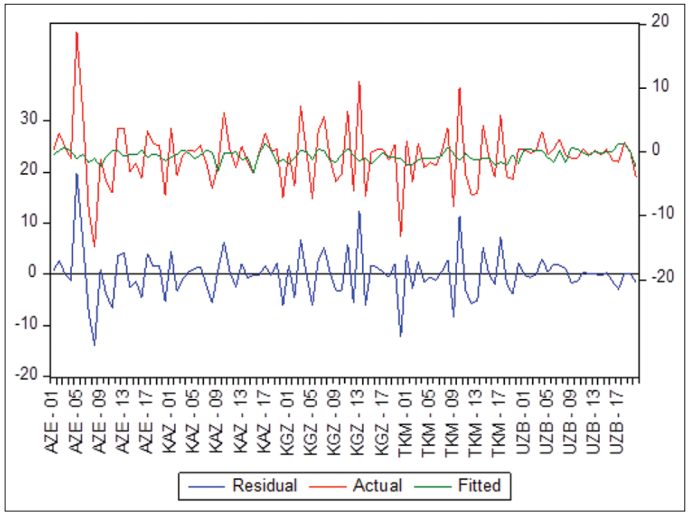
Table 8: Country effects according to the panel regression model

	Code	Effect
1	AZE	0.240597
2	KAZ	−0.66972
3	KGZ	0.171581
4	TKM	−0.26546
5	UZB	0.522996

Graph 3: Time path graph for Y161



Graph 4: Graph of predicted, residual, and observed values of the research model



the CADF test method was used as the second-generation unit root test to examine stationarity. The CADF test showed that the variable Y161 was stationary at level and the variables X161 and X162 were stationary at first difference.

The analysis findings of the research model are in Table 7. First, the Hausman test was used to determine whether the fixed or random effect model was appropriate. Following the findings, the random effect model was deemed to be more appropriate. The F-test proved the model to be statistically significant. The D.W. statistic shows that there is no autocorrelation between the residuals. Coefficient findings showed that energy production had a statistically significant and positive effect on economic growth, while foreign trade volume, although positive, was not statistically significant. According to the adjusted R-square value, energy production, and foreign trade volume explain 5.9% of the variability in economic growth.

The findings show that energy production has a positive effect on economic growth. The effect of foreign trade is found to be statistically insignificant.

The graph of predicted, residual, and observed values of the research model is given in Graph 4. The most successful results were obtained for Uzbekistan data, both in terms of the low difference in observed-predicted values and the small residual values in terms of absolute value.

Country effects according to the panel regression model are given in Table 8. The country effect estimate for Kazakhstan and Turkmenistan appears to be negative. Accordingly, for the regression estimation, the cut-off point value is lower for these two countries.

5. CONCLUSION AND RECOMMENDATIONS

This study examined whether energy production and foreign trade volume affect economic growth and, if so, to what extent this effect extends, using data obtained from the Turkish republics. Previous scientific studies have shown that many different variables impact economic growth. This study, unlike others, only focuses on the effect of energy production and foreign trade volume on economic growth. The findings showed that energy production affected the economic growth of Turkic Republics for the period 2000-2020. Another important finding is that the effect of foreign trade volume on economic growth is not significant when exports and imports are considered together. This is noteworthy as it shows that energy production invariably has a significant impact on the economic growth of

a country. In other words, it would be a beneficial approach for a country to give importance to energy production to increase economic growth.

As just mentioned, many variables impact economic growth. Future studies may analyze the effect of energy production on growth from a different perspective by including macroeconomic data such as industrial production, developments in the agricultural economy, and developments in the field of transportation among these variables.

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