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The Relationship between Energy Consumption, Agricultural and Industrial Production, and Economic Growth: ARDL Border Value Approach in the Case of Kazakhstan

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ABSTRACT

This study analyzes the impact of energy consumption and industrial and agricultural production on economic growth between 2000 and 2022 in Kazakhstan using the autoregressive distributed lag method. The research findings determined that all three variables affect the economic growth of Kazakhstan. Another important finding is that, within the framework of the variables included in the analysis, the model shows that after a shock, the economic structure will recover and regain its footing in a short period, such as 1.5 years. Therefore this study provides important information to Kazakh decision-makers and gives confidence in the solidity of the country's economic structure. The study employs a model that includes industrial production and agricultural production, along with energy consumption on economic growth, as only one variable (index variable). As well known, production and trade as fields of economic activity can also be taken separately. Therefore they can be included in the model separately and their individual effects on GDP can be analyzed. By carrying out studies in this manner, we can identify the determinants of the Kazakh economy and use sample applications to analyze the dynamics of economic growth in general.

Keywords: Kazakhstan, Energy Consumption, Agricultural Production, Industrial Production, Economic Growth, Autoregressive Distributed Lag
JEL Classifications: C13, C20, C22

1. INTRODUCTION

Kazakhstan declared its independence on December 16, 1991, following the dissolution of the USSR, and carried out noteworthy structural reforms towards the transition to a free market economy to overcome economic difficulties in this turbulent environment (Taibek et al., 2023; Bekzhanova et al., 2023; Yesbolova et al., 2024). During this period, Kazakhstan implemented various practices like introducing its currencies, ensuring price stability, keeping inflation under control, encouraging free entrepreneurship through privatizations, and implementing monetary and financial reform policies. This has been a long and painful process (Kasım, 2022; Sultanova et al., 2024). The economic reforms that were rapidly implemented caused problems, however, these subsided in the 2000s. As a result, Kazakhstan gained attention for its economic achievements among the states that gained independence after the USSR (Xiong et al., 2015; Myrzabekkyzy et al., 2022; Bolganbayev et al., 2021; Dyussembekova et al., 2023). In the 33 years since Kazakhstan's independence, the Kazakhstan economy has faced four major global crises. The crisis in the early 1990s, which led to the dissolution of the USSR, was the first of these. Negative consequences for Kazakhstan ended in

1998. However, the 1998 Asian crisis had also negatively affected the Kazakh economy. Kazakhstan's economy has managed to overcome the recent economic challenges, which include the 2007–2008 global economic crisis caused by the West and the COVID-19 pandemic's economic fallout. The country's economy strengthened by structural reforms, helped it to overcome these crises (Özdil and Turdalieva, 2015). The main factors that enabled Kazakhstan to overcome these global crises are the structural reforms in the economic field and the rich natural resources that Kazakhstan has (oil, coal, natural gas, etc.) (Mudarissov and Lee, 2014; Xiong et al., 2015; Myrzabekkyzy et al., 2022; Bolganbayev et al., 2021; Mashirova et al., 2023; Issayeva et al., 2023).

Nowadays, due to the fast advancements in technology, the energy requirement for production processes has increased significantly. Apart from the use of energy in the manufacturing process, the energy demand has also risen due to its consumption in other domains like heating, transportation, and lighting. As a result of the high energy demand, countries that lack energy resources or have limited access to them have been adversely affected and have become reliant on energy-provider countries (Şahin and Konak, 2019). Kazakhstan is a big energy producer, with 102 power plants, and has the largest installed power production capacity in Central Asia (Koç and Saidmurodov, 2018).

Kazakhstan has very rich fossil energy resources and also has great renewable energy potential such as wind energy, geothermal energy, solar energy, hydroelectricity, and biofuel (Xiong et al., 2015; Ongarova, 2018; Taibek et al., 2023; Sabenova et al., 2023; Niyetalina et al., 2023). Despite this wealth, Kazakhstan meets 75% of its total energy production from coal power plants and is largely dependent on fossil fuels in energy production. Kazakhstan is one of the leading countries in the world in terms of greenhouse gas emissions relative to GDP (Syzdykova, 2020). Therefore, Kazakhstan must shift towards renewable energy sources to promote environmental sustainability and diversify its energy resources. Renewable energy sources have immense potential and can play a significant role in the country's sustainable development. The administration of Kazakhstan has implemented new policies to promote the use of renewable energy sources and diversify energy resources. As a result, the production of renewable energy sources such as HEPP, wind, biogas, and solar power plants has increased significantly. In the first quarter of 2020, the production was 1470 million kWh, whereas in the first quarter of 2021, it increased to 2005.5 million kWh. In addition to fossil fuels and renewable energy sources, Kazakhstan also has a significant nuclear energy production potential due to its uranium mines (Smagulova et al., 2023).

Kazakhstan is the ninth largest state in the world with a 2,724,900 km2 surface area. But 40% of Kazakhstan's territory is desert, 23% is semi-desert, 20% is steppe, 7% is forest, and 10% is mountains (Timor et al., 2018). Kazakhstan is a country dominated by a continental climate with a diverse land structure consisting of vast plains and mountains. Kazakhstan is very rich in pastures that are indispensable for animal husbandry. According to Liang et al. (2020), grasslands cover 67.53% of the entire land area in the country. Before the dissolution of the USSR, Kazakhstan was a major producer of agriculture and livestock within the union. However, after gaining independence and investing in energy resources, the agriculture and livestock sectors took a back seat. Over the years, the ratio of the agriculture and livestock sector in GDP has decreased. However, with the introduction of technological innovations and agricultural regulations, production in this sector has increased in recent years (Timor et al., 2018; Sartbayeva et al., 2023). It is worth noting that the agriculture and livestock sector is Kazakhstan's third largest export item, following the energy (oil, natural gas) and mining sectors. The total share of grain, cotton, milk, and tobacco product exports in the country's total exports is 2.3% as of 2017 (Delice, 2019).

Economic growth is a term used to describe the increase in production levels of a country and per capita national income rate (Nafziger, 2006). It is also associated with the rise in the level of welfare. Economic growth is influenced by various factors such as political stability, government policies, human capital development, domestic capital structure, foreign trade policy, banking and financial infrastructure, energy production and consumption, foreign direct investment, and more. Therefore it is affected by many factors that determine economic growth (Neelankavil et al., 2012; Sandalcılar, 2012).

Energy consumption and agricultural and industrial production are important factors that directly affect the economic growth of a country. This study analyzed the effects of these factors on Kazakhstan's economic growth using the autoregressive distributed lag (ARDL) Boundary Value Approach.

2. LITERATURE REVIEW

The literature is full of studies on different dimensions of the Kazakhstan economy, which stands out with its performance among post-USSR countries. Since it is not possible to list them all here, we will only include the important ones for our topic.

The study conducted by Sarkhanov and Huseynli in 2022, performed an econometric analysis to examine the relationship between renewable energy consumption and economic growth in Kazakhstan and Kyrgyzstan. The data for the period between 1996 and 2018 was used. The study applied regression analysis after the variables, including economic growth and renewable energy consumption, underwent a series of assumption tests. The results revealed a positive correlation between economic growth in both countries and the amount of renewable energy consumed.

Taibek et al. (2023) analyzed the impact of oil and energy production on education and health expenditures in Kazakhstan using the ARDL method. They found that oil and natural gas production affects the health and education expenditures of the government and that this effect is valid both in the long and short term. Furthermore, the ARDL method revealed that oil and natural gas production affects people's health expenditures in the short term, but not in the long term.

Smagulova et al. (2023) used econometric modeling to determine the impact of electricity generation and digital farms on agricultural production in Kazakhstan and to identify patterns. They found that the digitalization of the energy and agro-industrial sectors contributes to economic growth and recommended encouraging the construction of new environment-friendly energy facilities and adopting measures to increase alternative energy investments.

Yılmaz and Şen (2018) focused on the relationship between economic growth, financial development level, and energy consumption in Turkey. They analyzed the relationship between fossil energy consumption (%), financial development (%), and GDP in Turkey's 1980–2014 period with the ARDL (Distributed Lag Autoregressive Model) bound test. Their findings showed a positive and significant relationship between fossil energy consumption, financial development, and national income in the long term. They found that a 1% increase in fossil energy consumption increases GDP by 4.68%, and a 1% increase in financial development increases GDP by 0.27%.

Ali et al. (2021) analyzed the long-term and short-term elasticities between the square of economic development, fossil energy consumption, foreign direct investment (FDI), and carbon dioxide emissions using the (ARDL) bound test, specifically in Pakistan. The analysis used data from the 1975–2014 period and detected a long-term relationship between the variables of the cointegration results. They also proved that fossil energy consumption has a positive effect on carbon dioxide emissions through the long-term and short-term coefficients of the ARDL model.

Myrzabekkyzy et al. (2022) analyzed the causality between economic growth, energy production, and technological investments in Kazakhstan using data from the 1993–2020 period and cointegration and vector error correction models. They found that energy production contributes significantly to Kazakhstan's economic growth and that technology investments are more effective in promoting economic growth than energy production.

In their study, Dyussembekova et al. (2023) analyzed the impact of energy production and transportation of both freight and passengers on economic growth. The study specifically focused on Kazakhstan and used the vector autoregressive (VAR) model to examine the 1996–2021 period. Their findings showed that both the current value and the one-period lagged value of freight transportation had a significant impact on economic growth. Based on this discovery, they conducted further analysis to determine whether this effect was causal. They determined that although none of the independent variables alone had a causal effect on economic growth, the model with three independent variables together had.

Sartbayeva et al. (2023) conducted a study analyzing the relationship between energy consumption, economic growth, and developments in the agricultural industrial sector in Kazakhstan from 1991 to 2021. They used the Hierarchical Regression model to examine how these factors interact with one another. The researchers found that developments in the agricultural industry have a significant impact on overall energy consumption, particularly on the consumption of renewable energy sources.

Issayeva et al. conducted a study in 2023 to investigate the connection between the industrial production index, economic growth, the percentage of energy generated from renewable sources, CO_2 emissions, and energy consumption in Kazakhstan from 1990 to 2021. They utilized several methods, including the Johansen cointegration test, VAR analysis, Granger causality analysis, and VECM model methods to analyze the data. The study found that these factors accounted for 16.1% of the changes in CO_2 emissions. Additionally, the study found that there exists a statistically significant link between CO_2 emissions and both the industrial production index and economic growth.

3. METHOD

Cointegration tests have some limitations, such as requiring variables in the model to be stationary at the same level and needing large samples. However, the ARDL bounds test offers a significant advantage by eliminating the condition of variables being stationary at the same level. This means that the test method can be applied to variables as I(0) or I(1). There are criticisms that the cointegration methods developed by Engle, Granger, and Johansen are unreliable for small sample sizes (Narayan and Narayan, 2005). An important advantage of the ARDL method is that it can be applied to data sets with small sample sizes (Gümüşsoy, 2021). This is especially critical for research that can only be obtained annually.

The mathematical structure of the ARDL model with two independent variables is as follows:

$$\aleph\aleph Y_t \aleph\, a_0 \quad \sum_{i=0}^{m} a_{1i} \quad Y_{t-i} \quad \sum_{i=0}^{m} a_{2i} \quad M_{t-i} \quad \sum_{i=0}^{m} a_{3i}\, EY_{t-i}$$

$$\aleph\aleph\aleph\aleph_{4uuuu} \quad {}_{-1} \quad {}_{5} \quad {}_{-1} \quad {}_{6} \quad {}_{-1}$$

ARDL is a two-stage method. The first stage looks for the existence of a long-term relationship between the variables. If there is, the second step estimates and tests the short and long-term coefficients (Narayan and Smyth, 2006). If there is no long-term relationship, ARDL regression coefficients are estimated. The existence of a long-term relationship between variables is examined using the bounds test based on the F statistic.

- ARDL bound test results are assessed per the following criteria.
- If F Statistics is < I(0) boundary, then there is no cointegration.
- If F Statistics is > I(1) boundary, then there is cointegration.
- If the case is I(0) Limit < F Statistics < I(1) Limit, then the cointegration relationship cannot be evaluated (Kalfa, 2022).

ARDL analysis has two steps. The first is to investigate the stationarity of the series. This is done through the ADF unit root test. The second step is to decide on the delay length. Commonly used criteria for delay length are the Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC), Log-maximum likelihood (LogL), Bayesian information criterion (BIC), and the Hannan-Quinn information criterion (HQ).

After obtaining the model, compatibility, and model goodness needed to be tested. For this, the Breusch Godfrety-LM test was applied to determine autocorrelation, the White Test and

Breusch-Pagan-Godfrey test to determine heteroscedasticity, and the Ramsey Reset test, which is a functional form test (Ak, 2021). The existence of a potential structural break in the estimated model was examined through the CUSUM and CUSUMSQ tests developed by Brown et al. (1975), and the results were presented graphically.

4. FINDINGS

The study aimed to investigate the impact of energy consumption, industrial production index, and agricultural production index on economic growth. Energy consumption is a significant variable as it indicates the country's industrial and economic activities' vitality for all social levels. Due to factors such as environmental damage from fossil fuels and increased production and access costs due to decreased resources, there is a global trend towards renewable energy sources. Hence, in this study, energy consumption was taken as a percentage of renewable energy sources. The industrial production index variable, which expresses the country's general structure instead of variables related to different sectors, was also included in the analysis. Moreover, considering the central role of agricultural production in meeting social needs and its significant economic impact, its effect was included in the model to make the study more methodologically sound.

The model took the rate of increase in GDP from year to year as the proxy of economic growth. Brief descriptions of the research variables and data sources are given in Table 1. The research data is obtained from the websites https://datacatalog.worldbank.org, https://ourworldindata.org, and https://w3.unece.org/PXWeb2015/pxweb/en/STAT/ (Date of access: 05/01/2024). The analysis period was 2000 – 2022.

Descriptive and distribution statistics of the research variables are given in Table 2. For the research period, the average value of Kazakhstan's Agricultural production index was 87.62, the renewable energy consumption rate was 4.09%, the industrial production index to GDP ratio was 4.66%, and the annual GDP growth average was 5.89%. In addition, the test showed that all four variables comply with normal distribution.

The change in research variables over time is given as a time path graph in Graph 1. While the agricultural production index was at 50 in 2000, it has shown a regular increase over the past 23 years and has increased to 120 as of 2020. It is also noteworthy that there was a significant increase in 2011. While renewable energy consumption was 6% in 2000, it tended to decrease until 2014 and fell below 3%. It has recovered since then and remained stable at around 4%. In the industrial investment index, a generally negative trend is observed in the examined period. The index to GDP ratio started at 16% but decreased to 4% by 2022. Although there was a negative trend in the GDP variable, it seemed to be stabilized at around 4%, especially after 2010.

ADF unit root test findings for the variables are given in Table 3. The findings show that the INPG variable is stationary at the 5% significance level, and the other three variables are stationary at

Table 1: Variable definitions and sources

Variable	Short description	Source
CRP	Agricultural production index	https://data.worldbank.org
INPG	The ratio of industrial production index to GDP	https://w3.unece.org
ENRR	The share of energy produced from renewable sources in energy consumption	https://ourworldindata.org
GDP	Economic growth	https://data.worldbank.org

Table 2: Descriptive statistics findings of variables

Statistics	CRP	ENRR	INPG	GDP
Mean	87.62435	4.090082	4.656522	5.891304
Median	87.30000	3.990229	4.100000	4.800000
Maximum	117.2400	6.120414	15.50000	13.50000
Minimum	50.70000	2.857217	−7.800000	−2.500000
Standard deviation	21.42353	0.957038	5.553118	3.879188
Skewness	−0.001802	0.777187	0.011943	-0.094074
Kurtosis	1.529726	2.778713	2.663556	2.428124
Jarque-Bera	2.071647	2.362335	0.109025	0.347340
Probability	0.354934	0.306920	0.946947	0.840574

Table 3: ADF unit root test findings of variables

Variable	Level		First diference	
	t-statistics	P value	t-statistics	P value
CRP	−0.984076	0.7393	−13.10629	0.0000
ENRR	−2.193177	0.2140	−3.585628	0.0154
GDP	−2.167579	0.2226	−4.810809	0.0012
INPG	−3.279314	0.0286	−8.640869	0.0000
Test critical values				
1% level	−3.769597		−3.78803	
5% level	−3.004861		−3.012363	
10% level	−2.642242		−2.646119	

the first difference. ADF unit root test findings of the variables are given in Table 3. The findings show that the INPG variable is stationary at the 5% significance level, and the other three variables are stationary at the first difference. As explained in the method section, in the ARDL model, it is sufficient for the variables to be stationary. It does not need to be expressed in terms of differences at the same level. For this reason, the first differences of CRP, ENRR, and GDP variables and the level value of the INPG variable were used in the analysis phase.

In the ARDL model, it is crucial to determine the number of lags in the equation. Table 4 displays the criterion values for the top-performing eight models based on LogL, AIC, BIC, and HQ criteria. The results indicate that the model with three lags for all four variables in the equation provides the best-fit value.

ARDL bounds test findings concerning the existence of a long-term relationship according to the ARDL model are given in Table 5. Since the F value calculated for the model was <I(0) value suggested in the study of Pesaran et al. (2001) at the 5% significance level. Therefore, it was decided that there was no long-term relationship between the variables. Following the findings, ARDL regression model analysis was performed instead of ARDL long-term form.

Graph 1: Time path graph of variables

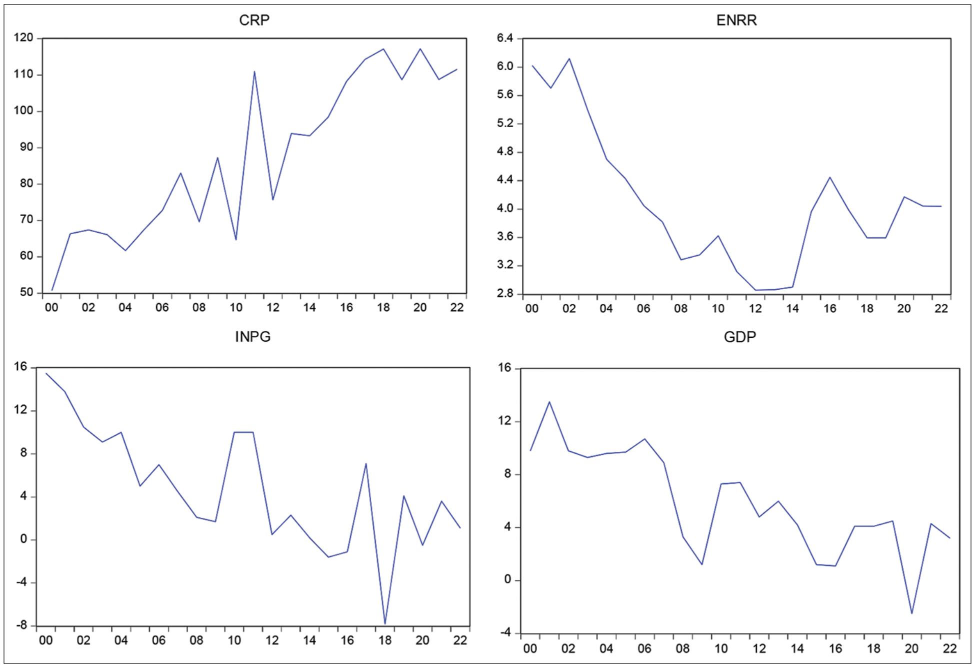


Table 4: ARDL model selection criterion values

Model specification	LogL	AIC	BIC	HQ	Adj, R-square
ARDL (3, 3, 3, 3)	−22.47699	4.050209	4.845526	4.184809	0.646944
ARDL (3, 1, 3, 3)	−31.78524	4.819499	5.515401	4.937273	0.435683
ARDL (3, 2, 3, 3)	−31.77207	4.923376	5.668986	5.049563	0.295581
ARDL (2, 0, 0, 3)	−38.50637	5.000670	5.448036	5.076382	0.427533
ARDL (2, 1, 0, 3)	−38.28994	5.083151	5.580224	5.167276	0.378252
ARDL (2, 0, 3, 3)	−36.33393	5.087782	5.684270	5.188732	0.349362
ARDL (3, 3, 3, 0)	−35.35643	5.090151	5.736346	5.199513	0.315143
ARDL (2, 1, 3, 3)	−35.38133	5.092771	5.738967	5.202133	0.313346

Table 5: ARDL bounds test findings

Test statistic	Value	Significant	I (0)	I (1)
F-statistic	1.906983	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Table 6 shows the ARDL regression model analysis findings for the impact of renewable energy consumption, agricultural production index, and industrial production index on GDP. The findings show that, at the 10% significance level, the industrial production index has a positive effect, while its third-lagged value has a negative one. The agricultural production index has a positive effect. The third lagged value of renewable energy consumption has a positive effect. Thus, all three variables included in the model have a statistically significant effect on GDP. The corrected R-square value of the model was calculated as 0.647. This result shows that 64.7% of the variability in GDP can be explained by renewable energy consumption, agricultural production index, and industrial production index.

Another criterion showing the compatibility of the ARDL regression model is the diagnostic test values. Table 7 shows that there was no autocorrelation problem according to the Breusch-Godfrey test, there were no existing variance problems according to the Breusch-Pagan-Godfrey test, the residuals were normally distributed according to the Jarque-Bera test (Petek and Çelik, 2017) and no model definition errors (functional form errors) according to the Ramsey RESET test (Güriş et al., 2017).

In addition to the diagnostic test values, the possible structural breaks were examined using CUSUM and CUSUMSQ tests (Brown et al., 1975), and the findings were presented graphically in Graph 2. The findings showed that the model does not contain structural breaks and gives stable results.

Graph 3 provides the ARDL model prediction values, the error values of the model prediction, and the time path graph of the observed values of research variables. The graph shows that the observed and predicted values can be considered "compatible" with each other. The model error values follow a random trend with zero mean, and there is a higher variability between 2013 and 2016 compared to other years.

Table 8 presents ARDL model error correction form findings. According to the model, except for the first difference of renewable energy consumption, the estimated values for all

Table 6: ARDL regression model findings

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DGDP(-1)	−0.24842	0.209831	−1.18391	0.3217
DGDP(-2)	−1.15837	0.372207	−3.11217	0.0528
DGDP(-3)	1.75168	0.637499	2.747739	0.0709
INPG	0.571901	0.207032	2.762383	0.0700
INPG(-1)	0.154138	0.190018	0.811173	0.4766
INPG(-2)	0.242161	0.184615	1.311705	0.2810
INPG(-3)	−0.78911	0.291551	−2.70658	0.0734
DCRP	0.392675	0.145061	2.706969	0.0734
DCRP(-1)	0.384242	0.178727	2.149885	0.1207
DCRP(-2)	−0.23365	0.130872	−1.7853	0.1722
DCRP(-3)	−0.226	0.101265	−2.23178	0.1118
DENRR	−0.08635	2.337056	−0.03695	0.9728
DENRR(-1)	−2.18895	2.333486	−0.93806	0.4174
DENRR(-2)	−4.52711	2.143756	−2.11176	0.1252
DENRR(-3)	8.668323	2.48855	3.483283	0.0400
C	−0.434500	1.347721	−0.32239	0.7683
R-squared	0.941157		Mean dependent var	−0.321050
Adjusted R-squared	0.646944		S.D. dependent var	3.345242
S.E. of regression	1.987692		Akaike info criterion	4.050209
Sum squared resid	11.85276		Schwarz criterion	4.845526
Log likelihood	−22.47700		Hannan-Quinn criter,	4.184809
F-statistic	3.198897		Durbin-Watson stat	1.587667
Prob (F-statistic)	0.183999			

Table 7: ARDL diagnostic test findings

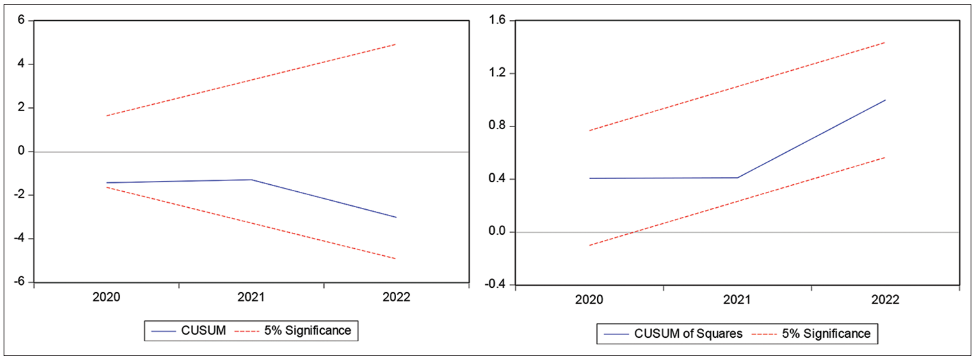
Test	Statistics	Prob.
Breusch-Godfrey serial correlation LM Test	F-statistic: 0.323555	Prob. F (2,1): 0.7792
Heteroskedasticity test: Breusch-Pagan-Godfrey	F-statistic: 0.909320	Prob. F (15,3): 0.4109
Ramsey RESET test	F-statistic: 5.184088	Prob. F (1, 2): 0.1505
Test of normality	Jarque-Bera: 0.687103	Prob.: 0.709247

Table 8: ARDL error correction regression model findings

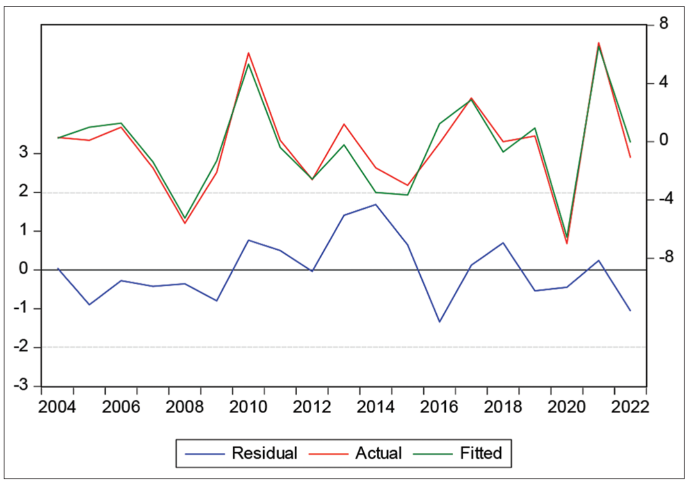
Variable	Coefficient	Std. Error	t-statistic	Prob.
D (DGDP(-1))	−0.593311	0.146060	−4.062111	0.0269
D (DGDP(-2))	−1.751680	0.203198	−8.620560	0.0033
D (DCRP)	0.392675	0.053940	7.279853	0.0054
D (DCRP(-1))	0.459646	0.103900	4.423932	0.0214
D (DCRP(-2))	0.226000	0.053503	4.224037	0.0243
D (DENRR)	−0.086348	1.051491	−0.082119	0.9397
D (DENRR(-1))	−4.141216	0.973663	−4.253233	0.0238
D (DENRR(-2))	−8.668323	1.226484	−7.067622	0.0058
D (INPG)	0.571901	0.091061	6.280413	0.0082
D (INPG(-1))	0.546946	0.118509	4.615241	0.0191
D (INPG(-2))	0.789107	0.120052	6.573027	0.0072
CointEq(-1)*	−0.655111	0.138889	−4.716793	0.0180
R-squared	0.976585		Mean dependent var	−0.031579
Adjusted R-squared	0.939790		S.D. dependent var	5.303044
S.E. of regression	1.301250		Akaike info criterion	3.629157
Sum squared resid	11.85276		Schwarz criterion	4.225645
Log likelihood	−22.47699		Hannan-Quinn criter,	3.730106
Durbin-Watson stat	1.587667			

other variables and the error correction term were statistically significant. If the error correction term is between −1 and 0, that indicates a convergence towards the equilibrium value. If it is between −2 and −1, the error correction term converges towards the long-term equilibrium value in decreasing waves. If the error correction term is less than −2 or has positive values, the equilibrium is not reached (Alam and Quazi, 2003). The fact that the error correction term calculated in the model is -0.655 shows that 65.5% of the shocks that will occur in the short term can be eliminated within 1 year. This means that the time to regain equilibrium after a short-term shock is 1.53 years (approximately 1 year and 7 months).

Graph 2: 95% confidence interval for CUSUM and CUSUMSQ test



Graph 3: Time path chart for observation values and prediction and error values according to the ARDL model



5. CONCLUSION AND RECOMMENDATIONS

This study examined the effects of energy consumption and industrial and agricultural production on economic growth using the ARDL method. The findings showed that all three variables were effective in economic growth for Kazakhstan. Another important finding is that, within the framework of the variables included in the analysis, a shock effect in the economic structure will recover and regain its normal structure in a short time, such as 1.5 years. In this respect, the study provides important support information for Kazakhstan decision-makers and gives confidence about the solidity of Kazakhstan's economic structure. The study also contributes to the literature in terms of both testing the method and testing the variables on a different case study.

This study included industrial production, agricultural production, and energy consumption as a single variable (index variable) to analyze their impact on economic growth. However, it's worth noting that production and trade can be considered as separate fields of economic activity and analyzed individually. Therefore, including different sectors in the model and analyzing their individual effects on GDP can be a valuable approach to identify the determinants of the Kazakhstan economy and provide insights into the dynamics of economic growth in general.

REFERENCES

Ak, Ö.K. (2021), Türkiye'deki ekonomik büyüme, enflasyon ve işsizlik arasındaki ilişkinin ARDL sınır testi yaklaşımıyla analizi. Pearson Journal, 6(15), 299-312.

Alam, I., Quazi, R. (2003), Determinants of capital flight: An econometric case study of Bangladesh. International Review of Applied Economics, 17(1), 85-103.

Ali, M.U., Gong, Z., Ali, M.U., Wu, X., Yao, C. (2021), Fossil energy consumption, economic development, inward FDI impact on CO_2 emissions in Pakistan: Testing EKC hypothesis through ARDL model. International Journal of Finance and Economics, 26(3), 3210-3221.

Bekzhanova, S., Tayauova, G., Akhanov, S., Tuleshova, G.B., Bolganbayev, A., Moldogaziyeva, G.M. (2023), 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. International Journal of Energy Economics and Policy, 13(5), 8-14.

Bolganbayev, A., Myrzabekkyzy, K., Baimaganbetov, S., Kelesbayev, D. (2021), The effect of oil prices on the economic growth of oil exporting countries bordering the caspian sea: Panel data analysis. International Journal of Energy Economics and Policy, 11(6), 432-437.

Brown, R.L., Durbin, J., Evans, J.M. (1975), Techniques for testing the constancy of regression relationships over time. Journal of the Royal Statistical Society Series B: Statistical Methodology, 37(2), 149-163.

Delice, Y. (2019), Türkiye Kazakistan Dış Ticaretinin Yapısal Analizi. (PhD Thesis). Sivas: Sivas Cumhuriyet Üniversitesi, Sosyal Bilimler Enstitüsü.

Dyussembekova, Z., Aidarova, A.B., Balapanova, E., Kuatova, D., Seitkhamzina, G., Bolganbayev, A. (2023), The effect of freight and passenger transportation and energy production on economic growth in the framework of macro-economic indicators: The case of Kazakhstan. International Journal of Energy Economics and Policy, 13(6), 74-80.

Gümüşsoy, F.G. (2021), Kuru soğan üretimi ve fiyat ilişkisinin ARDL Sınır Testi ve Almon Modeli ile tespit edilmesi: Örümcek Ağı Teoremi. Ekonomi Maliye İşletme Dergisi, 4(1), 37-55.

Güriş, S., Çağlayan, E.A., Güriş, B. (2017), Eviews ile Temel Ekonometri. İstanbul: Der Yayıncılık.

Issayeva, G., Dyussembekova, Z., Aidarova, A.B., Makhatova, A.B., Lukhmanova, G., Absemetova, D., Bolganbayev, A. (2023), The relationship between renewable energy consumption, CO_2 emissions, economic growth, and industrial production index: The case of Kazakhstan. International Journal of Energy Economics and Policy, 13(6), 1-7.

Kalfa, N.U. (2022), Türkiye'de Elektrik Enerjisi Tüketimi ve Seçilmiş Ekonomik Göstergeler Arasındaki İlişki: ARDL Sınır Testi

Yaklaşımı. International Journal of Economics Administrative and Social Sciences, 5(2), 67-82.

Kasım, M. (2022), Orta Asya Ülkelerinde Kalkınma Politikaları ve Ekonomik Gelişme. Bağımsızlıklarının 30. Ankara: Yılında Türk Devletleri Ekonomik, Politik ve Sosyal Dönüşüm, p31-62.

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

Liang, Y., Zhen, L., Zhang, C., Hu, Y. (2020), Consumption of products of livestock resources in Kazakhstan: Characteristics and influencing factors. Environmental Development, 34, 100492.

Mashirova, T., Tastanbekova, K., Nurgabylov, M., Lukhmanova, G., Myrzabekkyzy, K. (2023), Analysis of the relationship between the highest price and the trading volume of the energy company shares in Kazakhstan with frequency domain causality method. International Journal of Energy Economics and Policy, 13(4), 22-27.

Mudarissov, B.A., Lee, Y. (2014), The relationship between energy consumption and economic growth in Kazakhstan. Geosystem Engineering, 17(1), 63-68.

Myrzabekkyzy, K., Keneshbayev, B., Razakova, D., Kenzhebekova, I., Pirmanova, Z. (2022), Analysis of causality relationship between the economic growth and the energy production and technological investments in Kazakhstan. International Journal of Energy Economics and Policy, 12(6), 123-126.

Nafziger, E.W. (2006), Economic Development. 4th ed. Cambridge: Cambridge University Press.

Narayan, P.K., Narayan, S. (2005), Estimating income and price elasticities of imports for Fiji in a cointegration framework. Economic Modelling, 22(3), 423-438.

Narayan, P.K., Smyth, R. (2006), What determines migration flows from low-income to high-income countries? An empirical investigation of Fiji-Us migration 1972-2001. Contemporary Economic Policy, 24(2), 332-342.

Neelankavil, J.P., Stevans, L.K., Roman, F.L Jr. (2012), Correlates of economic growth in developing countries: A panel cointegration approach. International Review of Applied Economics, 26(1), 83-96.

Niyetalina, G., Balapanova, E., Kuralbayev, A., Lukhmanova, G., Bolganbayev, A. (2023), 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. International Journal of Energy Economics and Policy, 13(4), 9-15.

Ongarova, Y. (2018), Kazakistan'in Çok Yönlü Enerji Politikasi ve Hazar Denizi. Alınteri Sosyal Bilimler Dergisi, 2(3), 1-21.

Özdil, T., Turdalieva, A. (2015), The sources of economic growth in Kazakhstan economy: An ınput output analysis. Approach, International Conference On Eurasian Economies, 841-845.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Petek, A., Çelik, A. (2017), Türkiye'de enflasyon, döviz kuru, ihracat ve ithalat arasındaki ilişkininekonometrik analizi (1990-2015). Finans Politik ve Ekonomik Yorumlar, 626, 69-87.

Sabenova, B., Baubekova, I., Issayeva, G., Bigeldiyeva, Z., Bolganbayev, A. (2023), Comparative analysis of volatility structures of stock index and energy company returns in Kazakhstan. International Journal of Energy Economics and Policy, 13(2), 200-206.

Şahin, G., Konak, A. (2019), Türkiye ve Azerbaycan örnekleminde büyümenin, enerji ve dış ticaret dinamikleri. İnsan ve Toplum Bilimleri Araştırmaları Dergisi, 8(3), 1851-1874.

Sandalcilar, A.R. (2012), BRIC ülkelerinde ekonomik büyüme ve ihracat arasindaki ilişki: Panel eşbütünleşme ve panel nedensellik. Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 17(1), 161-179.

Sarkhanov, T., Huseynli, N. (2022), Econometric analysis of renewable energy consumption and economic growth: The case of Kazakhstan and Kyrgyzstan. International Journal of Energy Economics and Policy, 12(6), 163-167.

Sartbayeva, G., Balapanova, E., Mamytkanov, D., Talimova, L., Lukhmanova, G., Myrzabekkyzy, K. (2023), The relationship between energy consumption (renewable energy), economic growth and agro-industrial complex in Kazakhstan. International Journal of Energy Economics and Policy, 13(6), 227-233.

Smagulova, S., Yermukhanbetova, A., Nurgaliyeva, K., Sariya, B., Baimukasheva, Z., Manap, A., Koyshinova, G., Akimbekova, C. (2023), The ımpact of energy production on the ıntroduction of ICT and the growth of AIC in Kazakhstan. International Journal of Energy Economics and Policy. 13(1), 477-488.

Sultanova, Z., Pazilov, G.A., Baibulekova, L., Kassymbekova, G., Lukhmanova, G., Issayeva, G., Myrzabekkyzy, K. (2024), Comparative analysis of the volatility structures of the stock prices of energy companies traded on the Kazakhstan stock exchange and international gold and oil prices. International Journal of Energy Economics and Policy, 14(1), 21-30.

Syzdykova, A. (2020), Kazakistan'ın yenilenebilir enerji potansiyeli. Ekonomi, İşletme ve Maliye Araştırmaları Dergisi, 2(1), 79-88.

Taibek, Z., Kozhamkulova, I., Kuralbayev, A., Spanova, B., Myrzabekkyzy, K. (2023), Analysis of the effect of oil and energy production on health and education expenditures in Kazakhstan with autoregressive distributed lag (ARDL) method. International Journal of Energy Economics and Policy, 13(2), 215-221.

Timor, A.N., Bayramlı, G., Kapan, K. (2018), Geçmişten günümüze Kazakistan'da tarım faaliyetleri. Iğdır Üniversitesi Sosyal Bilimler Dergisi, 15, 233-255.

Xiong, C., Yang, D., Huo, J., Zhao, Y. (2015), The relationship between energy consumption and economic growth and the development strategy of a low-carbon economy in Kazakhstan. Journal of Arid Land, 7(5), 706-715.

Yesbolova, A.Y., Abdulova, T., Nurgabylov, M., Yessenbekova, S., Turalina, S., Baytaeva, G., Myrzabekkyzy, K. (2024), Analysis of the effect of renewable energy consumption and industrial production on CO_2 emissions in Turkic Republics by panel data analysis method. International Journal of Energy Economics and Policy, 14(1), 480-487.

Yılmaz, M., Şen, E. (2018), Türkiye'nin enerji tüketimi ve ekonomik büyüme ilişkisi: ARDL sınır testi yaklaşımı. International Journal of Disciplines in Economics and Administrative Sciences Studies, 4(8), 328-338.