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The Relationship between the Share of Renewable Energy in Total Energy Consumption and Economic Growth: Kazakhstan and Turkiye Comparision

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ABSTRACT

This study examines the relationship between the share of renewable energy sources in total energy consumption and economic growth by comparing the data of Kazakhstan and Turkiye using the annual data for the 1991-2019 period. Impulse - Response Analysis and Variance Decomposition Analysis were applied to the data using the Vector Autoregressive (VAR) model. Research findings showed that although there is a relationship between renewable energy consumption and economic growth for Kazakhstan, this is not valid for Turkiye. The causality of this relationship, which is valid for Kazakhstan, is determined by the Granger causality analysis. According to the analysis, renewable energy consumption affects Kazakhstan's economic growth, but this effect does not translate into a causal relationship. Again, for both countries, we see that the impact of renewable energy shocks on economic growth remained limited and faded in a few periods. Another important finding is that the share of renewable energy consumption in the economic growth variance decomposition is higher for Kazakhstan.

Keywords: Kazakhstan, Turkiye, Renewable Energy Resources, Economic Growth, VAR
JEL Classifications: C13, C20, C22

1. INTRODUCTION

In developed and developing countries, the increase in energy consumption and, accordingly, environmentally harmful wastes produced by conventional energy sources, raises concerns about the deterioration of sustainability and ecological balance. These concerns can be grouped under two main headings, namely the depletion of easily accessible fossil energy sources such as oil, gas, and coal, and the global warming caused by the greenhouse effect of carbon dioxide and methane gases produced by the consumption of these sources. These concerns have brought the use of clean and renewable energy sources such as geothermal, wind, solar, tidal waves, and biofuels. Although renewable energy technologies are more costly than fossil energy sources, new technologies are emerging to reduce the costs. This global orientation and investments in renewable energy indicate that renewable energy sources will overtake fossil energy sources in energy production over time (Apergis and Danuletiu, 2014).

Kazakhstan, which has 1.5% of the world's total natural gas reserves, about 3.3% of coal reserves, and about 3.2% of oil reserves, is also rich in renewable energy resources such as hydroelectric, wind, solar, geothermal, and biofuels (Xiong et al., 2015; Ongarova, 2018; Sabenova et al., 2023; Taibek et al., 2023).

Despite its richness in renewable energy resources, Kazakhstan's dependence on fossil fuels can be seen from the fact that 75% of the total energy produced in the country is produced in coal-fired power plants. Kazakhstan's dependence on coal in energy production puts Kazakhstan at the forefront of the world in terms of the ratio of greenhouse gas emissions to GDP (Syzdykova, 2020). Kazakhstan can reduce its national greenhouse gas emission rate only by diversifying its energy sources and turning to renewable energy sources in energy production. For this reason, Kazakhstan has published policies aiming to divert 50% of its electricity generation to renewable energy sources by 2050 (Karatayev et al., 2016; Koshim et al., 2018; Karatayev and Hall, 2020; Myrzabekkyzy et al., 2022; Bolganbayev et al., 2022; Saiymova et al., 2023).

Since the 1980s, the growth in the industry and service sectors, along with the integration into the world economy, has also increased Turkiye's energy demand. Unlike Kazakhstan, Turkiye has limited domestic fossil energy resources, meets more than 70% of its energy needs through imports, and is highly dependent on foreign energy. While Turkiye's dependence on foreign energy creates serious risks in terms of the balance of payments, it also increases input costs and causes local goods and services to lose their competitive advantage in the international market. Turkiye also should turn to renewable energy sources to reduce its dependence and CO_2 emissions (Durğun and Durğun, 2018; Alper, 2018). For Turkiye to reach its 35% absolute emission reduction target by 2030, the share of renewable energy sources in electricity generation should be increased to 75% (Alkan and Albayrak, 2020; Shan et al., 2021; Saiymova et al., 2023).

This study examines the relationship between the share of renewable energy sources in total energy consumption and economic growth by comparing Kazakhstan and Turkiye using the annual data for the 1991-2019 period. Annual percentage data are used in economic growth as well as in renewable energy consumption. We collected the data from the World Bank website (https://data.worldbank.org/indicator/). Impulse - Response Analysis and Variance Decomposition Analysis were applied to the data using the Vector Autoregressive (VAR) model.

2. LITERATURE REVIEW

In recent years, many academic studies have been published on the energy resources, renewable energy resources, energy policies, and economic growth indicators of Turkiye and Kazakhstan. Here we will only mention the major ones that are relevant to our objective.

Saiymova et al. (2023) examined the link between renewable energy consumption and economic development in Turkiye and Kazakhstan using vector auto-regression analysis for the period 1990-2021. They found that income level and energy prices have a significant impact on renewable energy use over the period studied, and a new market has emerged in the energy sector that has the potential to significantly replace existing traditional energy markets, at least in the medium or long term, if not in the short term.

Apergis and Danuletiu (2014) analyzed the relationship between renewable energy usage and economic development using the panel VAR model. They found both short- and long-run Granger causality between renewable energy usage and economic growth. They also found strong evidence that renewable energy is important for economic growth, and similarly, economic growth encourages the use of more renewable energy sources.

Bhattacharya et al. (2016) examined the effect of renewable energy consumption on economic growth in 38 countries using the data for the 1991-2012 period. The research concluded that renewable energy consumption has a significant positive effect on economic output in 57% of selected countries. They emphasized that governments, planners, international organizations, and relevant organizations should move together to increase the share of renewable energy investments for low-carbon growth.

Fotourehchi (2017) analyzed the long-term causality relationship between energy consumption and economic growth for 42 developing countries during the 1990-2012 period using the Canning and Pedroni (2008) long-term causality test. He found that renewable energy usage has a long-term positive causal effect on the GDP of developing countries.

Allam and Nader (2021) analyzed the relationship between renewable energy consumption and economic growth in three Mediterranean countries, namely France, Italy, and Turkiye, using data from the 1990-2015 period. According to this study, a one percent increase in the share of renewable energy in total energy consumption has resulted in a 10.44% increase in France's GDP Growth, a 6.77% increase in Italy's GDP Growth, and finally a 1.58% increase in Turkiye's GDP Growth. The accuracy of the measurement in France was 92%, in Italy 83%, and in Turkiye 97%.

Sarkhanov and Huseynli (2022) made an econometric analysis of the relationship between renewable energy consumption and economic growth in Kazakhstan and Kyrgyzstan using the data for the 1996-2018 period. They found that there is a positive relationship between economic growth and the amount of renewable energy consumption in both countries.

Xie et al. (2023) analyzed the relationship between the rate of renewable energy use and economic growth in N-11 countries using data for the period 1990-2020. In their analysis, they used a non-parametric panel data approach, namely the quantile moment regression method, together with the second-generation panel unit root test. Using the panel causality test, they determined a two-way causal relationship between the variables.

Durğun and Durğun (2018) examined the causality relationship between renewable energy consumption and economic growth in Turkiye by subjecting per capita GDP and per capita renewable energy consumption (including hydroelectric) data for the 1980-2015 period to time series analysis. By applying the Toda-Yamamoto causality test to their cointegrated series, they found a one-way causality running from renewable energy consumption to growth.

Alper (2018) analyzed the relationship between renewable energy and economic growth in Turkiye using data from the 1990-2017 period, using the Bayer-Hanck co-integration test and the Toda-Yamamoto causality test. He found that the variables are cointegrated in the long term, and a 1% increase in renewable energy use increases economic growth by 0.19%. Moreover, based on causality test results, he determined a unidirectional causality from economic growth to renewable energy use.

Naimoğlu (2022), on the other hand, analyzed the relationship between renewable energy use and economic growth in 16 energy-importing countries during the 1990-2018 period. In this study, unit root tests are used to determine the stationarity of the series. Then the cointegration relation is tested with the heterogeneous panel cointegration test, and its existence is identified. In addition, the error correction model used in the study showed a unidirectional causality from economic growth to renewable energy usage in both the short and long terms.

3. DATA AND ECONOMETRIC METHOD

This study examines the relationship between the share of renewable energy sources in total energy consumption and economic growth by comparing data from Kazakhstan and Turkiye. Both renewable energy consumption and economic growth are taken as annual percentages. The data period is 1991-2019 and the data period is annual (Source: https://data.worldbank.org/indicator/). Variable names and their short explanations are provided in Table 1.

3.1. Vector Autoregressive (VAR) Model

The vector autoregressive (Vector Autoregressive VAR) model is the generalized form of the autoregressive model to multivariate cases and was introduced to the econometrics literature by Sims (1980). It can be seen as an alternative to models consisting of simultaneous equation systems in terms of mathematical structure. All variables in the model are dependent variables. Thus, the value of each variable in the observed period can be expressed as a linear function of its lagged values and the lagged values of other variables.

The VAR model is handy for explaining and predicting the dynamic structure of economic and financial time series (Yavuz, 2014). It is easy-to-apply, especially on series with dynamic structures, such as the daily return of a stock.

The mathematical form of the VAR model is as follows:

$$Y_t = \alpha_1 + \sum_{j=1}^{m} \beta_j Y_{t-j} + \sum_{j=1}^{m} \delta_j X_{t-j} + \varepsilon_{1t} \quad (1)$$

Table 1: Variable names and explanations

Variable	Difference variable	Explanation
T_GDP	DT_GDP	Turkiye GDP growth (annual %)
K_GDP	DK_GDP	Kazakhstan GDP growth (annual %)
T_REC	DT_REC	Turkiye Renewable energy consumption (% of total final energy consumption)
K_REC	DK_REC	Kazakhstan Renewable energy consumption (% of total final energy consumption)

$$X_t = \alpha_2 + \sum_{j=1}^{m} \theta_j Y_{t-j} + \sum_{j=1}^{m} \vartheta_j X_{t-j} + \varepsilon_{2t} \quad (2)$$

And can be formulated as above (Ertek, 2000). As can be seen in the model, the lagged values of X affect Y, and the lagged values of Y affect X.

Although the VAR model was developed to analyze economic series, it has become an important method used in many series types that show dynamic structures ranging from economic to meteorological.

3.2. Impulse - Response Analysis

After estimating with the VAR model, the effect, period, and directionality of the shocks on the variables are determined using the impulse-response function. It is commonly used to examine the effects of shocks for the first ten periods. The reactions of the other series to the 1-unit change in shocks are revealed with the help of graphics (Tarı, 2010).

3.3. Variance Decomposition Analysis

Variance decomposition analysis is used to express the parts of the variability of a variable in the model arising from itself and other variables as percentages. In VAR analysis, variance decomposition analysis is one of the two analysis steps together with impulse-response analysis. It is calculated retrospectively for ten periods, like impulse-response analysis (Tarı, 2010).

The stationarity of the data was examined with the ADF (Augmented Dickey-Fuller) test. In the ADF test, if the null hypothesis is rejected for *k*=0, 1, 3.,values, the series is deemed stationary for the level (Sevüktekin and Nargeleçekenler, 2007).

The lag length of the VAR model was determined by calculating Sequential Modified LR, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ).

4. FINDINGS

This study analyzed the relationship between the ratio of renewable energy in total energy consumption and economic growth. The first step provides the explanatory statistics, goodness-of-fit, and time path graphs. The second step is to examine the stationarity of the variables. The third step applies VAR analysis by taking the appropriate difference. Variance decomposition analysis and impulse response function findings are obtained from VAR analysis. At each step of the study, a separate analysis was made for Kazakhstan and Turkiye, and the findings were compared.

When we examine the explanatory statistics (Table 2), we see that the average economic growth is 4.1 in Kazakhstan and 5.76 in Turkiye. In addition, the economic growth varies between −12.6 and 13.5 in Kazakhstan and between −5.75 and 11.20 in Turkiye. Likewise, renewable energy consumption is 1.73 on average in Kazakhstan, with a minimum of 1.15 and a maximum of 2.77. In Turkiye, on the other hand, the average is 16.75, with a minimum of 11.40 and a maximum of 24.24. Jarque-Bera test showed that the data fit the normal distribution.

The time path graph of economic growth (Graph 1) shows a stable situation in Turkiye, and an increase can be observed in Kazakhstan until 2000. While the time path graph of renewable energy consumption shows a stable situation for Kazakhstan, it shows a decrease for Turkiye.

The stationarity of the series was examined using the ADF unit root test, and the findings are presented in Table 3. According to the analysis, economic growth is stationary for Turkiye, while other series are stationary at the first difference. Therefore we used the first difference of all series.

Table 2: Descriptive statistics for data

Statistics	K_GDP	K_REC	T_GDP	T_REC
Mean	3.006897	1.730541	4.461920	16.74709
Median	4.100000	1.700000	5.763206	15.34000
Maximum	13.50000	2.770000	11.20011	24.24308
Minimum	−12.60000	1.150000	−5.75001	11.40000
Standard deviation	6.829345	0.427814	4.548346	4.385104
Skewness	−0.80128	0.578710	−0.9165	0.515560
Kurtosis	2.866712	2.622325	2.920707	1.808336
Jarque-Bera	3.124723	1.791062	4.067438	3.000620
Probability	0.209640	0.408391	0.130848	0.223061
Observations	29	29	29	29

Table 3: ADF unit root test findings for series

Variable code	Level		First diference	
	t-statistics	P-value	t- Statistics	P-value
K_GDP	−2.87552	0.0625	−6.23969	0.0000
T_GDP	−5.35378	0.0002	−8.75544	0.0000
K_REC	−2.06863	0.2580	−4.60364	0.0011
T_REC	−1.64792	0.4457	−5.07342	0.0004
Test critical values:				
1% level	−3.72407		−3.71146	
5% level	−2.98623		−2.98104	
10% level	−2.6326		−2.62991	

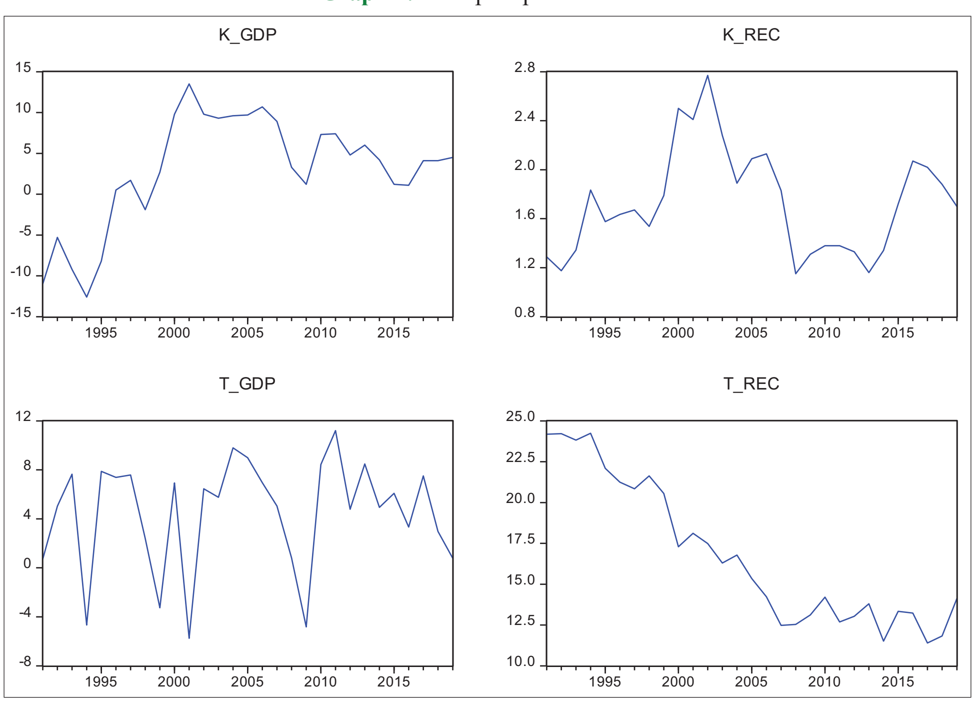
The analysis findings of the VAR models created for Kazakhstan and Turkiye are given in Table 4. In the preliminary stage of the analysis, the lag length was determined. For this purpose, optimum values of LR: sequential modified LR test statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion, and HQ: Hannan-Quinn Information Criterion (highest delay length criterion) was used and the lag length was calculated as 2 for both models. The findings show that the two-period lagged value of economic growth and the one-period lagged value of renewable energy consumption affects the economic growth of Kazakhstan. According to the estimation values, the two-period lagged value of economic growth has a negative effect, while renewable energy consumption has a positive effect. According to the model, the adjusted coefficient of determination of the economic growth model for Kazakhstan is 0.41. This means that the VAR model created in the research explains 41% of the variability in economic growth.

Findings for Turkiye show that only one period lagged value of economic growth is effective on economic growth, and this effect is also negative according to the prediction value. Again, according to the determination coefficient of the model, 27% of the variability in economic growth in Turkiye is explained by the research model.

The serial correlation and varying variance findings of the VAR models created for Turkiye and Kazakhstan are given in Table 5. The findings didn't show serial correlation and varying variance problems in both models.

The effects of a shock on either one of the economic growth and renewable energy consumption variables for Kazakhstan are given graphically in Graph 2. We see that the shock in economic growth continues for 7–8 consecutive periods, both negatively and positively, on itself and renewable energy consumption. We see

Graph 1: Time path plot for series



Graph 2: Impact of shocks on economic growth and renewable energy consumption for Kazakhstan

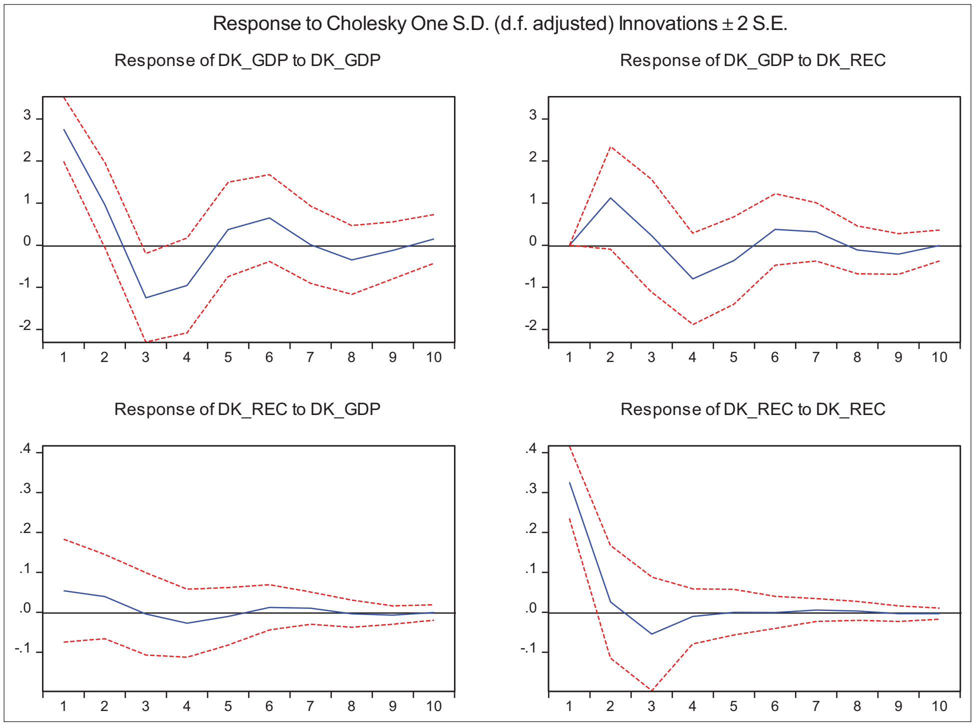


Table 4: VAR analysis findings for research models

Variable	DK_GDP	DK_REC	Variable	DT_GDP	DT_REC
DK_GDP (−1)	0.281777	0.012694	DT_GDP(−1)	−0.62881*	0.025264
DK_GDP (−2)	−0.58877*	−0.00274	DT_GDP(−2)	−0.16875	0.051574
DK_REC (−1)	3.446090*	0.079982	DT_REC(−1)	1.195661	−0.28878
DK_REC (−2)	−0.56160	−0.21664	DT_REC(−2)	1.365001	−0.3756
C	0.689305	0.014650	C	0.971130	−0.70704
R-squared	0.500765	0.059439		0.388544	0.222494
Adj, R-squared	0.405672	−0.11972		0.272076	0.074398
F-statistic	5.266083	0.331777		3.336060	1.502363
Log likelihood	−60.4917	−5.30947		−79.8422	−40.9278
Akaike AIC	5.037824	0.793036		6.526322	3.532904

*The predictive value for P<0.05 is statistically significant

Table 5: Serial correlation and varying variance findings for research models

VAR residual serial correlation LM tests						
Lag	Kazakhstan			Turkiye		
	LRE stat	df	Prob,	LRE stat	df	Prob,
1	5.634302	4	0.2282	4.202586	4	0.3793
2	1.097227	4	0.8947	1.316404	4	0.8586
3	6.766240	4	0.1488	4.626490	4	0.3278
VAR residual heteroskedasticity tests (levels and squares)						
Kazakhstan				Turkiye		
Chi-square		df	Prob,	Chi-square	df	Prob,
14.58141		24	0.9324	21.88111	24	0.5864

that the impact of the shock on renewable energy on economic growth is low. We see that the effect on itself is high in the first period, whereas it drops to low from the second period on.

The effects of a shock on either one of the economic growth and renewable energy consumption variables for Turkiye are given graphically in Graph 3. The effect of a shock on economic growth on itself is positive in the first period and negative in the second period. Although this effect in the third period is positive, it disappears from the fourth period. Whereas a shock in economic growth does not affect renewable energy in the first period, the effect appears in the second and third periods. As in the case of Kazakhstan, a shock in renewable energy consumption seems to have a low impact on economic growth and disappears as of the fifth period. We see that the effect of the shock on itself is high and positive in the first period, but decreases and disappears in the following periods.

The variance decomposition analysis findings of economic growth and renewable energy consumption according to the research model are given in Table 6. In the economic growth data of Kazakhstan, while all variance decomposition is on itself in the first period, at the end of the tenth period, this decomposition is differentiated as 83% economic growth and 17% renewable energy. In renewable energy consumption, the share of economic growth in variance decomposition is 2.7% in the first period and 4.9% at the end of the tenth period, but the share of renewable

Graph 3: Impact of shocks on economic growth and renewable energy consumption for Turkiye

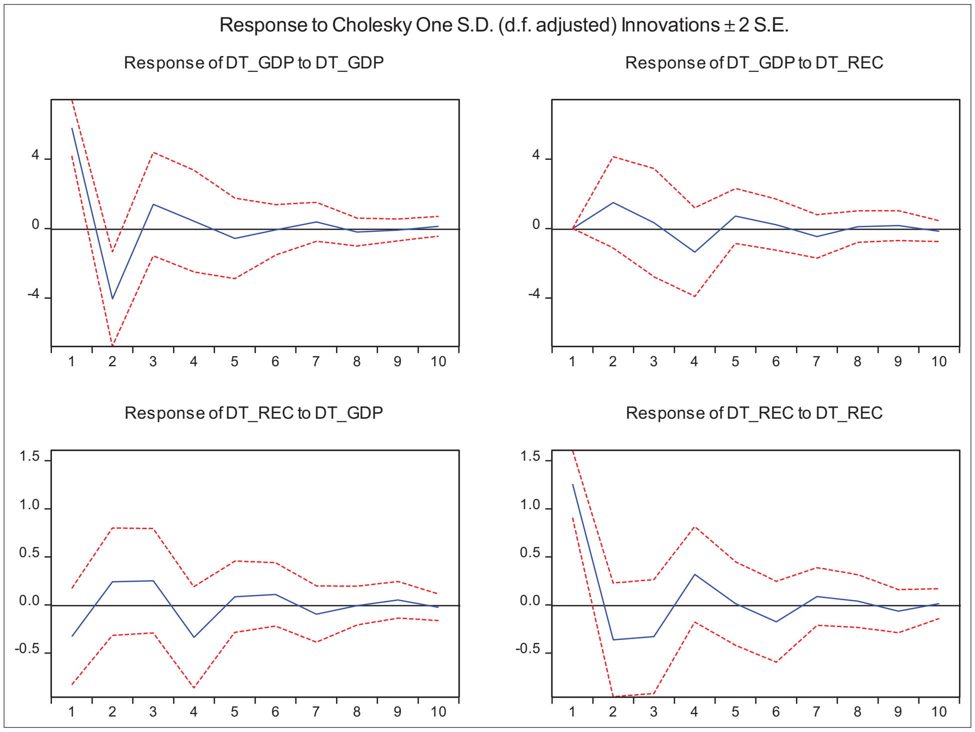


Table 6: Variance decomposition analysis findings of variables according to the VAR model

Period	Kazakhstan				Turkiye			
	Variance Decomposition of DK_GDP		Variance Decomposition of DK_REC		Variance Decomposition of DT_GDP		Variance Decomposition of DT_REC	
	DK_GDP	DK_REC	DK_GDP	DK_REC	DT_GDP	DT_REC	DT_GDP	DT_REC
1	100.0000	0.000000	2.697142	97.30286	100.0000	0.000000	6.390213	93.60979
2	87.13474	12.86526	4.034384	95.96562	95.67903	4.320966	8.847972	91.15203
3	88.50887	11.49113	3.943433	96.05657	95.63587	4.364129	11.17789	88.82211
4	84.94778	15.05222	4.562321	95.43768	92.53737	7.462634	15.11487	84.88513
5	84.26684	15.73316	4.645734	95.35427	91.72914	8.270856	15.39021	84.60979
6	83.88514	16.11486	4.774257	95.22574	91.64943	8.350568	15.62261	84.37739
7	83.27468	16.72532	4.861638	95.13836	91.34643	8.653571	15.89694	84.10306
8	83.34646	16.65354	4.871228	95.12877	91.33221	8.667792	15.88778	84.11222
9	83.10388	16.89612	4.911069	95.08893	91.28524	8.714761	15.95959	84.04041
10	83.13022	16.86978	4.910721	95.08928	91.25199	8.748006	15.98010	84.01990

energy is 97.3% in the first period and 95.1% at the end of the tenth period.

In the economic growth data of Turkiye, while all variance decomposition is on itself in the first period, at the end of the tenth period, this decomposition is differentiated as 91.3% economic growth and 8.7% renewable energy. In renewable energy consumption, the share of economic growth in the first period is 6.4%, while the share of renewable energy is 93.6%. At the end of the tenth period, the share of economic growth in the variance decomposition changed to 16%, and the share of renewable energy consumption to 84%.

Granger causality analysis findings based on Kazakhstan and Turkiye VAR models are given in Table 7. There is no causal relationship between renewable energy consumption and economic growth in both models.

Table 7: VAR/Granger causality analysis findings

Dependent variable	Independent variable	Chi-square	df	Prob,
DT_GDP	DT_REC	2.475817	2	0.2900
DT_REC	DT_GDP	1.251088	2	0.5350
DK_GDP	DK_REC	3.717321	2	0.1559
DK_REC	DK_GDP	0.451472	2	0.7979

5. CONCLUSION AND RECOMMENDATIONS

This study examined the effect of renewable energy consumption on economic growth in Turkiye and Kazakhstan. The findings showed that although there is a relationship between renewable energy consumption and economic growth in Kazakhstan, there is no such relationship in Turkiye. However, the Granger causality analysis determined that the relationship obtained for Kazakhstan is not causal. Accordingly, renewable energy consumption affects Kazakhstan's economic growth. However, this effect does not translate into a causal relationship. Again, in both countries, the impact of renewable energy shocks on economic growth remains limited and is reset after a few periods. Another important finding is that the share of renewable energy consumption in the variance decomposition of economic growth is higher in Kazakhstan.

The study only analyzes the effect of renewable energy consumption on economic growth. The study can be extended to analyze the effects of renewable energy on the economy and the environment by including other variables that renewable energy consumption affects. Carbon dioxide emissions and technology investments are some of the examples.

REFERENCES

Alkan, Ö., Albayrak, Ö.K. (2020), Ranking of renewable energy sources for regions in Turkey by fuzzy entropy based fuzzy COPRAS and fuzzy multımoora. Renewable Energy, 162, 712-726.

Allam, M., Nader, R.B. (2021), The relation between renewable energy consumption and economic growth: The case of 3 Mediterranean countries. South Florida Journal of Development, 2(4), 5776-5786.

Alper, F.Ö. (2018), Yenilenebilir enerji ve ekonomik büyüme arasındaki ilişki: 1990-2017 Türkiye örneği. Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 8(2), 223-242.

Apergis, N., Danuletiu, D.C. (2014), Renewable energy and economic growth: Evidence from the sign of panel long-run causality. International Journal of Energy Economics and Policy, 4(4), 578-587.

Available from: https://data.worldbank.org/indicator [Last accessed on 2023 Mar 01].

Bhattacharya, M., Paramati, S.R., Ozturk, I., Bhattacharya, S. (2016), The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. Applied energy, 162, 733-741.

Bolganbayev, A., Sabenova, B., Mombekova, G., Sultankhanova, G., Tazhibayeva, R. (2022), The effect of electricity generation, thermal energy production, fixed capital investment, and consumer price index on economic growth in Kazakhstan. International Journal of Energy Economics and Policy, 12(6), 67-72.

Durğun, B., Durğun, F. (2018), Yenilenebilir enerji tüketimi ile ekonomik büyüme arasinda nedensellik ilişkisi: Türkiye örneği. International Review of Economics and Management, 6(1), 1-27.

Ertek, T. (2000), Ekonometriye Giriş. İstanbul: Beta Yayınevi.

Fotourehchi, Z. (2017), Clean energy consumption and economic growth: A case study for developing countries. International Journal of Energy Economics and Policy, 7(2), 61-64.

Karatayev, M., Hall, S. (2020), Establishing and comparing energy security trends in resource-rich exporting nations (Russia and the Caspian Sea region). Resources Policy, 68, 101746.

Karatayev, M., Hall, S., Kalyuzhnova, Y., Clarke, M.L. (2016), Renewable energy technology uptake in Kazakhstan: Policy drivers and barriers in a transitional economy. Renewable and Sustainable Energy Reviews, 66, 120-136.

Koshim, A., Karatayev, M., Clarke, M.L., Nock, W. (2018), Spatial assessment of the distribution and potential of bioenergy resources in Kazakhstan. Advances in Geosciences, 45, 217-225.

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.

Naimoğlu, M. (2022), The relationship between renewable energy use and economic growth for energy ımporting emerging economies. Hacettepe University Journal of Economics and Administrative Sciences. 40(4), 818-836.

Ongarova, Y. (2018), Kazakistan'in çok yönlü enerji politikasi ve hazar denizi. Alınteri Sosyal Bilimler Dergisi, 2(3), 1-21.

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.

Saiymova, M., Troyanskaya, M., Shalgimbayeva, K., Babazhanova, Z., Jumabekova, R. (2023), The vector auto regression analysis of the link between renewable energy consumption and economic development for Turkey and Kazakhstan. International Journal of Energy Economics and Policy, 13(2), 309-315.

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.

Sevüktekin, M., Nargeleçekenler, M. (2007), Ekonometrik Zaman Serileri Analizi. Ankara: Nobel Akademik Yayın.

Shan, S., Genç, S.Y., Kamran, H.W., Dinca, G. (2021), Role of green technology innovation and renewable energy in carbon neutrality: A sustainable investigation from Turkey. Journal of Environmental Management, 294, 113004.

Sims, C.A. (1980), Macroeconomics and reality. Econometrica: Journal of the Econometric Society, 48, 1-48.

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.

Tarı, R. (2010), Ekonometri. Kocaeli: Umuttepe Yayınları.

Xie, P., Zhu, Z., Hu, G., Huang, J. (2023), Renewable energy and economic growth hypothesis: Evidence from N-11 countries. Economic Research-Ekonomska Istraživanja, 36(1), 2121741.

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.

Yavuz, N.Ç. (2014), Finansal Ekonometri. Ankara: Der Yayınları.