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Analysis of the Relationship between Energy Consumption, Foreign Direct Investment, and Labor Force Participation by Vector Error Correction Model: The Case of Kazakhstan

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ABSTRACT

This study examines the relationship between energy consumption, foreign direct investment, and labor force participation rate in Kazakhstan for the 1991-2021 period. Data on energy consumption are retrieved from the enerdata website, and data on foreign direct investment and labor force participation rate from the World Bank website. The vector error correction model (VCEM) method was used for data analysis. Research findings have shown that foreign direct investments have an effect on energy consumption for Kazakhstan both in the long run and the short run. The study found that although the labor force participation rate has an effect on energy consumption in the short term, it has no effect in the long term. These results are also important in terms of indirectly showing the long-term effects of foreign direct investments on the economy. The study used annual series for all three variables. Another important subject of study for explaining this relationship may be the use of series in different periods (especially quarterly).

Keywords: Kazakhstan, Energy Consumption, Foreign Direct Investment, Labor Force Participation Rate

JEL Classifications: C13, C20, C22

1. INTRODUCTION

This study examines the relationship between energy consumption, foreign direct investment, and labor force participation in Kazakhstan using the vector error correction model (VCEM) method. Kazakhstan, the ninth largest country in the world and the second largest among the former USSR countries after the Russian Federation, with an area of 2.724.900 km², gained its independence in 1991 after the dissolution of the USSR. After independence, Kazakhstan has undergone a rapid restructuring process to recover and develop its economy and integrate with the global markets. Due to the richness of its natural energy resources (about 3% of the world's total oil

reserves, about 1.1% of natural gas reserves, and about 3.3% of coal reserves) and investments in these natural resources, as well as the successful decisions of its managers, Kazakhstan successfully and quickly completed this transitional process (Mudarrisov and Lee, 2014; Xiong et al., 2015; Myrzabekkyzy et al., 2022; Bolganbayev et al., 2022). Due to its geographical location, Kazakhstan is very rich in terms of renewable energy resources such as hydroelectric, solar, wind, geothermal, and biofuels, as well as fossil energy (Xiong et al., 2015; Ongarova, 2018; Sabenova et al., 2023; Taibek et al., 2023). Therefore, it is an attractive country for foreign capital investment. According to the Kazakhstan National Bureau of Statistics (<https://stat.gov.kz/en/>), Kazakhstan has a current population

2. LITERATURE REVIEW

of 19.832.737 people and is one of the leading countries in terms of economic development among developing countries (Mukhtarov et al., 2020).

Energy consumption rates have become an essential indicator of economic growth after the industrial revolution in the 19th century. Energy consumption is the driving force behind production and essential in economic growth and development. As an extremely important production factor, an increase in energy consumption brings high growth, while a decrease in energy consumption results in an economic slowdown (Siddiqui, 2004). With the developing technology and the increase in production and demand, a great increase in energy consumption has been observed globally (Alshehry and Belloumi, 2015; Abidin et al., 2015; Matei, 2018). De Vita et al. (2021) found that foreign direct investment has a significant effect on energy demand in a study titled “The inward FDI - Energy intensity nexus in OECD countries: A sectoral R&D threshold analysis.”

Foreign direct investment is vital among many capital flows that support national economies. The first foreign direct investment dates back to the 18th century, when Britain invested in the extraction of raw materials, oil, and precious metals necessary for the production of its colonies. In the second half of the 19th century, the capital surplus created by the Industrial Revolution led large companies to pursue new investment areas that would maximize their profits, especially in Western countries. This pursuit has often taken the form of foreign direct investment (Çütçü and Enez, 2018). Investment areas were independent developing countries with cheap labor and natural resources to provide the raw materials needed by European industry and their colonies at the time. When the forces of globalization emerged after World War II, the importance of foreign direct investments increased and foreign direct investments expanded further. Foreign direct investment flows increased rapidly worldwide in the 1980s and 1990s, especially with the spread of liberal policies (Mahmoodi and Mahmoodi, 2016).

In addition to the physical capital factor, human capital also affects energy use. Odhiambo (2010) examined the dynamic causal relationship between electricity consumption and economic growth in Kenya during the 1972-2006 period and found a unidirectional causality between energy consumption and Labor Force Participation Rate. He found that the labor force participation rate not only affects energy consumption but also foreign direct investments. Nguyen (2021), on the other hand, found that the labor force plays an important role in attracting foreign direct investment in both developed and developing countries.

This study analyzed the relationship between energy consumption, foreign direct investment, and labor force participation rate in Kazakhstan for the 1991-2021 period. Energy consumption data is from the Enerdat website, and foreign direct investment and labor force participation rate data are from the World Bank website. The Vector Error Correction Model (VECM) method was used for data analysis.

The literature contains many studies that examine the causal relationship between energy consumption, labor force participation rate, and foreign direct investment (FDI) using different variables. Here we will only mention some of the relevant ones.

Wayhudi and Palupi (2023) examined the relationship between energy consumption, foreign direct investment, and labor force participation rate in OECD countries using the VECM model. Their research showed bidirectional causality between energy consumption and foreign direct investment, bidirectional causality between energy consumption and labor force participation rate, and bidirectional causality between foreign direct investment and labor force participation rate. Moreover, in the long term, FDI has a significant positive effect on energy consumption, and the labor force participation rate has a negligible negative effect. But in the short term, FDI and labor force participation rates had no effect.

Polat (2018) used Dynamic Panel Data analysis in his study on the effect of foreign direct investments on energy consumption in developed and developing countries. The research determined that foreign direct investments affect energy consumption in developed countries, whereas there was no such effect in developing countries.

Dai et al. (2022) analyzed the relationship between economic growth and energy consumption in terms of sustainable development and the relationship between energy consumption and economic growth according to the energy Kuznets curve. They examined the future trend of China’s sustainable development through a comparative analysis of the energy Kuznets curve of the United States and Germany. The results showed that at the energy consumption milestone, China’s energy economic growth rate was higher than that of Germany and the United States. Moreover, they introduced the concept of energy consumption milestone by empirically analyzing the relationship between energy consumption and economic growth in OECD countries to provide a theoretical basis to coordinate China’s energy consumption and economic growth.

Çetin (2019) examined the long-term effect of foreign direct investment on women’s labor force participation rate in emerging market economies in the 2001-2016 period using the panel autoregressive distributed lag (ARDL) method. The gross domestic product (GDP) was the most important factor in increasing the women’s labor force participation rate. Moreover, the long-term results of the panel ARDL analysis on the emerging market economies showed that increases in foreign direct investment had a statistically significant and positive effect on the women’s labor force participation rate.

Gharaibeh (2015) conducted a study to identify the main determinants of FDI inflows into a host country. The study showed that general government consumption expenditures, inflation rate, economic stability represented by annual interest

rate, labor force, openness to trade, public education, and welfare of the country represented by the population have statistically significant effects on the foreign direct investment inflows to Bahrain. Furthermore, this study found that export potential, market size, and exchange rate were statistically insignificant but positively related to FDI inflows, whereas national welfare was negatively related to FDI inflows, but this relationship was statistically insignificant.

Nguyen (2021), on the other hand, analyzed the impact of the workforce and several other factors on attracting FDI to Vietnam. The study analyzed the effects of labor force, real gross domestic product, inflation, job freedom index, and investment freedom index on Vietnam's FDI attractiveness using a secondary time series for the 1995-2018 period. The research found that both labor force and inflation have a positive effect on FDI at a 5% significance level, whereas the job freedom index has an effect at a 10% significance level, and the real gross domestic product and investment freedom index have an effect at 1% significance level.

Bekhet and Othman (2011) analyzed the causality between electricity consumption, consumer spending, gross domestic product (GDP), and foreign direct investment (FDI) in Malaysia by using the vector error correction model (VECM). They used time series data for the 1971-2009 period. The research found cointegration and long-term relationship between all variables. They also found that long-run causality from electricity consumption to FDI, GDP growth, and inflation is statistically significant.

3. DATA AND ECONOMETRIC METHOD

This study examines the effect of foreign direct investment and labor force participation rate on energy consumption in Kazakhstan. The data and variables used in the study are given in Table 1. Annual data for the period 1991-2021 were used in the analysis.

This framework enables the use of two candidate methods for data analysis: the first is the vector autoregressive (VAR) method and the second is the vector error correction model (VECM) method. In this case, to decide on the method, first of all, the cointegration between the series is investigated. If there is, the VECM method is used.

Cointegration is a method used to determine the existence of a long-term relationship in a series (Wahyudi and Papuli, 2023). Johansen's cointegration test was used in this study. In the

Table 1: Variable names and definitions

| Variable | Definition |
|----------|--|
| X1 | Total energy consumption/GDP |
| X2 | Foreign direct investment, net inflows (% of GDP) |
| X3 | Labor force participation rate, total (% of total population ages 15+) |

cointegration test, the null hypothesis argues that there is no cointegration in the related series. Moreover, for testing, the series must be stationary at the same level.

Examining the existence of a causal relationship in the series constitutes an important step of the analysis. The bivariate model investigates the causal effect of each variable on the other. The multivariate model, on the other hand, tests the causal effect of each variable, as well as whether other variables collectively have a causal effect on a variable.

The first step of the analysis is the stationarity analysis of the series. The stationarity of the series is investigated with Augmented Dickey-Fuller (ADF) unit root test. In the ADF test, the null hypothesis argues that the series contains a unit root. According to the unit root test findings, data analysis was performed using the series that is stationary at the same level.

In the second step, the optimal lag length is determined. For optimal lag length, econometric analysis programs use the following methods: LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information, and HQ: Hannan-Quinn information criterion (Widarjono, 2018). This study determined the optimum lag length by comparing the optimum lag lengths obtained with each test method.

The stability of the VAR model is determined by examining whether the inverse roots of the AR characteristic polynomial are within the unit circle (less than one in absolute value). Thus, the impulse response and variance decomposition analysis results become econometrically meaningful (Firdaus, 2020). The

Table 2: Descriptive statistics of research series

| Statistics | X1 | X2 | X3 |
|--------------|----------|----------|----------|
| Mean | 104.6405 | 6.323174 | 70.52523 |
| Median | 106.7138 | 5.405182 | 70.50800 |
| Maximum | 126.6756 | 13.01286 | 71.57100 |
| Minimum | 85.77120 | 0.196995 | 69.20000 |
| SD | 11.11805 | 3.956885 | 0.628655 |
| Skewness | 0.104415 | 0.321274 | -0.24519 |
| Kurtosis | 2.238165 | 2.001456 | 2.349049 |
| Jarque-Bera | 0.806005 | 1.821196 | 0.857944 |
| Probability | 0.668311 | 0.402284 | 0.651178 |
| Observations | 31 | 31 | 31 |

Table 3: ADF unit root test findings

| Series | Constant | | Constant and trend | |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | t-Statistics | Prob.* | t-Statistics | Prob.* |
| X1 (1 st diff.) | -7.49306 | 0.0000 | -7.35694 | 0.0000 |
| X2 (1 st diff.) | -8.12954 | 0.0000 | -4.32317 | 0.0122 |
| X3 (2 nd diff.) | -5.49454 | 0.0001 | -5.29933 | 0.0010 |
| Test critical values | 1 st diff. | 2 nd diff. | 1 st diff. | 2 nd diff. |
| 1% level | -3.67932 | -3.68919 | -4.30982 | -4.32398 |
| 5% level | -2.96777 | -2.97185 | -3.57424 | -3.58062 |
| 10% level | -2.62299 | -2.62512 | -3.22173 | -3.22533 |

Graph 1: Time path plot for research series

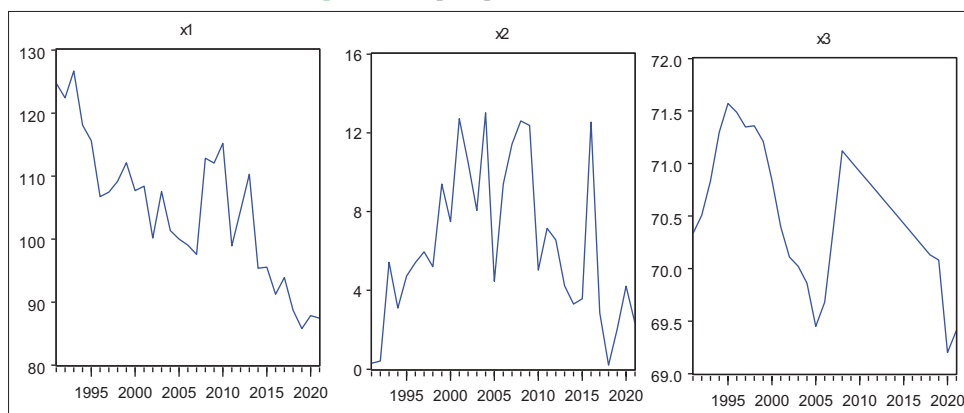


Table 4: Optimal lag length findings for the VAR model

| Lag | LogL | LR: Sequential modified LR test statistic (each test at 5% level) | FPE: final prediction error | AIC: Akaike information criterion | SC: Schwarz information criterion | HQ: Hannan-Quinn information criterion |
|-----|----------|---|-----------------------------|-----------------------------------|-----------------------------------|--|
| 0 | -189.15 | NA | 951.9391 | 15.37200 | 15.51827 | 15.41257 |
| 1 | -173.976 | 25.49239 | 585.6778 | 14.87808 | 15.46314 | 15.04035 |
| 2 | -154.46 | 28.10370* | 262.2309 | 14.03676 | 15.06062* | 14.32074 |
| 3 | -143.78 | 12.81515 | 252.3163* | 13.85949* | 15.36507 | 14.30810* |
| 4 | -134.244 | 9.155172 | 294.0934 | 13.90242 | 15.76094 | 14.38687 |

*Indicates lag order selected by the criterion (each test at 5% level)

econometric significance of the model is further evaluated by examining the existence of serial correlation and varying variance problems in the VAR model.

4. FINDINGS

This study examined the effect of foreign direct investment and labor force participation rate on energy consumption through VAR and VECM models. In the study, first of all, the explanatory statistics and graphics of the series were interpreted, then the stationarity was examined using the unit root test, and data series that is stationary at the same level were used in the analysis.

In the analysis phase, the optimum lag length was determined by creating a VAR model. The suitability of the VAR model produced according to the determined lag length was also proved by examining the inverse roots of the AR characteristic polynomial in terms of serial correlation and varying variance. Then, the existence of a long-term relationship between the series was examined using the cointegration test. In addition, the causal effects of foreign direct investments and labor force participation rate on energy consumption were examined using Granger causality analysis. This effect was estimated and interpreted using the VECM model performed in line with these findings. At the last stage of the analysis, the effect was interpreted in detail using the impulse response function and variance decomposition values.

The descriptive statistics are given in Table 2, and the timeline graph of the series is in Graph 1. According to average values,

Table 5: Serial correlation and varying variance findings for the research model

| Residual serial correlation LM tests | | | |
|--------------------------------------|-----------|--------|--------|
| Lag | LRE* stat | df | Prob. |
| 1 | 6.052360 | 9 | 0.7347 |
| 2 | 4.446187 | 9 | 0.8797 |
| 3 | 6.351583 | 9 | 0.7043 |
| 4 | 9.646466 | 9 | 0.3799 |
| Residual heteroskedasticity tests | | | |
| Chi-square | df | Prob. | |
| 125.6635 | 120 | 0.3435 | |

energy consumption is 104.64, foreign direct investments are 6.32 and the labor force participation rate is 70.53. In addition, according to the Jarque-Berra test, all three series fit the normal distribution. The line graph shows that energy consumption tends to decrease over the years.

According to the ADF unit root test findings in Table 3, the X1 and X2 variables are stationary at the first difference and the X3 variable at the second difference level. Following these findings, the analysis used the second difference for all series.

The appropriate lag length criterion findings for the VAR model are given in Table 4. The lag value (3) obtained for the FPE and AIC criteria was taken as the optimum lag value.

The graphical representation of the inverse roots of the AR characteristic polynomial calculated to determine the fitness of the VAR model is given in Graph 2. As explained in the method section, the inverses of all roots were within the unit circle.

Table 6: Cointegration test findings for research series

| Unrestricted cointegration rank test (trace) | | | | |
|---|------------|---------------------|---------------------|---------|
| Hypothesized No. of CE(s) | Eigenvalue | Trace statistic | 0.05 Critical value | Prob.** |
| None* | 0.710169 | 48.26927 | 29.79707 | 0.0001 |
| At most 1* | 0.371919 | 17.30787 | 15.49471 | 0.0264 |
| At most 2* | 0.203262 | 5.680725 | 3.841466 | 0.0171 |
| Unrestricted cointegration rank test (maximum eigenvalue) | | | | |
| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen statistic | 0.05 Critical value | Prob.** |
| None* | 0.710169 | 30.96140 | 21.13162 | 0.0015 |
| At most 1* | 0.371919 | 11.62715 | 14.26460 | 0.1254 |
| At most 2* | 0.203262 | 5.680725 | 3.841466 | 0.0171 |

Table 7: Granger causality analysis findings for research series

| Dependent variable | Independent variable | Chi-square | df | Prob. |
|--------------------|----------------------|------------|----|--------|
| D2X1 | D2X2 | 8.736629 | 3 | 0.0330 |
| | D2X3 | 6.463657 | 3 | 0.0911 |
| | All | 21.27631 | 6 | 0.0016 |
| D2X2 | D2X1 | 8.197572 | 3 | 0.0421 |
| | D2X3 | 1.581949 | 3 | 0.6635 |
| | All | 11.21121 | 6 | 0.0821 |
| D2X3 | D2X1 | 1.496977 | 3 | 0.6830 |
| | D2X2 | 6.082609 | 3 | 0.1077 |
| | All | 6.525447 | 6 | 0,3670 |

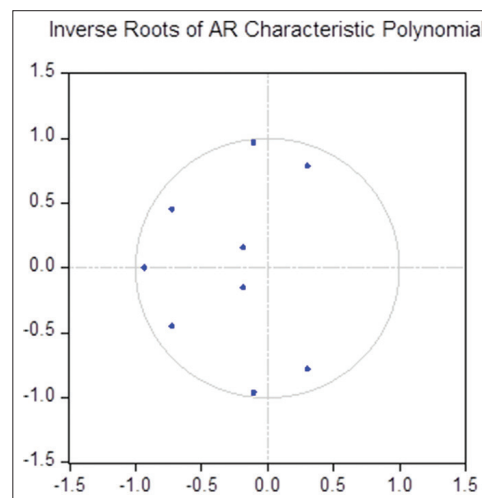
The test findings regarding the serial correlation and varying variance problems are given in Table 5. There were no serial correlation and varying variance problems.

The cointegration test findings for the research series are in Table 6. There are at least three cointegrations according to the Trace statistics and at least one according to the Max-Eigen statistics. The findings show that it is appropriate to analyze the relationship structure between research variables with the VECM model.

The Granger causality analysis findings of the research series are given in Table 7. The Granger causality analysis findings of the research series are given in Table 7. The model, in which energy consumption is taken as dependent and foreign direct investments and labor force participation rate as independent variables, shows that foreign direct investments have a causal effect on energy consumption, while the labor force participation rate has no causal effect. The causal effect of foreign direct investments and labor force participation variables on energy consumption was statistically significant. As in Table 6, the Granger causality analysis findings also show that it would be more accurate to analyze the relationship structure between research variables using the VECM model.

VECM estimation findings are given in Table 8. The first part of the table presents the long-term estimation values, and the second part presents the short-term estimation values. Long-term forecast values show that foreign direct investments have a negative and statistically significant effect, while the effect of labor force

Graph 2: Graph of the inverse roots of the AR characteristic polynomial for the VAR model



participation rate is statistically insignificant. The findings show that 1 point increase in foreign direct investments causes a 1.62 point decrease in energy consumption.

The short-term effect findings in the second part show that the three-term lagged value of foreign direct investments has a statistically significant and negative effect. On the other hand, only the two-period lagged value of the labor force participation rate was found to be statistically significant and positive.

The response of the energy consumption variable to the shocks in the variables is given in Table 9. The response of energy consumption to a shock on it is positive in the first period, negative in the second period, and positive in the third period. The shocks in foreign direct investments were positive in the second and third periods and negative in the fourth period. The shocks in the labor force participation rate were positive at the end of the third period and negative at the end of the fourth period.

The variance decomposition findings of the energy consumption variable are given in Table 10. In the first period, all variance decomposition is on itself. However, at the end of the tenth period, 38.67% of the decomposition is on its own, 20.89% is on foreign direct investments and 40.44% is on the labor force participation rate.

Table 8: VECM estimation findings

| Cointegrating Eq | Coint. Eq1 | | | | | | | | |
|------------------|------------|---------|----------|-----------|---------|----------|-----------|---------|----------|
| | Estimate | SE | t-stat. | | | | | | |
| D2X1(-1) | 1.000000 | | | | | | | | |
| D2X2(-1) | -1.61692 | 0.45051 | -3.58906 | | | | | | |
| D2X3(-1) | 1.030915 | 3.28291 | 0.31402 | | | | | | |
| C | -0.100174 | | | | | | | | |
| Error correction | D(D2X1) | | | D(D2X2) | | | D(D2X3) | | |
| | Estimate | SE | t-stat. | Estimate | SE | t-stat. | Estimate | SE | t-stat. |
| CointEq1 | -2.57519 | 0.76368 | -3.37207 | -1.331432 | 0.45854 | 2.90362 | -0.071559 | 0.04412 | -1.62183 |
| D(D2X1(-1)) | 0.738155 | 0.62940 | 1.17279 | -1.137643 | 0.37791 | -3.01032 | 0.051787 | 0.03636 | 1.42413 |
| D(D2X1(-2)) | 0.104905 | 0.37101 | 0.28276 | -0.995947 | 0.22277 | -4.47081 | 0.024021 | 0.02144 | 1.12064 |
| D(D2X1(-3)) | -0.07912 | 0.17781 | -0.44498 | -0.492996 | 0.10676 | -4.6177 | 0.007427 | 0.01027 | 0.72299 |
| D(D2X2(-1)) | -3.43453 | 1.13330 | -3.03056 | 0.362469 | 0.68047 | 0.53267 | -0.101987 | 0.06548 | -1.5576 |
| D(D2X2(-2)) | -1.93769 | 0.87637 | -2.21105 | 0.136197 | 0.52620 | 0.25883 | -0.055038 | 0.05063 | -1.08701 |
| D(D2X2(-3)) | -0.87006 | 0.41877 | -2.07766 | 0.026380 | 0.25145 | 0.10491 | -0.000296 | 0.02419 | -0.01221 |
| D(D2X3(-1)) | 3.046809 | 4.96431 | 0.61374 | 3.662294 | 2.98075 | 1.22865 | -0.837958 | 0.28682 | -2.92158 |
| D(D2X3(-2)) | 11.16571 | 4.67025 | 2.39081 | 4.609453 | 2.80418 | 1.64378 | -0.620526 | 0.26983 | -2.29972 |
| D(D2X3(-3)) | 1.558980 | 5.60397 | 0.27819 | -1.278511 | 3.36482 | -0.37996 | -0.811863 | 0.32377 | -2.5075 |
| C | 0.698343 | 1.41362 | 0.49401 | 0.230837 | 0.84879 | 0.27196 | 0.032788 | 0.08167 | 0.40145 |
| R-squared | 0.929929 | | | 0.940087 | | | 0.686661 | | |
| Adj. R-squared | 0.879878 | | | 0.897292 | | | 0.462848 | | |
| F-statistic | 18.57963 | | | 21.96724 | | | 3.068008 | | |
| Log likelihood | -76.7277 | | | -63.97518 | | | -5.448046 | | |
| Akaike AIC | 7.018218 | | | 5.998014 | | | 1.315844 | | |
| Schwarz SC | 7.554523 | | | 6.534320 | | | 1.852149 | | |

Table 9: The response of energy consumption

| Period | D2X1 | D2X2 | D2X3 |
|--------|----------|----------|----------|
| 1 | 6.959305 | 0.000000 | 0.000000 |
| 2 | -4.64327 | 2.855542 | 0.149226 |
| 3 | 3.106131 | 2.081689 | 4.376872 |
| 4 | -1.07623 | -2.04088 | -4.92804 |
| 5 | 3.820703 | 3.418787 | 1.540803 |
| 6 | 0.860251 | -2.73433 | -0.43292 |
| 7 | -0.16724 | 4.127759 | 5.039229 |
| 8 | 0.791352 | 0.359765 | -4.91127 |
| 9 | 1.853081 | 0.956850 | 2.384980 |
| 10 | -0.18446 | 0.521715 | -1.9021 |

Table 10: Variance decomposition findings of energy consumption variable

| Period | SE | D2X1 | D2X2 | D2X3 |
|--------|----------|----------|----------|----------|
| 1 | 6.959305 | 100.0000 | 0.000000 | 0.000000 |
| 2 | 8.841284 | 89.54002 | 10.43150 | 0.028488 |
| 3 | 10.55020 | 71.54996 | 11.21904 | 17.23101 |
| 4 | 11.87080 | 57.33793 | 11.81750 | 30.84457 |
| 5 | 13.02213 | 56.25567 | 16.71278 | 27.03155 |
| 6 | 13.34091 | 54.01514 | 20.12441 | 25.86045 |
| 7 | 14.84722 | 43.62366 | 23.97740 | 32.39893 |
| 8 | 15.66257 | 39.45529 | 21.59874 | 38.94597 |
| 9 | 15.97979 | 39.24913 | 21.10827 | 39.64260 |
| 10 | 16.10211 | 38.66821 | 20.89377 | 40.43801 |

5. CONCLUSION AND RECOMMENDATIONS

Energy consumption is one of the most important economic indicators. Therefore, it is essential to determine the variables affecting energy consumption, both for the economic life in a country and scientific literature. This study examines the impact of foreign direct investment and labor force participation on

energy consumption as possible factors. Our findings show that, for Kazakhstan, foreign direct investment affects energy consumption in both the long and the short term. Although the labor force participation rate is effective on energy consumption in the short term, it does not seem effective in the long term. This is important as it shows the long-term indirect effects of foreign direct investments on the economy. The study used annual data series for all three variables. Another important subject of study for explaining this relationship may be the use of series in different periods (especially quarterly).

REFERENCES

- Abidin, I.S.Z., Haseeb, M., Muhammad, A.Z.A.M., Islam, R. (2015), Foreign direct investment, financial development, international trade and energy consumption: Panel data evidence from selected ASEAN countries. *International Journal of Energy Economics and Policy*, 5(3), 841-850.
- Alshehry, A.S., Belloumi, M. (2015), Energy consumption, carbon dioxide emissions and economic growth: The case of Saudi Arabia. *Renewable and Sustainable Energy Reviews*, 41, 237-247.
- Available from: <https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS?locations=KZ> [Last accessed on 2023 May 02].
- Available from: <https://data.worldbank.org/indicator/SL.TLF.CACT.ZS?locations=KZ> [Last accessed on 2023 May 02].
- Available from: <https://stat.gov.kz/en/> [Last accessed on 2023 May 03].
- Available from: <https://yearbook.enerdata.net/total-energy/world-consumption-statistics.html> [Last accessed on 2023 May 03].
- Bekhet, H.A., bt Othman, N.S. (2011), Causality analysis among electricity consumption, consumer expenditure, gross domestic product (GDP) and foreign direct investment (FDI): Case study of Malaysia. *Journal of economics and international finance*, 3(4), 228-235.
- Bolganbayev, A., Sabenova, B., Mombekova, G., Sultankhanova, G., Tazhibayeva, R.M. (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.
- Çetin, M.A. (2019), The Role of Foreign Direct Investment on Female Labor Force Participation: Evidence from Emerging Markets. In: Conference: 5th International Congress of Economics and Business: New Economic Trends and Business Opportunities, Bursa. p1-18.
- Çütçü, İ., Enez, K.A.N. (2018), Doğrudan yabancı sermaye yatırımlarını etkileyen faktörler: Türkiye Örneği. *Sakarya İktisat Dergisi*, 7(3), 1-21.
- Dai, L., Jia, R., Wang, X. (2022), Relationship between economic growth and energy consumption from the perspective of sustainable development. *Journal of Environmental and Public Health*, 2022, 6884273.
- De Vita, G., Li, C., Luo, Y. (2021), The inward FDI-Energy intensity nexus in OECD countries: A sectoral RandD threshold analysis. *Journal of Environmental Management*, 287, 112290.
- Firdaus, M. (2020), Aplikasi Ekonometrika Dengan E-Views, Stata, dan R. PT Penerbit. Indonesia: IPB Press.
- Gharaibeh, A. (2015), The determinants of foreign direct investment-empirical evidence from Bahrain. *International Journal of Business and Social Science*, 6(8), 94-106.
- Mahmoodi, M., Mahmoodi, E. (2016), Foreign direct investment, exports and economic growth: Evidence from two panels of developing countries. *Economic Research-Ekonomika Istraživanja*, 29(1), 938-949.
- Matei, I. (2018), Is there a link between renewable energy consumption and economic growth? A dynamic panel investigation for OECD countries. *Revue d'Economie Politique*, 127(6), 985-1012.
- Mudarrisov, B.A., Lee, Y. (2014), The relationship between energy consumption and economic growth in Kazakhstan. *Geosystem Engineering*, 17, (1), 63-68,
- Mukhtarov, S., Humbatova, S., Seyfullayev, I., Kalbiyev, Y. (2020), The effect of financial development on energy consumption in the case of Kazakhstan. *Journal of Applied Economics*, 23(1), 75-88.
- 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.
- Nguyen, C.H. (2021), Labor force and foreign direct investment: Empirical evidence from Vietnam. *Journal of Asian Finance, Economics and Business*, 8(1), 103-112.
- Odhiambo, N.M. (2010), Electricity consumption, labour force participation rate and economic growth in Kenya: An empirical investigation. *Problems and Perspectives in Management*, 8(1), 31-38.
- Ongarova, Y. (2018), Kazakistan'ın çok yönlü enerji politikası ve Hazar denizi. *Alinteri Sosyal Bilimler Dergisi*, 2(3), 1-21.
- Polat, B. (2018), DYY'lerin gelişmekte ve gelişmiş ülkelerde' ki enerji tüketimi üzerindeki etkisi: Dinamik panel veri analizi. *Journal of Yasar University*, 13(49), 33-42.
- Sabenova, B., Baubekova, I., Issayeve, 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.
- Siddiqui, R. (2004), Energy and Economic Growth in Pakistan. *The Pakistan Development Review*, 43(2), 175-200.
- Taibek, Z., Kozhamkulova, I., Kuralbayev, A.K., 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.
- Wayhudi, H., Palupi, W.A. (2023), Relationship between energy consumption, foreign direct investment, and labor force participation using the VECM Model: Empirical study in OECD countries. *International Journal of Energy Economics and Policy*, 13(2), 157-165.
- Widarjono, A. (2018), Ekonometrika Pengantar dan Aplikasinya Disertasi Panduan Eviews. 5th ed. Indonesia: UPP STIM YKPN.
- 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.