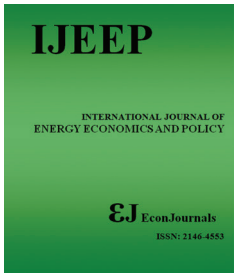

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Analysis of the Relationship between the Highest Price and the Trading Volume of the Energy Company Shares in Kazakhstan with Frequency Domain Causality Method

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ABSTRACT

This study analyzes the causal relationship between the highest price formation and trading volume in Energy Company stocks traded on KASE. In addition, Granger causality analysis is strengthened with frequency domain causality analysis to determine the concentration points of the causality relationship. This aspect provides vital decision support, especially in investment decisions. Three different relationships are identified for the causality between the highest price formation and the transaction volume. There is a two-way causality relationship for KEGC and a one-way for KZTO. No causal relationship was found for KZAP. These results can be interpreted as an indication that the Kazakhstan stock market offers a rich portfolio for investors. The causality structure of the investment climate in Kazakhstan can be analyzed by similar studies on the composite index and other companies traded in KASE. The time interval of the study was determined as between January 01, 2021 and January 31, 2023 and the data used were retrieved from the investing.com website.

Keywords: Kazakhstan, Kazakhstan Stock Exchange, Energy, Share Index, Transaction Volume, Price Formation, Granger Causality
JEL Classifications: C13, C20, C22

1. INTRODUCTION

The removal of barriers to capital movement and dazzling innovations in information and communication technologies have gradually increased the integration between financial markets in a globalizing world. This integration has deeply affected the economies of countries and made them more interconnected than ever before. However, this financial liberalization process had both positive and negative effects on the financial markets of developing countries. The transition to financial liberalization without the necessary macroeconomic preconditions has increased the fragility of emerging market markets (Şimşek, 2007; Kuzu, 2019).

Kazakhstan gained its independence in 1991, decided to transition to a free market economy immediately thereafter, and took important steps towards integrating with world markets. In the literature, this process, in which countries such as Kazakhstan undergo significant structural changes for the transition to a free market economy, is called the transition period or transition economy. Although there were many difficulties in this transition period, Kazakhstan's economy has recovered and started to rise since 2000. Kazakhstan's natural wealth has been effective as well as the policies of decision-makers in the successful recovery of the Kazakhstan economy. Kazakhstan possesses approximately 3% of the world's total oil reserves, 3.3% of coal reserves, and 1.1% of natural gas reserves (Xiong et al., 2015;

Myrzabekkyzy et al., 2022; Bolganbayev et al., 2022; Taibek et al., 2023).

One of the important steps taken by Kazakhstan in the transition to a free market economy was the establishment of the Kazakhstan Stock Exchange (KASE). On 5 November 1993, the national currency, the Tenge, was issued. On November 17, 1993, the Kazakhstan Interbank Currency Exchange was established by the Kazakhstan National Bank and 23 leading local commercial banks to regulate and develop the national currency market, and in 1996 it is renamed the Kazakhstan Stock Exchange (KASE). As a not-for-profit company, KASE has been the only trading platform in Kazakhstan serving the stock, currency, and currency markets since its foundation. KASE is divided into four sub-markets: the international trade market, the authorized securities market, the supranational securities of Kazakhstan, the stock and corporate securities market, and the derivatives market (Gnahe, 2020; https://kase.kz/en/history/).

The relationship between price formation and transaction volume in financial markets has attracted the attention of many researchers and investors since the early times. The number of studies on the subject since the 1950s is significant proof. Osborne's pioneering work showed a theoretical relationship between volume and price (Osborne, 1959). Most early studies found a positive relationship between the absolute value of daily price changes and daily volume for both market indices and individual stocks. Granger and Morgenstern (1963) found no relationship between the absolute value of daily price changes and daily volume. However, subsequent studies by Ying (1966), Crouch (1970), Epps and Epps (1976), and Harris (1986) found a relationship between an absolute price change and volume change. But Chen et al. (2001), Khan and Rizwan (2008), Lee and Rui (2002), and Pisedtasalasai and Gunasekarage (2007) found a simultaneous and lagged relationship between stock returns and trading volume (Pathirawasam and Idirisinghe, 2011). There are even more studies on different stock markets using different analysis methods (Xu and Wu, 1999; Chen, 2012; Liu et al.,: 2015).

This study examines the causality relationship between the highest price formation and the trading volume in the energy companies' stocks traded in KASE with Granger causality analysis and frequency domain causality analysis. The period between January 01, 2021 and January 31, 2023 was determined as the time interval of the study. The data used in the research were retrieved from the investing.com website (https://tr.investing.com/).

2. LITERATURE REVIEW

Although there are many studies in the academic literature on price formation and trading volume in world stock markets, studies on KASE are limited. Here we will only mention some of the main ones.

Oskenbayev et al. (2011) analyzed the causality relationship between the KASE index and macroeconomic indicators for the 2001-2009 period. They revealed a cointegration between the series, which indicates the violation of the market efficiency hypothesis. Their analysis used the boundary test approach within the framework of the ARDL model, and the results were consistent with both theory and practice. In addition, with the Johansen cointegration test, the Engel-Granger two-step approach, and the Granger causality tests, they found that the main determinants of KASE are inflation, per capita income, and the exchange rate and dummy variables that explain the impact of global crises. They also revealed that fluctuations in oil prices affect KASE stock indices.

Syzdykova (2018) analyzed the relationship between five macroeconomic variables and the KASE stock market index and used the EKK method, Johansen cointegration test, error correction model, and Granger causality analysis. He revealed that the changes in the CPI, interest rate, industrial production index, oil prices, and exchange rate variables explain the Kazakhstan stock market by 62%. He also showed that the independent variables, namely oil price and exchange rate, are statistically significant and affect the stock market negatively.

Pathirawasam and Idirisinghe (2011) examined the relationship between trading volume and stock returns over 266 stocks traded on the Colombo Stock Exchange (CSE) between 2000 and 2008. Their analysis determined that stock returns are positively correlated with current changes in trading volume, and past changes are negatively correlated with stock returns.

Tripathy (2011) analyzed the dynamic relationship between stock return and trading volume of the Indian stock market. He employed the Bivariate Regression model, VECM Model, VAR, IRF, and Johansen's Cointegration test. He found bidirectional causality between trading volume and stock return volatility and showed that trading volume affects the Indian stock market. He also showed that the stock return in India is cointegrated with the trade volume and shows a long-term equilibrium.

Erdem et al. (2020) analyzed whether there is a dynamic and causal relationship between the price index values and the trading volume in Turkey in their study, which deals with the relationship between the highest price formation in share indices and the trading volume. Autoregression analysis (VAR), Granger causality, and Breitung and Candelon's (2006) frequency domain causality analysis were performed on the daily trading volume and the highest price and closing price of the BIST30 price index between 2010 and 2019. They concluded that the existence of the price-volume relationship depends on the type of price data and its direction depends on the frequency.

Sabenova et al. (2023) comparatively examined the volatility structures of the returns of oil and energy companies traded on the Kazakhstan stock exchange for January 5, 2021-January 4, 2023. They determined that the volatility structure of the past period affects the current period. Based on this finding, the structure of the series was evaluated through four different models. All four return series conform with the same model, GARCH-M (1,1).

3. METHODS

The causality structure between the variables is critical in examining the relationship between econometric time series. The

causality test by Granger (1969) reveals the time dimension of this relationship.

Frequency distribution causality tests proposed by Geweke (1982), Hosoya (1991), and Breitung and Candelon (2006) examine the relationships between variables over time and different frequencies. This aspect of the frequency domain causality test adds a different approach and interpretation power to the analysis.

The basic structure on which frequency domain causality analysis is based is the Fourier time series transform. For the bivariate model, the VAR (p) model is expressed in matrix notation, and the lag operator is as follows:

$$\varphi(L)=\begin{pmatrix}Y_t\\X_t\end{pmatrix}=\begin{bmatrix}\varphi_{11}(L) & \varphi_{12}(L)\\ \varphi_{21}(L) & \varphi_{22}(L)\end{bmatrix}+\begin{pmatrix}\varepsilon_{1t}\\\varepsilon_{2t}\end{pmatrix} \quad (1)$$

By adding Cholesky decomposition to (1), the VAR model is converted to a moving average model.

$$\begin{pmatrix}Y_t\\X_t\end{pmatrix}=\psi(L)\eta=\begin{pmatrix}\psi_{11}(L) & \psi_{12}(L)\\ \psi_{21}(L) & \psi_{22}(L)\end{pmatrix}\begin{pmatrix}\eta_{1t}\\\eta_{2t}\end{pmatrix} \quad (2)$$

Based on (2), Geweke's proposed measure of causality is expressed as follows:

$$M_{y\to x}(\omega)=\log\left[\frac{2\pi f_x(\omega)}{\left|\psi_{11}\left(e^{-i\omega}\right)\right|^2}\right]=\log\left[1+\frac{\left|\psi_{12}\left(e^{-i\omega}\right)\right|^2}{\left|\psi_{11}\left(e^{-i\omega}\right)\right|^2}\right] \quad (3)$$

Having $\left|\psi_{12}\left(e^{-i\omega}\right)\right|=0$ in the resulting expression means that Y_t is not the Granger cause X_t.

According to the information given, frequency domain causality analysis is started with the VAR(p) model. Then, by applying the Fourier transform to the obtained model, the statistical value for the frequency domain causality test is calculated. The existence of a causal relationship is decided according to the result of the Granger causality test at ω frequency by using the F test (Aydin, 2020).

4. ANALYSIS AND FINDINGS

This study uses frequency domain causality analysis to examine the relationship between the highest price formation and trading volume of energy companies traded on the Kazakhstan stock exchange. The variables of the companies included are given in Table 1. Since there are three companies traded on the stock exchange, six variables are defined, two for each.

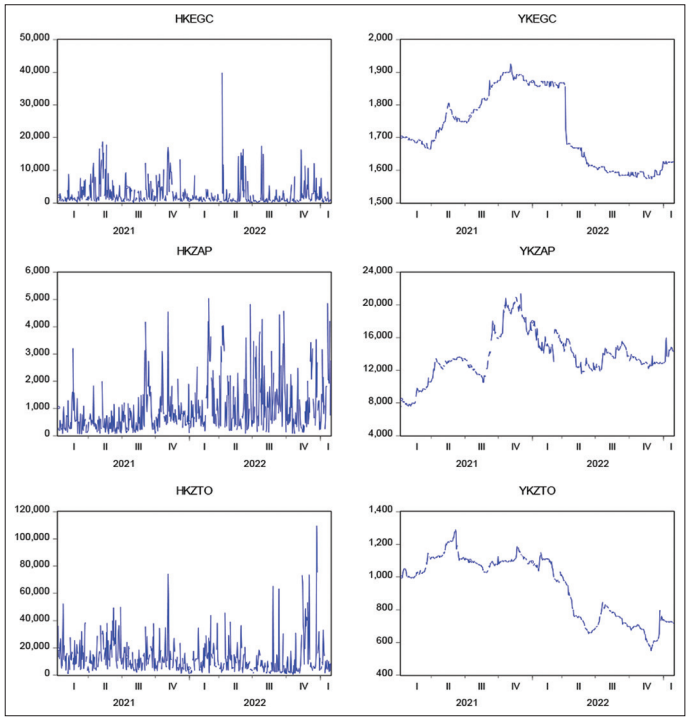
The daily data of the companies for the period January 01, 2021-January 31, 2023 were used. Descriptive statistics are given in Table 2 and daily changes are given in Graph 1.

ADF (Augmented Dickey-Fuller) unit root test was used to examine the existence of a unit root in the series and the findings are given in Table 3. The findings show that the trading volume series is stationary at level, while the highest price formation series is stationary at the first difference for all three companies.

Table 1: Analysis variables and descriptions

Variable code	Description
HKEGC	KEGC's trading volume
HKZAP	KZAP's trading volume
HKZTO	KZTO's trading volume
YKEGC	KEGC's highest price
YKZAP	KZAP's highest price
YKZTO	KZTO's highest price

Graph 1: Line chart for daily data



In line with this result, the analysis was performed with the first difference of the series. Variables expressing the first difference were coded by adding (_D) to the end of each variable.

To determine the VAR(p) model, which is the first step of the causality analysis, the lag length is calculated for each company and the VAR model corresponding to the appropriate lag length is used. The lag length is selected using AIC (Akaike Information Criteria) (Table 4).

The model fit for each model was examined with the LM (Lagrange Multiplier) method, which determines the existence of a serial autocorrelation in the residuals, and no serial autocorrelation was found. The variable variance problem was examined with the White varying variance test and no problem was found. The third criterion for the fitness of the model is tested by graphically examining the inverse roots of the AR characteristic polynomial. Graphical analysis showed that all roots are within the unit circle.

VAR(p) granger causality test findings are given in Table 5. According to the table, for the KEGC company, both the highest trading volume is the cause of the highest price formation and the highest price formation is the cause of the highest trading volume. On the other hand, only the trading volume is a cause for the highest price formation in KZTO. There was no causal

Table 2: Descriptive statistics for research variables

Statistics	HKEGC	HKZAP	HKZTO	YKEGC	YKZAP	YKZTO
Mean	2644.355	1000.292	12968.77	1725.484	943.9634	13740.93
Median	1195.000	670.0000	9255.000	1699.800	1027.200	13399.00
Maximum	39810.00	5040.000	109360.0	1925.000	1290.000	21405.90
Minimum	120.0000	70.00000	640.0000	1574.000	550.0000	7580.000
SD	3812.887	960.1668	12894.07	112.0686	190.1600	2773.540
Skewness	3.633290	1.821512	2.680512	0.193796	−0.41225	0.245625
Kurtosis	23.91149	6.221623	13.62445	1.538037	1.664300	3.414000

SD: Standard deviation

Table 3: Unit root test findings for series

Variable code	Level				First difference			
	Constant		Constant, linear trend		Constant		Constant, linear trend	
	T-statistics	P	T-statistics	P	T-statistics	P	T-statistics	P
YKEGC	−0.6049	0.8666	−1.3813	0.8655	−13.4662	0.0000	−13.5005	0.0000
HKEGC	−11.2019	0.0000	−11.319	0.0000	−18.2299	0.0000	−18.2127	0.0000
YKZTO	−0.41865	0.9032	−2.18998	0.4937	−20.5261	0.0000	−20.54	0.0000
HKZTO	−15.4261	0.0000	−15.4519	0.0000	−16.124	0.0000	−16.1077	0.0000
YKZAP	−2.39613	0.1433	−2.17681	0.5010	−25.5423	0.0000	−25.5697	0.0000
HKZAP	−8.00515	0.0000	−11.0433	0.0000	−13.6921	0.0000	−13.6808	0.0000
Test critical values								
1% level	−3.44307		−3.97633		−3.44312		−3.97641	
5% level	−2.86704		−3.41874		−2.86707		−3.41878	
10% level	−2.56976		−3.1319		−2.56978		−3.13192	

Table 4: The lag length value for the VAR(p) model

Model		Lag length
YKEGC_D	HKEGC_D	5
HKZTO_D	YKZTO_D	5
HKZAP_D	YKZAP_D	10

Table 5: VAR(p) granger causality analysis findings for variables

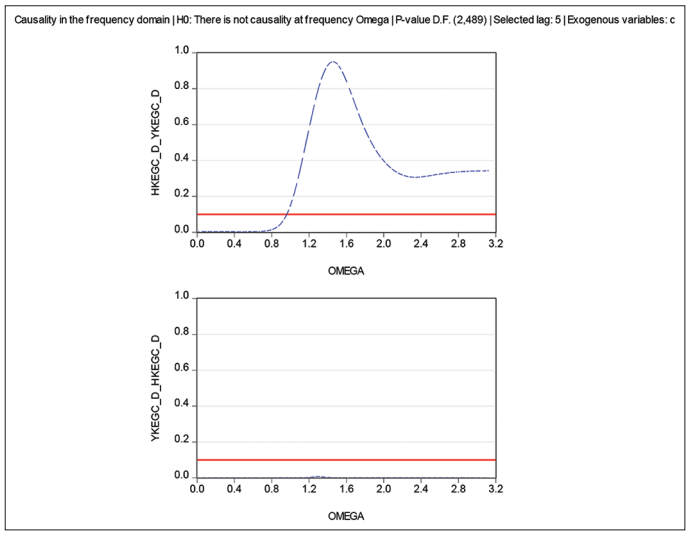
Independent variable	Dependent variable	χ^2	df	P
YKEGC_D	HKEGC_D	13.96753	5	0.0158
HKEGC_D	YKEGC_D	110.7849	5	0.0000
YKZTO_D	HKZTO_D	4.600244	5	0.4666
HKZTO_D	YKZTO_D	30.02959	5	0.0000
YKZAP_D	HKZAP_D	5.468889	10	0.8577
HKZAP_D	YKZAP_D	12.32286	10	0.2640

relationship between the highest price formation and the trading volume in KZAP.

The frequency domain causality analysis findings between the highest price formation and the trading volume for KEGC are given in Graph 2. The significance of the frequency domain causality relationship at the 0.10 level is also shown by the horizontal line. Omega values below the horizontal line show the frequency domains where the causality effect is significant. The graph shows that there is a causal relationship from the trading volume to the highest price formation in the short run, while a causal relationship from the highest price formation to the trading volume is present in all terms.

The frequency domain causality analysis findings between the highest price formation and the trading volume for KZTO are given in Graph 3. The significance of the frequency domain

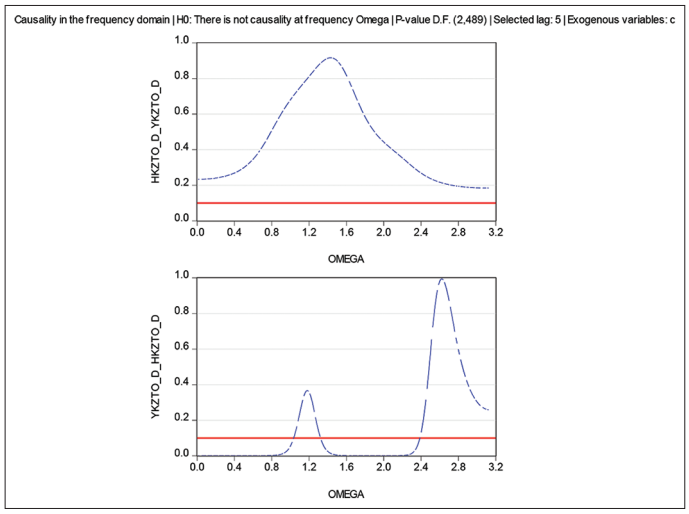
Graph 2: Frequency domain causality analysis findings between the highest price formation and the highest trading volume for KEGC



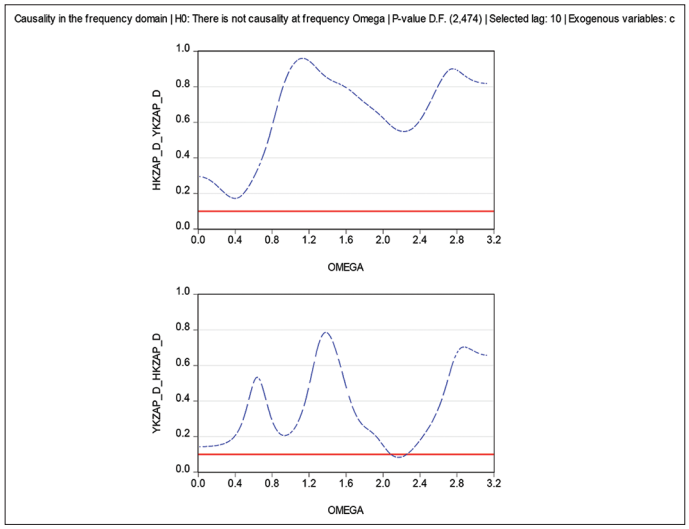
causality relationship at the 0.10 level is also shown by the horizontal line. Omega values below the horizontal line show the frequency domains where the causality effect is significant. The graph shows that there is a causal relationship leading from the highest price formation to the trading volume present both in the short and medium terms.

The frequency domain causality analysis findings between the highest price formation and the trading volume for KZAP are given in Graph 4. The significance of the frequency domain causality relationship at the 0.10 level is also shown by the horizontal line. Omega values below the horizontal line show the frequency domains where the causality effect is significant. The graph does not show bidirectional causality in any term.

Graph 3: Frequency domain causality analysis findings between the highest price formation and the highest trading volume for KZTO



Graph 4: Frequency domain causality analysis findings between the highest price formation and the highest trading volume for KZAP



5. CONCLUSION

This study analyzes the causal relationship between the highest price formation and trading volume in Energy Company stocks traded on Kazakhstan Stock Exchange. Granger causality analysis is strengthened with frequency domain causality analysis to determine the concentration points of the causality relationship. This aspect provides vital decision support, especially in investment decisions. Three different relationships are identified for the causality between the highest price formation and the transaction volume. There is a two-way causality relationship for KEGC and a one-way for KZTO. No causal relationship was found for KZAP. These results can be interpreted as an indication that the Kazakhstan stock market offers a rich portfolio for investors. The causality structure of the investment climate in Kazakhstan can be analyzed by similar studies on the composite index and other companies traded in KASE.

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