IJEEP
INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(3), 28-35.

The Relationship between the Highest Prices and Trading Volume in the Share Indices of Energy and Oil Companies in Kazakhstan

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Received: 17 January 2023 **Accepted:** 02 April 2023 **DOI:** https://doi.org/10.32479/ijeep.14189

ABSTRACT

This study uses econometric methods to reveal the relationship between the highest price formation and trading volume in the share indices of energy and oil companies traded on the Kazakhstan Stock Exchange (KASE). The study used daily transaction data of KEGC, KZAP, and KZTO companies for 200 trading days in 2022. The analysis is based on the Vector autoregressive models method. The shock effect analysis concluded that there is a mutual interaction between the trading volume and the highest price formation for all three companies. Trading volume had a causal effect on the highest price of only one company (KZTO). The existence of a correlation between the trading volume and the highest price formation is important for investment decisions. This can be interpreted as an indication of a connection between the trading volume and the highest price formation in KASE. More information on this relationship can be obtained by performing similar analyses for other companies traded in the KASE.

Keywords: Kazakhstan, KASE, Oil, Energy, Share Index, Transaction Volume, Price Formation, Vector Autoregressive Models Analysis
JEL Classifications: C13, C20, C22

1. INTRODUCTION

This study employed the Vector autoregressive models (VAR) method to examine the relationship between the highest price formation and trading volume in energy and oil companies' share indices in Kazakhstan. Kazakhstan passed through a period of restructuring in many areas, especially in the economy, after declaring independence in 1991. This period, in which reforms aimed at harmonization with global markets were made, is known as the transition period/transition economy. Although this transition period was painful, it started to bear fruit in 2000, and Kazakhstan's economy began to rise. Kazakhstan completed this transition relatively quickly, thanks to its rich natural resources (about 3% of the global oil reserves, about 1.1% of natural gas reserves, and about 3.3% of coal reserves) and its successful policymakers (Xiong et al., 2015; Myrzabekkyzy et al., 2022; Bolganbayev et al., 2022). Kazakhstan Stock Exchange (KASE) was established on November 17, 1993, as the crown symbol of economic transformation. The shareholders of KASE are 23 Kazakh banks, especially the Kazakhstan National Bank, which has the largest share with 50.1%. KASE, whose duties include the regulation of the national currency market of Kazakhstan, has an important position in the economy of Kazakhstan as it is the only stock exchange of the country that operates the stock and foreign exchange markets (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. The history of studies on the relationship between trading volume and price formation dates back to the 1950s. Most early studies found a positive relationship between daily price volatility and daily volume for market indices and individual stocks (Pathirawasam, 2011). There are still new studies analyzing different exchanges using different methods (Xu and Wu, 1999; Chen and Liao, 2005; Chen, 2012; Liu et al., 2015).

The time interval of the study was determined as January-December 2022. The data were taken from the investing.com website (Access Date: 15.12.2022).

2. LITERATURE REVIEW

Although the studies on the transactions carried out in KASE are limited in the literature, there are very few studies on price formation and transaction volume in the stock markets. Here, we will only mention the major ones.

Oskenbayev et al. (2011) discussed the causality relationship between macroeconomic indicators and the Kazakhstan stock market (KASE) index. They found cointegration between the series in the 2001-2009 period, which indicates that the market efficiency hypothesis is violated. They showed that the results of the bounds test in the framework of the Autoregressive Distributed Latency model conform with both theory and practice. With the Johansen, Engel-Granger, and Granger tests, they found that the main determinants of KASE are inflation, per capita income and exchange rate and dummy variables, and fluctuations in oil prices have an effect on the index of stocks traded in KASE.

Yalçın (2015) analyzed the effects of increased oil prices due to supply or demand shocks on the transactions in the stock markets of Russia, Kazakhstan, and Ukraine using the structural VAR model. The real returns of the world real economic activity index, world oil production, real crude oil prices, and closing prices of MICEX, KASE, and PFTS stock exchanges for the period from January 2000 to July 2013 were analyzed. The 2008 crisis, which was in the time interval of the research and affected all world markets, was taken as the separation point. Thus, by comparing the period before and after 2008, the differences are determined.

Syzdykova (2018) analyzed the relationship between five macroeconomic variables and the KASE stock market index. This study employed the EKK method, Johansen cointegration test, error correction model, and Granger causality analysis methods. It has been determined that the changes in the industrial production index, interest rate, CPI, exchange rate, and oil prices explain the Kazakhstan stock market by 62%, the oil price and exchange rate variables, which are among the independent variables included in the model, are statistically significant and affect the stock market negatively.

Gazel et al. (2022) analyzed the relations between the stock market index returns of Russia, Turkey, Kazakhstan, and Ukraine and selected macroeconomic variables. This research used the stock market index quarterly data and macroeconomic data of Russia, Turkey, Kazakhstan, and Ukraine for the period 2009-2021 obtained from the Thomson Reuters database. The relations between the stock market indices of the relevant countries and macroeconomic variables such as exchange rate, GDP growth rate, import, export, inflation, and interest rate were analyzed in the specified period. The panel regression model showed that the relationships between stock market index returns and macroeconomic variables are in different directions and dimensions.

Saatcioğlu and Starks (1998) examined the stock price-volume relationship in some Latin American markets. Consistent with the results of the previous study, they found a positive relationship between the volume and the size of the price change and the price change itself, using monthly index data. However, when they used (VAR) analysis to test for Granger causality, they found no strong evidence that changes in stock price lead to volume changes, unlike previous studies. They found that this contradicts the findings on developed markets. They concluded that the emerging markets, which have different institutions and information flows from the developed markets, do not present a stock price-volume leading-lag relationship similar to the developed markets.

Pathirawasam (2011) examined the relationship between trading volume and stock returns. The study found that stock returns were positively related to the change in trading volume between 2000 and 2008. It also revealed that historical trading volume change is negatively related to stock returns.

Tripathy (2011) analyzed the relationship between stock return and trading volume in the Indian stock market using the Bivariate Regression model, VECM Model, VAR, IRF, and Johansen's Cointegration test. The research found bidirectional causality between trading volume and stock return volatility. The Variance Decomposition Technique, which was performed to compare the explanatory power of the trading volume for the stock return, revealed that the trading volume has an effective role in the Indian stock market. Johansen's cointegration analysis also showed that stock return is cointegrated with trading volume, indicating a long-run equilibrium relationship.

Çelik and Koy (2019) empirically analyzed the price-volume relationship in the Istanbul Stock Exchange. The study used the frequency domain causality analysis of Breitung and Candelon and the wavelet analysis of Grinsted et al. The research proved the difficulty of finding a distinct pattern in a developing stock market such as the Istanbul Stock Exchange, and that the relationship between price formation and trading volume varies according to indices.

Erdem et al. (2020) examined the price formation and trading volume data in the BIST30 price index in the period of 2010-2019 with VAR analysis, Granger causality test, and Breitung-Candelon frequency domain causality analysis. They found that the existence of the relationship between price formation and trading volume varies depending on the type of price data, and its direction changes depending on the frequency.

3. METHODS

As in other general time series analysis methods, the series must also be stationary at the same level in VAR analysis. We used the Augmented Dickey-Fuller (ADF) test to examine the stationarity of the time series. The test statistic is given by the following equality:

$$\Delta Y_t = \beta_0 + \beta_1 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

If the null hypothesis is rejected in the ADF test, the series is considered stationary at the relevant level (Sevüktekin and Nargeleçekenler, 2007).

The complex nature of the relationships between economic variables requires the use of more than one equation in traditional forecasting models. This is analyzed through models known as the simultaneous equations systems. Simultaneous equation systems may require the application of structural constraints to overcome the determinism problem of the relevant model, depending on the state of the data (Tari and Bozkurt, 2006; Uysal et al., 2008). VAR, unlike simultaneous equations, are the preferred method in financial time series since they do not impose restrictions on the model (Keating, 1990). The VAR model for bivariate situations can be expressed as follows.

$$y_t = a_1 + \sum_{i=1}^{p} b_{1i} y_{t-i} + \sum_{i=1}^{p} b_{2i} x_{t-i} + \varepsilon_{1t} \quad (2)$$

$$x_t = c_1 + \sum_{i=1}^{p} d_{1i} y_{t-i} + \sum_{i=1}^{p} d_{2i} x_{t-i} + \varepsilon_{2t} \quad (3)$$

In the model, p represents the lag length, and e represents the error term with constant variance and zero covariance with lag values. The zero covariance of the error terms seems to be a constraint at first sight. However, the VAR model can eliminate the autocorrelation problem by increasing the lag length. Since only internal variables are included (right side of the model), the problem of simultaneity does not arise. Thus, parameter estimations can be performed using the least squares method (Özgen and Güloğlu, 2004).

Various tests are available to decide the lag length in the VAR model. In this study, the lag length was determined based on the results of the sequential modified (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ) tests.

The goodness-of-fit of the model is analyzed in three different ways over residuals. The first method checks whether the inverse roots of the AR characteristic polynomial are in the unit circle. The second method tests whether there is a serial correlation in the residuals. Serial correlation is tested with the Lagrange multiplier (LM). The third method checks whether the variable variance problem exists. Whether there is a variable variance problem is examined with the White variable variance test.

3.1. Granger Causality Analysis

If the VAR model decides that there is a reciprocal relationship between the past periods of two variables, the next step is to examine the causality of the relationship. The model was developed by Granger (1969) and has wide application.

4. ANALYSIS AND FINDINGS

Energy companies traded on the KASE constitute an important part of the stock market. This study analyzed the relationship between the daily trading volumes and the highest price formations of three energy companies traded on KASE using econometric methods. Daily transaction data of KEGC, KZAP, and KZTO for 200 trading days in 2022 are used (https://tr.investing.com, Access Date: 15.12.2022). Since the series is price values, we used their logarithms in our analysis. Definitions of research variables are given in Table 1.

This research performed a VAR model analysis for the relationship between transaction volume and the highest price for each company. Thus, three models, each with two variables, are created.

- Model 1: Trading volume – highest price relationship for KEGC company
- Model 2: Transaction volume – highest price relationship for KZAP company

Table 1: Research variables

Variable Code	Explanation
HKEGC	Transaction Volume of KEGC Company
HKZAP	Transaction Volume of KZAP Company
HKZTO	Transaction Volume of KZTO Company
YKEGC	Highest Price for KEGC Company
YKZAP	Highest Price for KZAP Company
YKZTO	Highest Price for KZTO Company

Table 2: ADF unit root test findings for research variables

	Level				First Difference			
	Constant		Constant, Linear Trend		Constant		Constant, Linear Trend	
	t-Statistic	Prob*	t-Statistic	Prob*	t-Statistic	Prob*	t-Statistic	Prob*
HKEGC	−9.88216	0.0000	−10.1030	0.0000	−15.1999	0.0000	−15.1839	0.0000
HKZAP	−7.12792	0.0000	−7.97394	0.0000	−16.5078	0.0000	−16.4915	0.0000
HKZTO	−8.00344	0.0000	−8.33600	0.0000	−14.8346	0.0000	−14.8227	0.0000
YKEGC	−0.57461	0.8731	−1.34830	0.8744	−12.9639	0.0000	−12.995	0.0000
YKZAP	−2.72808	0.0700	−2.30938	0.4275	−24.1611	0.0000	−24.2737	0.0000
YKZTO	−0.52418	0.8835	−2.06728	0.5623	−20.0498	0.0000	−20.0516	0.0000
Test critical values:								
1% level	−3.44358		−3.97705		−3.44358		−3.97705	
5% level	−2.86727		−3.41909		−2.86727		−3.4191	
10% level	−2.56988		−3.13210		−2.56988		−3.13211	

- Model 3: Trading volume – highest price relationship for KZTO company.

Thus, we can both examine the transaction volume of the companies and the highest price formation within the model, and also examine whether this relationship changes from company to company by making a comparison between the models.

The stationarities of six variables belonging to three companies were examined with the ADF test and the findings are shown in Table 2. Trading volume variables are stationary at the level and high price variables are stationary at the first difference. Accordingly, it was decided to analyze six variables by taking their first differences.

First of all, LAG criterion values are calculated to determine the lag lengths. Based on the findings in Table 3, we decided to select lag lengths of 2, 2, and 6 for Models 1, Models 2, and Model 3, respectively.

According to the findings of the LAG criterion, we created the equation VAR(2) for Model 1 and Model 2, and VAR(6) for

Table 3: LAG criteria values calculated to decide the latency length of 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
Model 1: FHKEGC FYKEGC						
0	614.7638	NA	1.48e-05	−5.4467	−5.41642	−5.43453
1	641.1420	52.05302	1.21e-05	−5.6457	−5.55461*	−5.60894*
2	647.2358	11.91675*	1.19e-05*	−5.6643*	−5.51249	−5.60304
3	648.7823	2.99670	1.21e-05	−5.6425	−5.42995	−5.55672
4	652.2819	6.71936	1.22e-05	−5.6380	−5.36477	−5.52776
Model 2: FHKZAP FYKZAP						
0	146.0182	NA	0.000953	−1.2801	−1.24980	−1.26791
1	162.6629	32.84543	0.000852	−1.3925	−1.30146	−1.35579
2	174.1962	22.55415*	0.000797*	−1.4595*	−1.30769*	−1.39824*
3	175.6990	2.91200	0.000814	−1.4373	−1.22477	−1.35154
4	177.0230	2.54206	0.000834	−1.4135	−1.14025	−1.30324
Model 3: FHKZTO FYKZTO						
0	322.5386	NA	0.000188	−2.9008	−2.87005	−2.88839
1	345.8093	45.90962	0.000158	−3.0752	−2.98294*	−3.03795
2	356.4183	20.73790	0.000149	−3.1350	−2.98124	−3.07292*
3	362.3146	11.41914	0.000147	−3.1521	−2.93691	−3.06525
4	364.9245	5.00713	0.000148	−3.1395	−2.86282	−3.02783
5	371.9175	13.28987*	0.000144	−3.1666	−2.82842	−3.03008
6	376.4730	8.57501	0.000144*	−3.1717*	−2.77192	−3.01028
7	378.7341	4.21537	0.000146	−3.1559	−2.69468	−2.96971
8	379.6048	1.60739	0.000150	−3.1276	−2.60485	−2.91655

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

Table 4: VAR estimation results of models

MODEL 1			MODEL 2			MODEL 3		
	FHKEGC	FYKEGC		FHKZAP	FYKZAP		FHKZTO	FYKZTO
FHKEGC (−1)	−0.571855*	−0.00026	FHKZAP (−1)	−0.429788*	−0.000921	FHKZTO(−1)	−0.569917*	−0.00246*
FHKEGC (−2)	−0.228787*	−8.20E−07	FHKZAP (−2)	−0.293711*	0.000708	FHKZTO(−2)	−0.432546*	−0.00117
FYKEGC (−1)	39.60903	−0.058727	FYKZAP (−1)	0.007739	−0.156323*	FHKZTO(−3)	−0.354531*	−0.00067
FYKEGC (−2)	22.50546	0.055113	FYKZAP (−2)	1.280654	0.084742	FHKZTO(−4)	−0.221158*	−0.00216*
C	−0.007086	−0.000507	C	−0.043395	−0.001924	FHKZTO(−5)	−0.200937*	−0.00173
						FHKZTO(−6)	−0.172679*	0.000662
						FYKZTO(−1)	-3.45918	0.129875
						FYKZTO(−2)	10.89975*	0.179904
						FYKZTO(−3)	1.482320	0.027673
						FYKZTO(−4)	−4.461785	−0.05301
						FYKZTO(−5)	1.364436	0.207835*
						FYKZTO(−6)	−0.803176	0.038797
						C	0.026485	−0.00138
R-squared	0.251543	0.018433	R-squared	0.186331	0.042293	R-squared	0.290418	0.151808
F-statistic	18.65252	1.042236	F-statistic	12.70955	2.450919	F-statistic	7.162413	3.132123
Log likelihood	−334.9713	980.7547	Log likelihood	−316.7741	491.4961	Log likelihood	−291.0731	669.6649
Akaike AIC	2.995342	−8.596958	Akaike AIC	2.835014	−4.286309	Akaike AIC	2.727113	−5.88937
Schwarz SC	3.070781	−8.521518	Schwarz SC	2.910454	−4.21087	Schwarz SC	2.925738	−5.69075

*P<0.05 indicates statistical significance

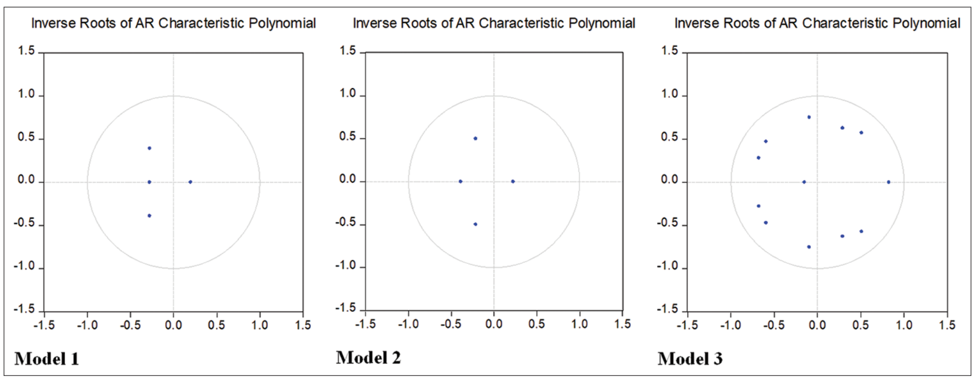
Model 3. The findings in Table 4 show that the two-period lags both affect the trading volume of the KEGC company. However, the lagged values of the highest price do not affect the trading volume. Also, the lagged values of both the trading volume and the highest price do not affect the current value of the highest price. The effect of the two-period lagged values of the transaction volume on its current value is significant in the KZAP company. One period lag of the highest price variable is also effective on its current value. In KZTO, all of the previous six-period values of the trading volume and the two-period lagged value of the highest price variable are effective on the current price of the trading volume. In the highest price variable, one and four-period lagged values of the transaction volume and its five-period lagged value are effective on its current value.

Whether there is autocorrelation in residuals, which is one of the goodness-of-fit criteria for the models, was examined with the LM test and the findings are given in Table 5. The test performed for 3 period lags for Model 1 and Model 2 and 6 for Model 3 showed that there was no autocorrelation problem in residuals.

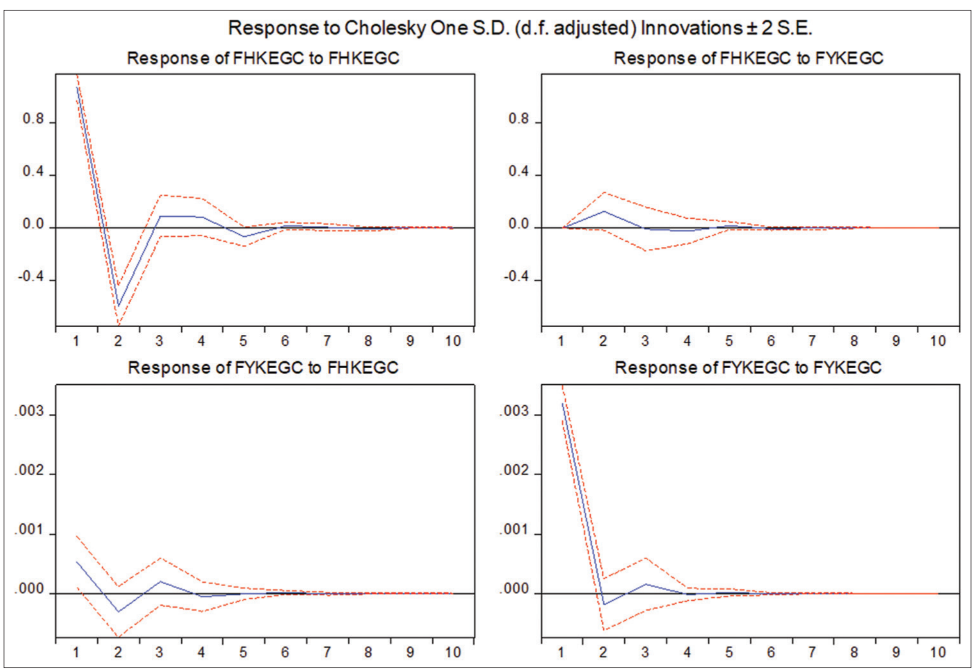
Table 5: LM test results for model residual values

Lag	MODEL 1			MODEL 2			MODEL 3		
	LRE* stat	df	Prob,	LRE* stat	df	Prob,	LRE* stat	df	Prob,
1	2.693404	4	0.6104	2.333019	4	0.6748	4.408753	4	0.3535
2	6.552881	4	0.1615	3.389280	4	0.4949	1.080751	4	0.8973
3	8.468799	4	0.0758	4.106390	4	0.3918	1.438526	4	0.8375
4							2.303966	4	0.6800
5							2.022104	4	0.7317
6							1.599687	4	0.8088
7							2.952011	4	0.5659

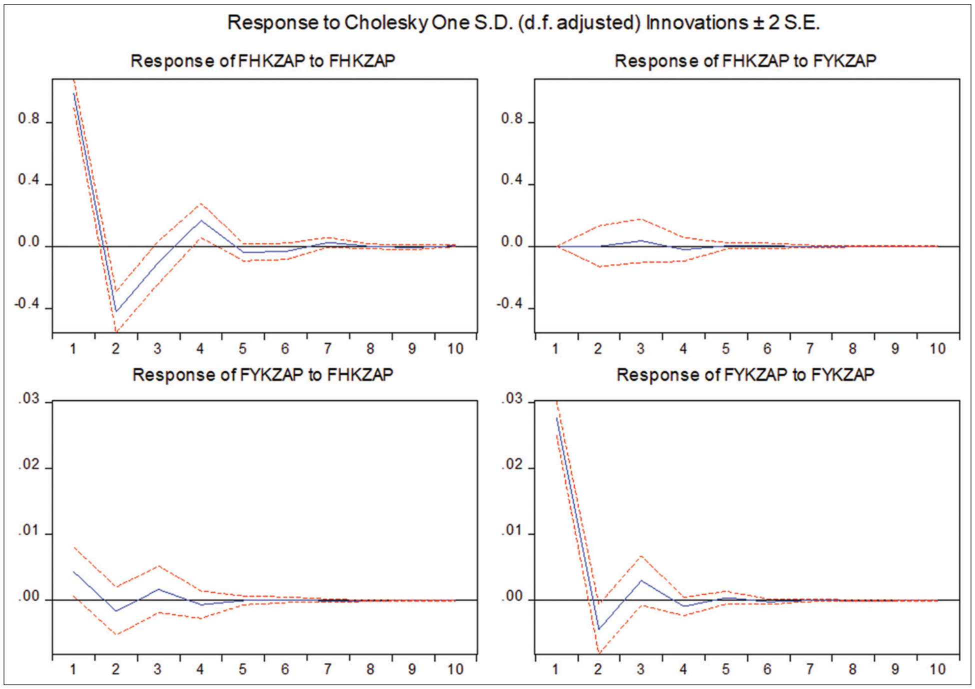
Graph 1: Inverse roots of the AR characteristic polynomial



Graph 2: Effects of shocks in peak price and trading volume variables for KEGC company over time



Graph 3: Effects of shocks in peak price and trading volume variables for KZAP company over time



Graph 4: Effects of shocks in peak price and trading volume variables for KZTO company over time

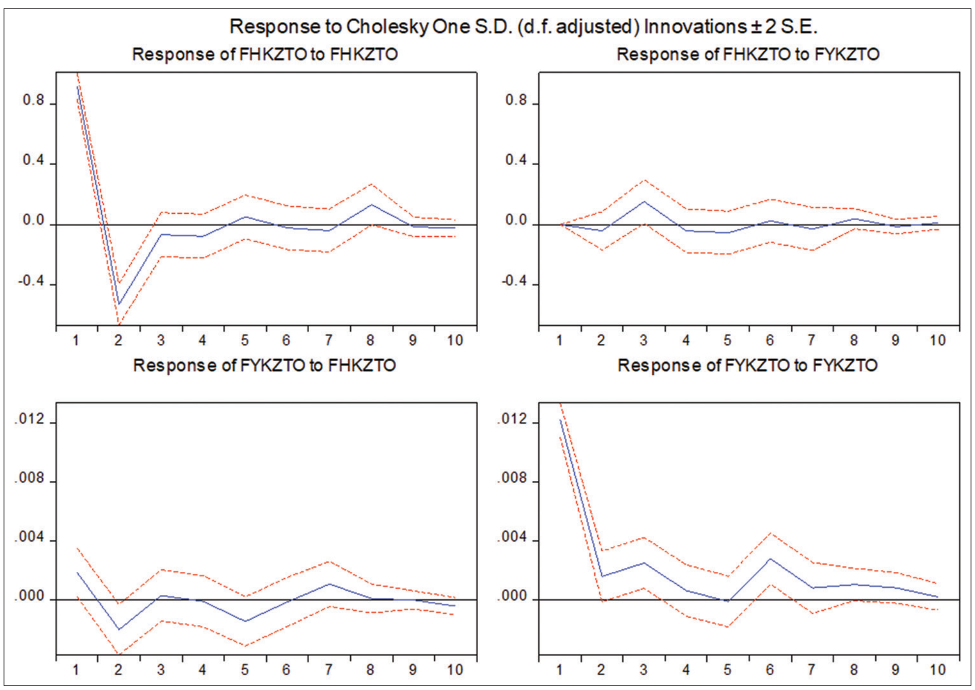


Table 6: Variance test results in residuals

	Chi-sq	df	Prob
MODEL 1	31,55888	24	0,1383
MODEL 2	32,13327	24	0,1237
MODEL 3	86,50652	72	0,1169

White's test is used to determine the variance in residuals for all three models, and the results are given in Table 6. Results show no problem of varying variance in all three models.

The third indicator of the fit of a model is that the inverse roots of the AR characteristic polynomial are within the unit circle. The values obtained for the research models are given in Graph 1. As seen in Graph 1, all three models satisfy the criterion (their inverse roots are in the unit circle).

The next step, examining the causality relationship between the variables, was carried out with the VAR-Granger causality test and the findings are given in Table 7. The findings show that only

Table 7: Results of VAR Granger causality analysis for variables

Independent variable	Dependent variable	Chi-sq	df	Prob
FYKEGC	FHKEGC	3,869356	2	0,1445
FHKEGC	FYKEGC	2,059426	2	0,3571
FYKZAP	FHKZAP	0,300491	2	0,8605
FHKZAP	FYKZAP	5,450693	6	0,4874
FYKZTO	FHKZTO	0,586301	2	0,7459
FHKZTO	FYKZTO	14,44933	6	0,0250

for the KZTO company, the trading volume has a causal effect on the highest price formation. In the other two companies, there is no causal relationship between the highest price formation and the trading volume.

Graph 2 shows the effect of a shock occurring in one of the variables of the highest price formation and the trading volume for the KEGC company over time. A shock in the trading volume variable has a fluctuating (alternating between positive and negative) effect on itself. This effect disappears on the 6th day. The effect of the shock in the trading volume on the highest price is seen after the 2nd and 3rd days. It disappears on the 5th day. A shock to the highest price variable causes a fluctuating effect (alternating between positive and negative) on itself. The effect of the shock completely disappears on the 5th day. A shock in the highest price variable has a fluctuating effect on the trading volume, but this effect is limited and completely disappears on the 5th day.

The effect of a shock in one of the highest price formation and trading volume variables for the KZAP company over time is given in Graph 3. A shock in the trading volume variable has a fluctuating (alternating positive-negative) effect on itself. This effect disappears on the 5th or 6th day. The effect of the shock in the trading volume on the peak price is negligible. A shock that occurs in the highest price variable causes fluctuating (positive-negative changing) effect. This effect completely disappears after the sixth transaction. A shock in the highest price variable also has a fluctuating effect on the trading volume. However, the effect is limited and disappears completely on the 5th day.

The effect of a shock in one of the variables of the highest price formation and the trading volume for the KZTO company over time is given in Graph 4. A shock in the trading volume variable has a fluctuating (alternating positive-negative) effect on itself. The effect of the shock disappears on the 9th day. The effect of the shock in the trading volume on the highest price starts on the 2nd day and continues until the 8th day. A shock to the highest price variable has a positive effect on it and lasts for nine trading days. A shock in the highest price variable has a fluctuating effect on the trading volume and the effect continues until the 8th day.

5. CONCLUSION AND RECOMMENDATIONS

Investors' rational investment decisions depend on their ability to predict the future value of financial assets. This study examines the relationship between the trading volumes and the highest prices of oil and energy companies traded on the KASE and analyzes the mutual effects of these variables with the VAR method. Thus, rational decisions were supported by making the best use of the available information on this financial asset. The shock analysis showed that there is an interaction between the trading volume and the highest price formation for all three companies. In particular, it was observed that the shocks in both variables had a positive effect on them after one trading day. Only one company (KZTO) trading volume had a causal effect on the peak price. In terms of investment decisions, the existence of a correlation between the transaction volume and the highest price formation is important. This result can be interpreted as an indication that there is a connection between the transaction volume and the highest price formation in KASE. More information about the existence of this relationship can be obtained by performing similar analyzes for other companies traded on KASE. In this study, causal relationships were analyzed with the Granger model. The causality relationship can also be examined with Frequency Domain Causality Analysis, and the obtained findings can be interpreted comparatively.

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