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Investigating the effect of US dollar, gold and oil prices on the stock market

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A B S T R A C T

The capital market, as one of the main components of the financial markets, plays an important role in the economic development of countries. As financial markets become more globalized through the free flow of capital and international trade, price fluctuations in financial assets also affect other assets and markets. Due to the high impact of foreign exchange, gold, and oil markets on other financial markets, this study examined the impact of these markets on the Tehran Stock Exchange market from April 2015 to March 2021. In this regard, US dollar, ounces of gold, and crude oil are used as independent variables, and Tehran Price Index (TEPIX) is considered as a dependent variable. The results of the final model indicate that the prices of dollars, gold, and oil had significant effects on the total price index of the Tehran Stock Exchange.

1. Introduction

The capital market as one of the basic components of the financial markets plays an important role in economic development (Eskorouchi, Mohammadi, & Sadjadi, 2022; Gokmenoglu, Amin, & Taspinar, 2015). The capital market is not only a center for collecting liquidity of the private sector to provide financial resources for investment projects but also it is an official and reliable reference for people's investment (Nieh & Lee, 2001). In this market, stocks, bonds, and derivative instruments are traded, and among them, stocks play the most important role in a sense (Eskorouchi & Mohammadi, 2022). Due to the globalization of financial markets, fluctuations in the value of assets in other markets spread to the price of financial assets existing in the stock market and affect them through the free flow of capital and international trade (Helleiner, 2008). Foreign exchange rates' oscillation not only causes fluctuations in the total costs and foreign currency assets of companies but also changes the level of profitability and the competitive position of domestic producers (Gokmenoglu et al., 2021; Suriani, Dileep Kumar, Jamil, & Muneer, 2015). Fluctuations in the gold price also affect the capital market in many ways. At first glance, changes in the global price of gold cause fluctuations in global political and economic variables, including interest rates and inflation rates, and due to the free flow of information at the macroeconomic levels that were mentioned earlier. These fluctuations affect capital markets and various economic variables (Akgül, Bildirici, & Özdemir, 2015; Gokmenoglu et al., 2015). It is utterly hard work to do an exhaustive investigation into the impact of oil price fluctuations on various economic variables of the country, especially the capital market, because even a minimal change in oil prices affects almost all economic variables (Shabbir et al., 2020). Almost every sector of the economy depends on international exchanges today (Massell, Pearson, & Fitch, 1972). Due to this, the increase in exchange rate increases production costs for companies whose import value exceeds their export value, reducing their profit margins, and resulting in a decrease in stock price. Similarly, an increase in the exchange rate will increase the profit margin for companies whose exports are greater than their imports, resulting in an increase in stock price (Olivei, 2002). Investors see gold as a low-risk financial asset

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alternative to the stock market. In reality, it can be seen that when there is an economic recession or when political uncertainties increase, people's capital is transferred from the stock market to the gold market. It is also observed that with economic growth and the prediction of increased profitability of companies, capital is transferred to the stock market. Therefore, people's desire to choose gold in their asset portfolio depends on changing conditions and has a close relationship with the stock market (Haugen & Heins, 1975). One of the important concerns of many economists in recent decades has been to examine the impact of oil shocks on the domestic economy of countries, especially developing countries. The effect of oil prices on the stock market is different depending on whether the country is an oil importer or exporter. The increase in oil prices in countries that export improves the trade balance, thereby increasing company profitability, which causes stock prices to rise and the total index to rise as well. The exact opposite problem occurs in oil-importing countries (Handoyo, Wibowo, Padilla, Ridzuan, & Razak, 2020; Shavvalpour, Jabbarzadeh, & Khanjarpanah, 2018). As noticed earlier, the capital market is one of the most important official sources for people's investment. In the prestigious stock exchanges of the entire world, there are many indices to examine and analyze their performance. In the Tehran Stock Exchange, one of the critical factors for investing is the total index of the stock market. Thus, knowing the status of the total index provides valuable information for investors. In this research, we intend to investigate the effectiveness of foreign exchange, gold and oil markets on the Tehran Stock Exchange. For this purpose, the government dollar, ounces of gold, and crude oil are considered independent variables, and the total price index of the stock exchange is the dependent variable.

2. Research background

2.1. Theoretical Foundations

As the capital market is an important supplier of financial resources to the expansion of economic activities, numerous transactions have been fulfilled there by investors. Hence, the total index of the stock exchange, along with all the various economic analyzes such as the study of the behavior of shareholders, fundamental analyzes of companies, and technical analyzes of stock trends can lead to better knowledge for making investment decisions. To emphasize the importance of the research, it must be stated that many macro and micro variables directly and indirectly impact the situation of the companies. Therefore, if any factor affects the value of these companies, it can cause a change in the total stock index of the stock exchange. These economic variables can affect the returns of the investors' asset portfolio in two ways, firstly because people keep different combinations of cash, stocks, bank deposits, bonds, gold and currency in their financial asset portfolios and secondly because the mentioned variables also affect the financial conditions of economic enterprises and their stock value. The stock exchange index is a reflection of the state of the country's capital market and economy, and therefore, the increase in this index means economic prosperity and its decrease indicates economic stagnation. All the shares of the companies admitted to the Tehran Stock Exchange are included in the total index of the stock exchange, and each company is given weight according to the ratio of its shares. The method of calculating the total index of the Tehran Stock Exchange is as follows:

$$TEPIX_t = \frac{\sum_{i=1}^{n} p_{it} q_{it}}{\sum_{i=1}^{n} p_{i0} q_{i0}} \tag{1}$$

where, p_{it}denotes the stock price of the company i at time t and q_{it} is the number of shares the company i at time t. The denominator of the fraction (1) is also the basic number at time t, which is represented by D_t. This relationship is equal to $\sum_{i=1}^{n} p_{i0} q_{i0}$ at the time of origin. In this relationship, p_{i0} and q_{i0} also represent the price and number of shares i in the first period of admission to the stock exchange, respectively.

2.2. Literature Review

In the following, a summary of the previous research conducted in this field is described. Siourounis (2002) estimated the Athens stock exchange's daily returns using various GARCH models. The obtained results indicated the asymmetric effect of negative shocks on the daily return series of the market. Azman-Saini et al. (2007) investigated the causal relationship between stock price and exchange rate in Malaysia. The time period of this study was from 1993 to 1998, the results of which show the existence of two-way causality for the period before the crisis and one-way causality from the exchange rate to the stock price during the crisis. Adam and Tweneboah (2009) investigated the relationship between macroeconomic variables in the Ghana stock market in the period from 1991 to 2006. The results of this research indicate a positive relationship between stock prices and foreign investment, and inflation and a negative relationship between stock prices and exchange rates, and interest rates. Adjasi et al. (2010) also investigated the relationship between exchange rate fluctuations and the stock market in Ghana. The results of this study indicated the existence of a negative relationship between exchange rate fluctuations and stock market returns. Blair et al. (2010) compared the stock price index with the components of the shock by using the estimation of ARCH and TARCH models. According to the results obtained from this study, the price of most stocks fluctuated more in response to negative returns than to positive returns. Using the structural VAR model, Abouwafia and Chambers (2015) investigated the relationship between monetary policy, exchange rate, and stock price in 5 countries Kuwait, Oman, Saudi Arabia, Greece and Jordan, separately. The results of the research indicated that in most countries, monetary policy and exchange rate had significant effects on the stock price index.

3. General structure of the model and statistical analyses

In this research, the model (2) is approximated using EViews 10 software:

$$TEPIX_t = \beta_0 + \beta_1 DR_t + \beta_2 GP_t + \beta_3 OP_t + u_t \quad (2)$$

where the variables are defined as follows:

TEPIX: Total Index of Tehran Stock Exchange
DR: Dollar rate
GP: Gold price
OP: Oil price

3.1 Statistical analyses

The statistical population of this research includes monthly data from April 2014 to March 2019. These data were collected through databases of the Central Bank of the Islamic Republic of Iran and the Tehran Stock Exchange Technology Management Company. Moreover, in the Table 1, the values of descriptive statistics can be seen.

Table 1
The value of descriptive statistics

	TSEI	DR	GP	OP
Mean	333501.8	36777.18	11368.556	51.30944
Median	97471.80	37420.00	1281.500	51.40000
Maximum	19040509.	43730.00	1941.000	72.40000
Minimum	61414.20	27994.00	1069.000	22.80000
Std. Dev.	476426.0	5461.184	233.0680	10.26383
Skewness	1.965986	-0.186649	1.240192	-0.284225
Kurtosis	5.527795	1.255397	3.438624	3.254861
Jarque-Bera	65.55047	9.548973	19.03408	1.164270
Probability	0.000000	0.008442	0.000074	0.558704
Sum	24012129	2647957	98536.00	3694.280
Sum Sq. Dev.	1.61E+13	2.12E+09	3856770	7479.584
Observation	72	72	72	72

To test the normality of the data, the Jarque-Bera test statistic is used; If the value of this statistic is less than 5.99 or the corresponding significance level is more than 0.05, it can be concluded that the data has an almost normal distribution. Here, according to the significance level of the data, it can be seen that the data follow the normal distribution.

3.2 Covariance between variables

The covariance between all 2 variables can be seen in Table 2.

Table 2
The covariance between all two variables

	TSEI	DR	GP	OP
TSEI	2.24E+11	1.35E+09	1.01E+08	-1532387.
DR	1.35E+09	29410304	771209.1	14732.01
GP	1.01E+08	771209.1	53566.25	-508.0991
OP	-1532387.	14732.01	-508.0991	103.8831

3.3 Linear correlation and correlation coefficient

Linear correlation is used to examine the relationship between various attributes between 2 or more variables. Correlation shows the presence or absence of a relationship between variables using a data scatterplot. The correlation coefficient is also a statistic to measure the linear relationship between 2 variables and has a range between -1 and 1. The closer these values are to zero, the stronger the correlation between the two is. The correlation coefficients between the variables can be seen in Table 3.

Table 3
Correlation Coefficient

	TSEI	DR	GP	OP
TSEI	1.000000	0.527283	0.924789	-0.317788
DR	0.527283	1.000000	0.614436	0.266526
GP	0.924789	0.614436	1.000000	-0.215392
OP	-0.317788	0.266526	-0.215392	1.000000

The correlation coefficients of logarithm of explanatory variables can be seen in Table 4.

Table 4
Correlation coefficient of logarithm of explanatory variables

	LOG(TSEI)	LOG(DR)	LOG(GP)	LOG(OP)
LOG(TSEI)	1.000000	0.745670	0.936003	-0.240021
LOG(DR)	0.745670	1.000000	0.636106	0.196744
LOG(GP)	0.936003	0.636106	1.000000	-0.205293
LOG(OP)	-0.240021	0.196744	-0.205293	1.000000

4. Initial estimation of the model and tests

4.1. Estimation of the initial linear regression model

The estimation of the model (2) has been done using EViews 10 software, the results of which are represented in Table 5.

Table 5
Initial estimation of linear regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1887076	182892.7	-10.31794	0.0000
DR	1.659096	5.647708	0.293764	0.7698
GP	1808.261	130.6145	13.84426	0.0000
OP	-6142.026	2427.86	-2.529811	0.0137
R-squared	0.870148	Mean dependent var		333501.8
Adjusted R-squared	0.864419	S.D. dependent var		476426
S.E. of regression	175426.1	Akaike info criterion		27.04178
Sum squared resid	2.09E+12	Schwarz criterion		27.16826
Log likelihood	-969.504	Hannan-Quinn criter.		27.09213
F-statistic	151.8912 (0.0000)	Durbin-Watson stat		0.554719

The estimation of regression equation coefficients is represented in model 3.

$$TEPIX_t = -1887076 + 1.659096\, DR_t + 1808.261\, GP_t - 6142.026\, OP_t + u_t \quad (3)$$

4.2. Significance test of coefficients

In order to test the hypothesis of the significance of the coefficients, we test the hypothesis H_0 against the hypothesis H_1 using the t statistic. According to the Table above, the value of the statistic is greater than 2 and is in the critical area, and the significance level of all the coefficients is less than 0.05, so here the hypothesis H_0 is rejected, which indicates the significance of the coefficients.

4.3. Regression significance test

In order to test the significance assumption of the whole regression, we test hypothesis H_0, non-significance of the regression, against the hypothesis H_1, significance of the regression, using the F statistic. In the above Table, the F-statistic with a value of 151.8912 is higher than F in the table, 3.98, which indicates the rejection of the hypothesis H_0. Also, R^2 is the explanatory power or the goodness of the model with a value of 0.87. The estimated value for the regression standard deviation is also equal to 175426.1, which indicates the dispersion of observations around the regression line. In fact, this average number shows the deviation of the real model from its estimated value. By interpreting all these cases, it is concluded that, as could be predicted, the variables of dollar, gold, and oil affect the model, that is, the price change of each of these 3 items will eventually lead to fluctuations in the index of the Tehran Stock Exchange.

4.4. Analyzing the graph of the actual and estimated values

As it is obvious in Fig. 1, the graphs of the actual values of the dependent variable and the estimated values are very close, which indicates the appropriate estimation of the regression model.

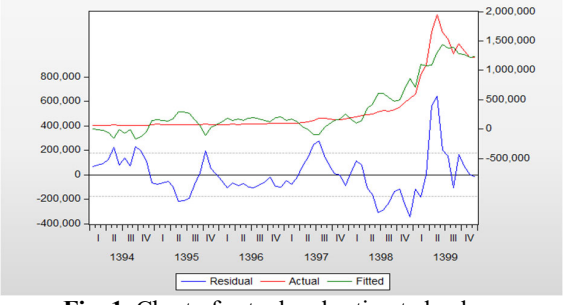

Fig. 1. Chart of actual and estimated values

4.5. Classic assignment tests

4.5.1. Durbin Watson autocorrelation test

Considering that the defaults of the Durbin Watson autocorrelation test require that the model has an intercept, the least squares model is used in this section. Therefore, it should be considered that theoretically, the results of this part are not acceptable. The zero hypothesis of this test is the absence of autocorrelation of residual sentences and the one hypothesis is the existence of a correlation between them. Considering that the problem model has the above conditions, the null hypothesis is rejected and the model has first-order autocorrelation.

4.5.2. Breusch-Godfrey autocorrelation test

Durbin-Watson's test is used to check first-order autocorrelation and cannot test other forms of autocorrelation. For this purpose, to solve this problem, Breusch Godfrey's autocorrelation test is used to examine the r_{th} order autocorrelation.

Table 6
Breusch-Godfrey test

Heteroskedasticity Test Breusch-Pagan-Godfrey			
F-statistic	3.651279	Prob. F (3,68)	0.0167
Obs*R-squared	9.98908	Prob. Chi-Square (3)	0.0187
Scaled explained SS	20.29858	Prob. Chi-Square (3)	0.0001
Test Equation:			
Dependent Variable: RESID^2			
Method: Least Squares			
Date: 01/26/22 Time: 20:36			
Sample: 1394M01 1399M12			
Included observations: 72			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.17E+10	6.18E+10	-0.999311	0.3212
DR	1321787.	1907354.	0.692995	0.4907
GP	65803502	44111340	1.491759	0.1404
OP	-9.33E+08	8.20E+08	-1.138046	0.2591

R-squared	0.138737	Mean dependent var	2.91E+10
Adjusted R-squared	0.100740	S.D. dependent var	6.25E+10
S.E. of regression	5.92E+10	Akaike info criterion	52.50173
Sum squared resid	2.39E+23	Schwarz criterion	52.62821
Log likelihood	-1886.062	Hannan-Quinn criter.	52.55208
F-statistic	3.651279	Durbin-Watson stat	1.242492
Prob(F-statistic)	0.016713		

According to the value of the F-statistic and also the significance level, less than 0.05, represented in Table 6, the null hypothesis of no autocorrelation is rejected and the model has the third autocorrelation.

4.5.3. Normal residual test

One of the assumptions related to error statements is whether u_t is normally distributed or not. If u_t has a normal distribution with zero mean, then it is symmetrically distributed around its mean.

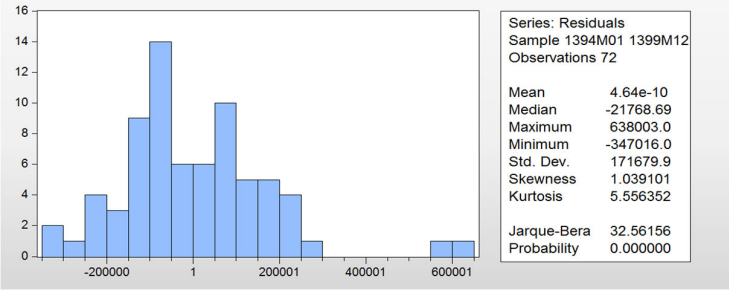

Fig. 2. Normality test of residual sentences

It is conspicuous in Fig. 2 that considering that the Jarque-Bera statistic is equal to 32.56, its value is greater than 9.77, the assumption of normality of the residuals is rejected.

4.5.4. Chow breakpoint test

Chaw's breakpoint test divides the study period into two parts. This study considers the 6th month of 1396 to be the breaking point. the results of which are represented in Table 7.

Table 7
Chow breakpoint test

F-statistic	7.346719	Prob. F (3,65)	0.0003
Log likelihood ratio	21.02273	Prob. Chi-Square (3)	0.0001
Wald Statistic	22.04016	Prob. Chi-Square (3)	0.0001

Given Table 7, considering the value of F, which is smaller than the statistic in the table, as well as its significance level, which is less than 0.05, the hypothesis of stability of coefficients is not rejected.

4.6. Model specification

The first order autocorrelation process or AR (1) is presented in (5):

$$u_t = pu_{t-1} + \varepsilon_t \tag{5}$$

The least squares model has a correlation of order 1, so to solve the problem, we can add the AR of the model to itself.

Table 8
A least squares model with the addition of AR

Variable		Coefficient	Std. Error	t-Statistic	Prob.
C		-321937.2	1399062	-0.230109	0.8187
DR		7.191606	32.68421	0.220033	0.8265
GP		292.0712	224.3011	1.302139	0.1975
OP		1017.895	4769.843	0.213402	0.8317
AR (1)		1.268170	0.134237	9.447217	0.0000
AR (2)		-0.226903	0.183620	-1.235722	0.2211
AR (3)		-0.088563	0.080795	-1.096143	0.2771
SIGMASQ		9.12E+09	8.08E+08	11.28286	0.0000
R-squared	0.959266	Mean dependent var		333501.8	
Adjusted R-squared	0.954811	S.D. dependent var		476426.0	
S.E. of regression	101277.4	Akaike info criterion		26.03558	
Sum squared resid	6.56E+11	Schwarz criterion		26.28854	
Log likelihood	-929.2807	Hannan-Quinn criter.		26.13628	
F-statistic	215.3107	Durbin-Watson stat		1.956452	
Prob(F-statistic)	0.000000				
Inverted AR Roots	91	0.54	-0.18		

Durbin Watson's (DW) statistic illustrated in Table 8 with a value of 1.956452 is in the range of 1.8 to 2.2, which indicates that the null hypothesis is not accepted, i.e., no autocorrelation. As a result, the correlation problem of the model has been solved.

4.7. In-sample prediction

The results of the in-sample prediction are shown in Fig. 3. The value of Theil Inequality Coefficient indicates the quality of the prediction, which is equal to 0.180669 in the final model. The closer this value is to zero, the better the forecast.

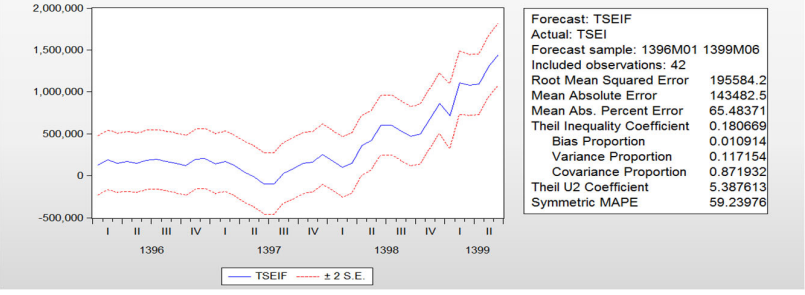

Fig. 3. In-sample prediction

5. Conclusion and summary

Tehran Stock Exchange is known as one of the critical investment options in Iran, in this research, tried to provide a good view for investors by examining the factors affecting the total index of the stock market, which is a very key criterion for investors to make decisions. Pay attention to these things to form your investment portfolios in the future. In this research, by examining the effect of the dollar, gold, and oil prices on the Tehran Price Index, it was concluded that the change in the price of gold and oil strongly affects the total index, so investors should take these two factors into account if they wish to predict market movements.

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