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Relationship between oil price fluctuations and stock price index in Iran

Abstract

The present study aims to investigate the impact of oil price fluctuations and a set of other macroeconomic variables on stock price index using structural vector auto regression models, impulse response function, and variance decomposition during 2001-2013. The results of the study reveal that there is no consensus on the effect of oil price on stock price index in different countries. In other words, a group of studies reported a positive relationship between oil price and stock price index, while other studies have argued that there is no relationship between these variables.

Keywords: oil price, stock price, Iran.
JEL Classification: C58, D22, D51.

Introduction

During the past decades oil has an important factor in the economic survival of countries, such that it is considered as the lifeblood of modern economies (Basher & Sadorsky, 2006). Iran, as a rich country with energy resources; oil and gas reserves, has been one of the main producers and exporters of oil in the world. Therefore, Iran's increasing dependence on oil revenues becomes a serious challenge for the country. Due to its strategic importance, global oil price fluctuations, especially during the past four decades, affect many macroeconomic variables in the process of development, which in turn affects all the markets of an economy, including financial and stock markets. Thus, predicting the effect of oil price fluctuations on real and financial sectors is of utmost importance. Understanding this relationship and making accurate predictions can help economic decision makers in their attempts to maintain economic balance and stability, to minimize the adverse effect of oil price fluctuations on the stock market, and to prevent exogenous economic crises. Therefore, studying the role of oil in Iran and its effects on other economic sectors is an important issue. Achieving long-term sustainable economic growth entails optimal allocation of financial resources in the country, which is feasible only with the help of financial markets, especially an extensive and efficient capital market. Oil is one of the most important sources of energy in the world and many economic activities depend on this crucial material. Since oil price fluctuations affect all key economic variables, these changes are significant for global economy. Like other developing countries, Iran has an oil-dependent economy, and special events and oil price fluctuations have considerably affected the country's economy (Ghanbarzadeh, 2008). So, the main question of the study is that whether there is any relation between oil price fluctuations and stock price index in Iran or not?

1. Theoretical background

One of the major concerns of many economists in the past decades has been the effect of oil shocks on the economy of oil exporting countries, especially the developing ones.

The impact of falling oil prices on stock market and exchange rates will differ from country to country depending on whether the country is an oil-exporter or oil-importer. In an oil-exporting country, a rise in world oil prices improves the trade balance, leading to a higher current account surplus and an improving net foreign asset position. At the same time, increase in oil prices tends to increase private disposable income in oil-exporting countries. This in turn increases corporate profitability, raises domestic demand and stock prices, thereby causing exchange rate to appreciate. In oil-importing countries, the process works broadly in reverse: trade deficit is offset by weaker growth and, over time, real exchange rate depreciates and stock prices decrease (Abdelaziz et al., 2008).

Increased oil price during the recent oil boom provided Iran with unique opportunities and oil revenues have a considerable share in the country's economy. Clearly, assets such as stocks are very fluid, for they can readily be converted into cash and vice versa. The stock market is thus greatly affected by economic events, especially oil price fluctuations. There is little possibility that the government reduces its costs when oil price decreases; therefore, there will be budget deficit, forcing the government to borrow from the central bank. So in both conditions the monetary base. Increased price levels can have different effects on the capital market:

A. It increases the cost of housing, rent, and industrial machinery, while at the same time

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increasing corporate profitability. Thus, the stock price is also expected to increase. Studies have shown the positive relationship between price levels and stock index, and we can conclude that stock price of firms increases as a result of increased liquidity and inflation (Golestani, 2007).

B. In Iran's economy that is currently experiencing stagflation, increased price levels have adverse effects instead of increasing GDP and employment. This situation can lead to even more increase in price levels and stagnation, thereby reducing investment. Reduced investment in different industrial sectors decreases or hinders growth and profitability in industries. Therefore, the stock prices are also expected to drop (Golestani, 2007).

C. The relationship between price levels and money demand has been established. In the short term, increased price levels increase cash flow velocity and reduce people's tendency to hold money. Inflation reduces people's purchasing power, including investors. These individuals have a mixture of cash, assets, deposits, bonds, gold, and foreign exchange in their portfolio of financial assets as investment alternatives, but due to reduced purchasing power they are less inclined to hold their cash, trying to maintain the value of their assets by shifting their portfolio toward profitable assets such as foreign exchange, stocks, and land.

Obviously, changes in money volume and anticipation of increased prices affect people's demand for keeping the above assets, which in turn affects stock indexes. It can be concluded that, in short term, inflation expectations can have a positive effect on the stock market (Keshavarz Hadad & Manavi, 2008). The effect of "A", where increased price levels increase stock index, and the effect of "B", where increased price levels reduce stock index, are expected to neutralize each other. Therefore, the effect of "C" remains as the sum of these effects which is the focus of the present research. Iran is one of the biggest oil exporters in the world, and oil revenues have a considerable share in the country's budget. Thus, oil has led to major transformations in Iran at economic and political levels (Hemati, 1995).

2. Stock exchange

Stock exchange is a self-regulatory market where securities are traded by stock brokers and traders. Stock exchange in Iran is established as a publicly traded company and implements the general policies established by the Supreme Council of Securities and Exchange Organization (SEO). Securities are listed in the stock exchange based on the instructions proposed by the stock market and approved by SEO (Ministry of Economic Affairs and Finance, 2005).

2.1. Tehran Stock Exchange main index. In 1990, TSE started calculating and issuing its main index called *TEPIX*. This index included 52 firms that were listed in TSE at that time. *TEPIX* is calculated from the following equation:

$$TEPIX_t = \frac{\sum_{t=1}^{n} p_{it} q_{it}}{D_t} \times 100. \tag{1}$$

$$D_t = \sum p_{io} q_{io},$$

where p_{it} is the price of firm i in time t, q_{it} is the number of shares issued by firm i in time t, p_{io} is the price of firm i at the close of trading, q_{io} is the number of shares issued by firm i at the close of trading, and n is the total number of listed firms. Based on equation (1), the number of shares issues by the firms is the weighted criteria in *TEPIX*, which increases the effect of larger firms on the index.

2.2. Adjusting the index base. Price index indicates general price trends among the studied firm that must be affected by price changes, not other parameters. Equation (1) suggests that the number of issued shares also affects *TEPIX*. Therefore, the index must be adjusted not to be affected by the changes in issued shares which is usually due to increased capital. The adjustments are made to the denominator of the equation. Assume that price at time t is calculated from the following equation:

$$PI_t = \frac{\sum p_{it} q_{it}}{FD_t} \times 100. \tag{2}$$

When one or several firms decide to increase their capital (from cash) at time $t + 1$, PI_{t+1} changes with prices and free float coefficient kept constant:

$$PI_{t+1} = \frac{\sum p_{it} q_{it+1}}{FD_t} \times 100. \tag{3}$$

Now, the denominator is adjusted so that the index once again equals PI_t

$$FD_{t+1} = \frac{\sum p_{it} q_{it+1}}{\sum p_{it} q_{it}} \times FD_t. \tag{4}$$

Replacing FD_{t+1} in the denominator, the index will equal PI_t:

$$PI_{t+1} = \frac{\sum p_{it} q_{it+1}}{FD_{t+1}} \times 100 = PI_t.$$

(5)

Usually, the following issues can adjust the base index:

1. increased capital of firms from cash;
2. increased number of firms in the index;
3. reduced number of firms in the index;
4. acquisitions;
5. mergers.

3. Review of literature

The literature on the effect of oil price fluctuations on stock markets has basically focused on oil importing countries, while a smaller body of research has been dedicated to the effect of these shocks in the financial markets of oil exporting countries like Iran.

Huang et al. (1996) examined the effect of oil price on stock returns in the US. Using VAR model and monthly data, they concluded that oil price changes can only explain the changes in the stock returns of oil companies, while it does not affect the indexes of other industries.

Manera et al. (2005) focused on long-term determinants of the stock prices of six major oil companies over the period from January 1998 to April 2003. Using multivariate cointegration techniques and vector error correction models, they found that the major financial variables are statistically significant in explaining the long-run dynamics of oil companies' stock values.

In the UK, El-Sharif et al. (2005) found that the price of crude oil has a significant positive effect on equity values in the gas and oil sector.

Basher and Sadorsky (2006) used an international multifactor model allowed for both unconditional and conditional risk factors to investigate the relationship between oil price risk and emerging stock market returns. They found strong evidence that oil price risk impacts stock price returns in emerging markets.

Adebiyi et al. (2008) examined the effect of oil price shocks and exchange rate on real stock returns in Nigeria over 1985:1-2008:4 using a multivariate VAR analysis. Empirical results showed the significant negative effect of oil price on real stock returns. The Granger causality test indicated that causation runs from oil price shocks to stock returns, implying that variation in stock market is explained by oil price volatility.

Bjørnland (2009) incorporated stock returns into a SVAR model for the period 1993:1-2005:12, and showed that stock returns increase by 2.5 percent following a 10 percent increase in oil prices. She concluded that the Norwegian economy responds to higher oil prices by increasing aggregate wealth and demand, while highlighting the role of other shocks, monetary policy in particular, as important driving forces behind stock price variability in the short term.

Miller and Ratti (2009) analyzed the long-run relationship between the world price of crude oil and international stock markets over 1971:1-2008:3 using a cointegrated vector error correction model with additional regressors. They found that stock market indices respond negatively to increases in the oil price in the long run.

Aloui and Jammazi (2009) examined the relationship between crude oil shocks and stock markets using a two-regime Markov-switching EGARCH model. They applied the model to stock markets of UK, France and Japan over the period from January 1989 to December 2007 and found a negative relationship between crude oil shocks and stock markets.

Islam-Alavian and Zare (2006) used autoregressive distributed lag approach (ARDL) and the Lucas Asset Pricing Model to examine the effect of macroeconomic variables on stock price index in TSE during the period 1993-2003. The results indicated a long-term positive relationship between oil price and stock price index. In addition, estimating the error correction model suggested that about half of the imbalance in each period is adjusted.

Karimzadeh (2006) studied the long-term relationship between TSE's price index and monetary macroeconomic variables using Portfolio Theory, Fisher Effect Theory, and monthly data for the period 1990-2002. They used such variables as stock price, liquidity, real exchange rate, and real interest rate. They also applied ARDL to estimate the model. The results suggested a cointegration vector between stock price index and monetary variables. Moreover, the estimated long-run relationship showed the positive effect of liquidity and the negative effect of real exchange rate and real interest rate on stock price index.

Samadi et al. (2007) studied the impact of global oil and gold prices on the stock price index of TSE using monthly data for the period 1997-2006 and the ARCH/GARCH models. They employed econometric models in order to the impact of oil and gold prices on the Tehran Stock Index. The results showed that despite the unquestionable effects of oil price changes on many macroeconomic variables, TSE has had little response to these changes due to the small capital market of Iran and the lagged effect of oil price changes on profitability and stock price of firms. The effect of oil price changes on stock price index was less strong than the effect of gold price changes, and changes in stock price index can be predicted by gold price changes. The results suggest that there is no agreement in the literature about the relationship between oil price and stock price index in different countries. This conclusion may rise from perhaps the Iranian stock market is inefficient.

Financial markets are an important aspect of the economic environment. These markets act as a cushion that protects real economic variables. Financial markets include capital market and money market. One of the main components of the capital market is the stock exchange. The stock exchange is responsible for attracting and channeling small or large savings toward productive investments (Abasian, 2008). Also optimal allocation of resources is another major role of the stock exchange (Falahati, 2006). Stagnation or boom of a stock market affects national economy as well as global economy (Karimzadeh, 2006). The most important factor in investment decisions in the stock exchange is stock price index. There are, however, many factors that affect the stock price index of firms. Some of these factors are internal, such as earnings per share, dividends per share, and price per share. There are also external factors that are beyond the scope of internal operations, such as international events or decisions that affect stock price index. These factors are commonly divided into two categories: (1) political factors, and (2) economic factors (Karimzadeh, 2006). Oil price index is one of the key indices that affect the political and economic settings of a country (Farzanegan & Markwardt, 2008).

4. Methodology

4.1. Design. The present research is applied and descriptive. The theoretical framework comprises the effect of world oil prices on TSE stock price index, with a special approach to monetary policy using a SVAR model.

4.2. Population and sample. The sample of the research consists of all the listed companies on the Tehran Stock Exchange during the period 2001-2013.

4.3. Procedure. The data were collected as follows: Iran's oil and gold prices were extracted from the time-series database of the Central Bank of Iran (CBI); stock price index was extracted from TSE's website[1]; and unemployment rate and consumer price index were extracted from the indicators provided by CBI. Unemployment rate and gold price which were seasonal values were adjusted to monthly data using EViews 6 software. The daily data were also converted into monthly averages. The effect of oil price and a set of other macroeconomic variables on stock price index is examined using structural vector autoregression (SVAR), impulse response function (IRF), and forecast error variance decomposition (FEVD) for the period 2001-2013. All the statistical operations were done in EViews 6.

4.4. Hypothesis. The present research investigates the effect of oil price on stock price index of TSE. Thus, the hypothesis can be developed as:

- There is a significant positive relationship between oil price fluctuations and TSE's stock price index.
- There is a significant negative relationship between oil price fluctuations and stock returns.

4.5. Results. Iran's oil price (USD per barrel) during the period 1980-2009 (Sources: CBI; U.S. Energy Information Administration website).

In the long-term, however, investors behave differently, for they come to realize that the increase in stock price is due to the overall increase in price levels and the real value of the stocks has not increased. Therefore, the demand for buying stocks and its price decreases in the long-term.

Apparently, the only determinant of the oil revenues of oil-exporting countries is the world oil prices as an exogenous variable. Therefore, oil-exporting countries, including Iran, can use oil revenues effectively only if they learn from the experiences of other oil-dependent countries and find strategies for preventing the effect of oil shocks on oil revenues, whether these shocks are positive or negative. Otherwise, Iran's economy will always be exposed to the consequences of oil shocks, and the experience of Iran's oil-dependent economy is a clear evidence for this claim.

4.6. Variables. *4.6.1. Dependent variable.* The dependent variable in this research is TSE's stock price index. The logarithm form of the index is used to examine the growth in this index. Considering the Laspeyres price index, the index can be calculated as follows:

$$TEPIX = \frac{\sum_{i=1}^{n} P_{it} Q_{io}}{\sum_{i=1}^{n} P_{io} Q_{io}}, \quad (6)$$

where P_{it} is the current price of firm i in time t, Q_{io} is the total number of shares issued by firm i in time t, P_{io} is the price of firm i at opening time, and Q_{io} is the number of shares issued by firm i at opening time. The opening time is 1990.

4.6.2. Independent variable. Five variables are used as independent variables: Iran's crude oil basket price, nominal exchange rate, consumer price index (inflation rate), unemployment rate, and gold price.

4.6.3. The proposed model. Due to the difference of Iran and advanced economies in economic structure, i.e. the extensive government interference in Iran's economy and the country's dependence on oil revenues, a structural vector autoregression (SVAR) model is used to examine the effect of oil price fluctuations on TSE's stock price index.

[1] http://www.irbourse.com.

The vector autoregression model is an evolved form of time-series models. In VAR models, all the variables are treated as endogenous, and they fully interact with each other. The dynamic structure of these models allows for more than one evolving variable. The main application of these models is in predicting macroeconomic variables or in examining the effect of different shocks on the model's variables over time using impulse response functions. The degree of freedom problem is one of the main drawbacks of VAR models. Also these models are not based on economic theories and thus cannot be as effective as structural models in analyzing policies. Of course the latter was later solved by the introduction of structural VAR models (Moshiri, 2002). Sims (1980), Gali (1992), and Blanchard and Quah (1993) were the pioneers of the SVAR approach. They argued that SVAR models can overcome the shortcomings of VAR models through incorporating data based on economic theories. Accordingly, structural coefficients are estimated by imposing structural constraints on the interaction between the variables. Another advantage of SVAR is its ability in determining the effect of structural shocks on internal markets using structural impulse response function and Cholesky variance decomposition, thus obtaining the share of each variable in explaining the forecast error variance (Khoshbakht & Akhbari, 2007).

Among different models proposed for examining the effect of oil price on stock index (e.g. Adebiyi et al., 2008; Blanchard & Quah, 1993; Park et al., 2008), the one proposed by Bjørnland (2008) was used in the present research due to the specific conditions of Iran's economy. The SVAR model can be expressed in the following simple form:

$$Y_t = \alpha + \sum_{i=0}^{p} A_{i=0} Y_{t-1} + V_t , \quad (7)$$

where Y_t is the vector of endogenous variables (including Iran's oil price, stock price index, nominal exchange rate, consumer price index, unemployment rate, and gold), $A_{i=0}$ is the matrix of auto-regressive coefficients, α is the intercept, and V_t is the vector of white noise residuals.

4.7. Estimation of the SVAR model. To examine the effect of oil price fluctuations on stock price index, the present research takes the approach of Blanchard and Quah (1993) to SVAR. In their approach, structural shocks are identified through imposing constraints on the long-term effects of shock on certain variables. To impose these constraints on the SVAR model, first the vector of the variables is defined as follows:

$$Y_t = [\Delta lop, \Delta lcp, \Delta ler, \Delta lp, \Delta un, \Delta lsp]. \quad (8)$$

Δ is the difference operator and Y_t is the vector of endogenous variables, where *lop* is the logarithm of Iran's oil price, *lcp* is the logarithm of consumer price index, *ler* is the logarithm of nominal exchange rate, *lp* is the logarithm of gold price, *un* is the logarithm of unemployment rate, and *lcp* is the logarithm of stock price index.

In general, given the interactions between gold price, exchange rate, and consumer price index, it can be argued that consumer price index comes first in order of nominal variables in both impulse functions (IRF) and forecast error variance decomposition (FEVD), exchange rate comes second, and gold price comes third. That is because the response speed of consumer price is faster than exchange rate and gold price. Therefore, the order of the variables in the model is as follows: oil price, consumer price index, exchange rate, gold price, unemployment rate, and stock price index.

$$Y_t = A_{o^{\varepsilon_t}} + A_{1^{\varepsilon_t}} + \cdots = \sum\nolimits_{i=0}^{\infty} A_{i^{\varepsilon_{t-1}}} = \sum\nolimits_{i=0}^{\infty} A_i L^i \varepsilon_t \qquad i = 0,1,2,\ldots \quad (9)$$

To identify structural shocks and impulse response coefficients, first a vector autoregression model must be estimated as follows[2]:

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \cdots + B_p Y_{t-p} = \sum_{I=1}^{p} B_i L^i Y_t + e_t = B(L) Y_t + e_t . \quad (10)$$

$$\rightarrow Y_t = B(L)Y_t + e_t \rightarrow [I - B(L)]Y_t = e_t \rightarrow Y_t = [I - B(L)]e_t . \quad (11)$$

Applying geometric progression gives:

$$Y_t = [I + B(L) + B(L)^2 + \cdots]e_t . \quad (12)$$

$$Y_t = e_t + C_1 e_{t-1} + C_2 e_{t-2} + \cdots . \quad (13)$$

[2] The results of estimating VAR and SVAR models are provided in the Appendix.

$$C_i = \begin{bmatrix} C_{21}(i) & C_{22}(i) & 0 & 0 & 0 & 0 \\ C_{31}(i) & C_{32}(i) & C_{33}(i) & 0 & 0 & 0 \\ C_{41}(i) & C_{42}(i) & C_{43}(i) & C_{44}(i) & 0 & 0 \\ C_{51}(i) & C_{52}(i) & C_{53}(i) & C_{54}(i) & C_{55}(i) & 0 \\ C_{61}(i) & C_{62}(i) & C_{63}(i) & C_{64}(i) & C_{65}(i) & C_{66}(i) \end{bmatrix} \varepsilon_t = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix}. \quad (14)$$

$$E(e_t e_t') = \sum e = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} & \sigma_{14} & \sigma_{15} & \sigma_{16} \\ \sigma_{21} & \sigma_2^2 & \sigma_{23} & \sigma_{24} & \sigma_{25} & \sigma_{26} \\ \sigma_{31} & \sigma_{32} & \sigma_3^2 & \sigma_{34} & \sigma_{35} & \sigma_{36} \\ \sigma_{41} & \sigma_{42} & \sigma_{43} & \sigma_4^2 & \sigma_{45} & \sigma_{46} \\ \sigma_{51} & \sigma_{52} & \sigma_{53} & \sigma_{54} & \sigma_5^2 & \sigma_{56} \\ \sigma_{61} & \sigma_{62} & \sigma_{63} & \sigma_{64} & \sigma_{65} & \sigma_6^2 \end{bmatrix}, E(e_t) = 0. \quad (15)$$

$E(e_t e_t') = 0 \quad \forall s \neq t.$

Comparing equations 9 and 11 gives:

$$E_t = A_i \, \varepsilon_t. \quad (16)$$

$$\begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \\ e_{6t} \end{bmatrix} = \begin{bmatrix} a_{21}(i) & a_{22}(i) & 0 & 0 & 0 & 0 \\ a_{31}(i) & a_{32}(i) & a_{33}(i) & 0 & 0 & 0 \\ a_{41}(i) & a_{42}(i) & a_{43}(i) & a_{44}(i) & 0 & 0 \\ a_{51}(i) & a_{52}(i) & a_{53}(i) & a_{54}(i) & a_{55}(i) & 0 \\ a_{61}(i) & a_{62}(i) & a_{63}(i) & a_{64}(i) & a_{65}(i) & a_{66}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix}. \quad (17)$$

ε_t includes structural shocks: ε_{1t} oil market shock, ε_{2t} is foreign exchange market shock, ε_{3t} is inflation shock, ε_{4t} is gold market shock, ε_{5t} is labor market shock, and ε_{6t} is stock market shock. The assumption is that structural shocks are orthogonal. The relation between the components of structural shocks and VAR errors is obtained by imposing 15 zero restrictions[3] on the matrix to show the simultaneous impact of the shocks. In estimation of a VAR model all the variables must be stationary. Therefore, first unit root test of the variables must be performed.

5. Unit root test

An important issue in estimation of econometric models is the stationarity of the variables. It is imperative that all the variables be stationary, for otherwise the t- and F-statistics from ordinary least squares are no longer efficient and the regression may be spurious. The necessary and sufficient condition for stationarity of a VAR is that the characteristic roots must lie outside the unit circle. Moreover, the necessary condition for using ordinary least squares in estimation of VAR model equations is the lack of autocorrelation in the error terms. Therefore, augmented Dickey-Fuller test (ADF) is used to examine the stationarity of the time-series used in this research (Table 1).

The above Table shows that in estimation of the structural VAR model, all the variables are stationary in the presence of a constant, trend, and first-order difference. None of the variables were level stationary. After testing stationarity, the optimal lag length must also be determined. Since the degree of freedom of the system decreases with every lag, it is very important to determine the optimal lag length of the model. Thus, Akaike information criterion is applied which is more appropriate for large databases. The results are provided in Table 2.

[3] The number of zero restrictions is obtained from $n\ (n - 1)/2$, where n is the number of variables in the model.

Table 1. Results of unit root test

Variable		Number of lags	ADF statistic	Critical value[4]	Result
Oil price	Level stationary	1	-3.301476	-3.441777	Non-stationary
	First difference stationary	0	-8.863107	-3.441777	Stationary
Consumer price index	Level stationary	1	-2.370644	-3.441777	Non-stationary
	First difference stationary	0	-8.869613	-3.441777	Stationary
Nominal exchange rate	Level stationary	0	-1.755843	-3.441552	Non-stationary
	First difference stationary	0	-11.92966	-3.441777	Stationary
Gold price	Level stationary	7	-2.447558	-3.444756	Non-stationary
	First difference stationary	6	-3.041645	-2.883753	Stationary
Unemployment rate	Level stationary	13	-2.499734	-3.444756	Non-stationary
	First difference stationary	12	-2.916051	-2.883753	Stationary
Stock price index	Level stationary	2	-0.995828	-3.442006	Non-stationary
	First difference stationary	1	-6.389096	-3.442006	Stationary

Table 2. The optimal lag length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1623.248	NA	2.56E-19	-25.78	-25.5085	-25.6697
1	1730.882	201.491	8.16E-20	-26.9261	-25.84004*	-26.48490*
2	1750.315	34.51298	1.07E-19	-26.661	-24.7604	-25.8889
3	1803.819	89.88641	8.17E-20	-26.9411	-24.2259	-25.8381
4	1844.157	63.895	7.77E-20	-27.0105	-23.4808	-25.5766
5	1885.227	61.11344	7.41E-20	-27.0916	-22.7474	-25.3268
6	1931.388	64.25575	6.61E-20	-27.2542	-22.0954	-25.1584
7	1990.386	76.4616	4.91E-20	-27.6222	-21.6488	-25.1955
8	2023.493	39.72824	5.65E-20	-27.5759	-20.7879	-24.8183
9	2081.172	63.67743*	4.54E-20	-27.92275*	-20.3202	-24.8343
10	2110.542	29.60474	5.95E-20	-27.8167	-19.3996	-24.3973
11	2143.345	29.91616	7.76E-20	-27.7655	-18.5339	-24.0152
12	2183.482	32.75255	9.56E-20	-27.8317	-17.7856	-23.7505

Notes: * indicates lag order selected by the criterion. 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.

The results suggest that estimation of the model with 9 lags satisfies both necessary conditions for stationarity. The interaction between the shocks is analyzed using impulse response functions and forecast error variance decomposition.

6. Impulse response function

The important issue in estimation of VAR models is the interactions between variables and how they affect each other. Therefore, the impulse response function (IRF) is estimated. IRF is the dynamic reaction of any of the endogenous variables of a system over time in response to one standard deviation shock to error terms. Here, the cumulative[5] responses of the variables in response to structural shocks are examined for 60 periods (5 years). Table 3 present the IRF of stock price index to structural shocks with 1 standard deviation.

Table 3. IRF of stock price index (cumulative)

Period	D (LOP)	D (LCP)	D (LER)	D (LP)	D (UN)	D (LSP)
1	0.003671	0.00829	0.002539	0.007812	-0.00141	0.028333
6	0.012537	0.024853	0.018356	0.002301	-0.02293	0.067229
12	0.044642	0.02021	0.01085	0.013998	-0.03469	0.097738
18	0.044785	0.006523	0.008483	-0.00018	-0.04972	0.098165
24	0.040665	-0.00486	0.009115	-0.00426	-0.03996	0.115124
30	0.046868	-0.0058	0.009499	-0.00184	-0.03827	0.12249
36	0.051487	-0.01588	0.004764	0.00016	-0.04783	0.124732
42	0.052097	-0.02047	0.004865	-0.00522	-0.0525	0.125346
48	0.049457	-0.01995	0.005886	-0.00528	-0.04535	0.125287
54	0.046456	-0.02218	0.005616	-0.0038	-0.04602	0.128919

[4] At the 5% significance level.
[5] This means that the responses of each period are due to all the previous shocks.

Table 3 (cont.). IRF of stock price index (cumulative)

Period	D (LOP)	D (LCP)	D (LER)	D (LP)	D (UN)	D (LSP)
60	0.05209	-0.02338	0.004301	-0.00426	-0.04876	0.129446
Cholskey ordering: D (LOP) D (LCP) D (LER) D (LP) D (UN) D (LSP)						

Based on the estimation of impulse response functions, the following conclusions can be made:

- Both in the short-term and the long-term increased oil price leads to increase in stock price index. Therefore, there is no evidence that rejects the hypothesis.
- The impact of foreign exchange shocks is positive both in the short-term and the long-term.
- The impact of inflation shock on stock price index is positive in the short-term, but negative in the long-term.
- Any shock to the gold market increases stock price index in the short-term. In the long-term, however, the effect is suppressed.
- In the short-term, the impact of unemployment rate on stock price index is negative, but in the long-term the impact labor market shock steadies stock price index.
- Stock market shock follows and increasing trend in the short-run and has positive incremental effect on stock price index in the long-term.

7. Forecast error variance decomposition (FEVD)

The results of FEVD for stock price index are provided in Table 5. The standard error column shows the forecast error for a given forecast horizon. The next columns also attribute a standard deviation to each of the variables. The sum of the values in each row equals 100%. Variance decomposition includes the same data as impulse response. At any given period, the more the error of a variable, the more will be their contribution to variation in the dependent variable.

Based on FEVD data in Table 4, the following conclusions can be made:

- Both in the short-term and the long-term, stock market shock has the highest share in explaining the variance in stock price index.
- After stock market shock, labor market shock and gold market shock are respectively the next predictors of variance in stock price index.
- Among other shocks, oil market shock and inflation shock are short-term predictors of stock price index variance.

Table 4. Results of FEVD of stock price index

Period	SE	Shock 1	Shock 2	Shock 3	Shock 4	Shock 5	Shock 6
1	0.09272	0.25489	4.84896	0.01683	24.7852	26.5874	43.5067
6	0.10555	1.83491	8.24062	1.93935	24.4888	29.1269	34.3694
12	0.11597	9.49172	8.08195	2.92601	19.0363	24.1672	36.2969
18	0.12311	10.1457	9.56134	3.17922	18.1619	24.5355	34.4164
24	0.12664	10.0823	10.8426	3.25951	18.9204	23.3909	33.5043
30	0.12901	10.6833	10.88	3.27461	18.7007	23.1307	33.3307
36	0.1303	11.0185	11.1020	3.37087	18.5188	23.2756	32.7136
42	0.1313	11.1742	11.2654	3.3479	18.3911	23.2276	32.5938
48	0.13177	11.2564	11.276	3.3773	18.3872	23.2394	32.4636
54	0.13192	11.2952	11.3066	3.3767	18.3956	23.2245	32.4013
60	0.13213	11.4886	11.2935	3.37473	18.3485	23.1689	32.3258

Notes: Shock 1: Oil market shock. Shock 2: Inflation shock. Shock 3: Foreign exchange market shock. Shock 4: Gold market shock. Shock 5: Labor market shock. Shock 6: stock market shock.

8. Model's strength

To increase the strength of the model, unemployment rate whose data may be less valid was removed from the model and the model was again estimated. Accordingly, the optimal lag length must be reestablished. The results are provided in Table 5. The data suggests that estimating the model with 1 lag satisfies the condition of stationarity.

Table 5. Optimal lag length of the model without unemployment rate

Lag	LogL	LR	FPR	AIC	SC	HQ
0	1148.744	NA	1.48e-14	-17.65495	-17.43326	-17.56487
1	1235.249	163.6220	5.71e-15*	-18.60852	-17.83260*	-18.29325
2	1246.358	20.15109	7.09e-15	-18.39315	-17.06301	-17.85269
3	1269.151	39.57828	7.38e-15	-18.35893	-16.47456	-17.59327
4	1280.818	19.35397	9.15e-15	-18.15221	-15.71361	-17.16136
5	1319.684	47.23057	8.61e-15	-18.22766	-15.23484	-17.01162

Table 5 (cont.). Optimal lag length of the model without unemployment rate

Lag	LogL	LR	FPR	AIC	SC	HQ
6	1335.049	36.64093	8.89e-15	-18.21781	-14.67075	-16.77657
7	1362.249	38.79797*	8.85e-15	-18.25193	-14.15065	-16.58549
8	1387.796	34.45876	9.13e-15	-18.26041	-13.60490	-16.36878

Notes: * indicates lag order selected by the criterion. 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.

Impulse response function without unemployment rate.

The results of IRF are provided in Table 6. According to the second column in Table 6, a sudden shock in oil price in the first period leads to increased stock price index, which elevates gradually. During a period of almost one year, any oil price shock increases stock price index, and this is in line with our expectations. In the long-term, however, the impact of the shock gradually decreases and is finally suppressed.

The third column in Table 6 indicates that the effect of inflation shock on stock price index is positive in the short-term. However, in the long-term the effect is suppressed. Column 4 of Table 6 shows that foreign exchange market shock has a positive effect on stock price index. Up to the sixth period, the effect is positive and incremental, but afterwards it decreases until it is totally suppressed. The data also show that gold market shock decreases stock price index in the short-term. However, the effect is suppressed in the long-term. The data also indicates that stock market shock follows an increasing trend in the short-term and a fluctuating trend in the long-term, thus having little effect on stock price index in the long run. Therefore, the results of IRF show that in the long-term the effects of all the shocks are suppressed and that these shocks only have short-term impact on stock price index.

Table 6 impulses response function and (cumulative) growth in stock price index in the model without unemployment rate.

Table 6. Growth in stock price index in the model without unemployment rate

Period	D (LOP)	D (LCP)	D (LER)	D (LP)	D (LSP)
1	0.003481	0.004924	-0.00092	-0.00258	0.033431
6	0.017045	0.021117	0.005399	-0.00951	0.075296
12	0.018173	0.022361	0.005878	-0.00986	0.07823
18`	0.018217	0.022417	0.005898	-0.00985	0.078352
24	0.018219	0.02242	0.005899	-0.00984	0.078358
30	0.018219	0.02242	0.005899	-0.00984	0.078358
36	0.018219	0.02242	0.005899	-0.00984	0.078358
42	0.018219	0.02242	0.005899	-0.00984	0.078358
48	0.018219	0.02242	0.005899	-0.00984	0.078358
54	0.018219	0.02242	0.005899	-0.00984	0.078358
60	0.018219	0.02242	0.005899	-0.00984	0.078358

Note: Cholesky ordering: D (LOP) D (LCP) D (LER) D (LP) D (LCP).

9. Structural analysis

The results of variance decomposition for growth in stock price index are provided in Table 7. The results show that at different periods (short-term and long-term) stock market shock with 77-84% has the highest share in explaining the variance in stock price index. Stock market shock arises from internal factors. However, the effect of internal factors decreases with time and external factors plays a greater role in changes in stock price index. After stock market shock, oil market shock is the highest predictor of variance in stock price index. The effect of other shocks becomes more considerable in the long-term.

During a period of 5 years (60 months), oil market shock has the highest share in explaining stock price index variance. The gold market shock is next highest predictor of stock price index. The reason may be the fact that gold is an alternative asset to stocks and each variable is affected by fluctuations in the other variable. Fluctuations in the gold market pose a dilemma for investors to decide how much stock or gold to invest on. Thus, the impact of gold market on stock market is theoretically plausible. Table 7 shows the results of variance decomposition for stock price index without unemployment rate.

Table 7. The results of variance decomposition for stock price index without unemployment rate

Period	SE	Shock 1	Shock 2	Shock 3	Shock 4	Shock 5
1	0.09547	14.1756	0.0116	0.51573	1.18269	84.1144
6	0.10148	18.1283	0.78153	0.64675	3.53077	76.9126
12	0.10155	18.1511	0.78601	0.64745	3.53808	76.8774
18	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
24	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
30	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
36	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
42	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
48	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
54	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773
60	0.10155	18.1512	0.78603	0.64745	3.53808	76.8773

Notes: Shock 1: Oil market shock. Shock 2: Inflation shock. Shock 3: Foreign exchange market shock. Shock 4: Gold market shock. Shock 5: Stock market shock.

Based on the results of IRF and FEVD, the following conclusions can be made:

- Increased oil price leads to increase in stock price index, and oil market shock is one of the main predictors of stock price index variance.
- The impact of foreign exchange shocks on the stock market is not significant.
- Stock market shock has a positive effect on stock price index and is one of the main predictors of its variance.

Conclusion

The present research investigated the impact of oil price fluctuations and a set of other macroeconomic variables on stock price index using structural vector autoregression models, impulse response function, and variance decomposition for the period 2001-2013. As discussed in the review of the literature, there is no consensus on the effect of oil price on stock price index in different countries. In other words, a group of studies has reported a positive relationship between oil price and stock price index, while other studies have argued that there is no relationship between these variables. It seems that the only determinant of oil revenues of oil-exporting countries such as Iran is the world price of oil which is an exogenous variable. Therefore, these countries can use oil revenues effectively only if they learn from the experiences of other oil-dependent countries and find strategies for preventing the effect of oil shocks on oil revenues, whether these shocks are positive or negative. Otherwise, Iran's economy will always be exposed to the consequences of oil shocks.

A SVAR model was used in this research to investigate the impact of oil price fluctuations on Iran's stock market. The advantage of SVAR is its ability to determine the impact of structural shocks on internal markets using IRF and FEVD. Using IRF, the present research showed the dynamic response of each endogenous variable in the system against a standard deviation of shock in other variables over time. Variance decomposition functions were also obtained from the variance-covariance matrix from the residuals of vector autoregression, which is a function of structural shock components (ε_t). In FEVD, the short- and long-term share of each shock in explaining a given variable is identified. The more the standard deviation of a variable, the more will be their share in the variance of the dependent variable.

The results of the present research suggest the impact of oil price fluctuations on stock price index. Both in the short-term and the long-term, stock price index increases with oil price. Indeed the short-term impact is greater, which is consistent with our expectations. Moreover, oil market shock is the most important predictor of stock price index variance.

Recommendations

Policy recommendations:

- There is a dire need to prevent the adverse economic outcomes caused by the excessive role of oil revenues in Iran's economy. Creating a savings and investment fund for oil revenues is one such strategy. So long as the economic capacity of the country is improved, oil revenues should not be injected to the economy. This provides enough capital when oil prices decrease.
- Economic decision makers and policy makers must pay attention to the impacts of their decisions on the stock market or other market when making monetary policies at the macro level.

Research recommendations:

- Future research can examine the effect of oil price on other capital market variables such as volume of transactions or market value of firms.
- The results of the present study regarding the relationship between oil price and stock price index in Iran can be compared with countries that have similar economies.

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