



Impact of Direct and Indirect Oil Shocks on Iran's Energy-intensive industries stock returns (Applying Simultaneous Equation System on Panel Data)

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ABSTRACT

Regarding the fact that each country might be a net oil seller or net buyer, and considering its large share in the whole economy, the price of this commodity as well as its volatility could affect all economies around the world. The impact of oil price volatility on the economy is seemed to be more dominant in Iran rather than any other developed or emerging economies, especially in recent years. The purpose of this study is to investigate the effect of direct and indirect oil shocks on the stock returns in the selected energy companies listed in Tehran Stock Exchange.

The reason behind choosing such industries is that energy prices play an important role in the production cost. For this reason, we used monthly basis data spanning the period starting from April 2009 to July 2019. Applying three-stage least squares (3SLS) and Panel data, the direct effect of oil shocks on stock returns found to be negative even though those for indirect effect were positive

Keywords:

Oil Shock, Market Return, Stock Return, Capital Asset Pricing Model (CAPM).

1. Introduction

Regarding the fact that each country might be a net oil seller or net consumer, and considering its large share in the whole economy, the price of this commodity as well as its volatility could affect all economies around the world. Consequently, it is expected that oil price variations may affect the global economy. One could define oil price shocks as unexpected changes in the oil price which are able to affect the economy either positively or negatively. The United States economic recessions in the 70s can be attributed to this phenomenon which led to an increase in general price levels and a significant decrease in productivity (Soyemi et al, 2017). On the other hand, due to their dependency on oil, the oil-producing countries such as Iran will be highly impressed by oil index variations. Similarly, some studies suggested that oil price shocks may necessitate sequential alterations in different economic aspects such as monetary policy, labor market adjustments, and changes in energy technologies. The volatility in the real price of oil was so important that it has led to a focus on and a resurgence of researches on the oil market and its consequential effects on global economies (Kilian and Murphy, 2014; Soyemi et al, 2017).

The impact of oil price volatility is felt even more in Iran than any other developed or developing countries, especially in recent years. There has been a great number of documents to approve a fall in global oil prices that would stimulate most of the macro-economic indices and accelerated many economies move towards recession. Regarding the monolithic nature of economies, it is expected that the whole economy, especially financial markets, will be susceptible to the changes in oil prices. Moreover, one should bear in mind that energy-related securities comprise a big part of the total stocks in the stock exchange market. Hence, the energy market and their related stock returns are more sensitive to the oil price volatilities.

A review of the previous researches reveals that oil price shocks impact the stock market via two separate channels. The first mechanism, known as the direct impact of oil shocks, is a one that impacts the company stocks (or a subset of its indices). Via the indirect impact, as the next mechanism, oil shocks impact the individual stock value as a result of their effect on all markets. While both of the mentioned

procedures are confirmed in the literature, experimental researches that focus simultaneously on the direct and indirect impact of oil shocks on the stock return of a firm or stock portfolio are less welcome and lack of these types of research is felt. The main objective of this to examine these two impacts simultaneously. To achieve these goals, we used a simple capital asset pricing model (CAPM) for the test of significance of oil price shocks on the monthly return of stocks. Moreover, based on our research hypothesis, which claims that the market returns impacts the stock return and stock portfolio, not vice versa, we summarize the experimental problem in two independent regression equations that can be estimated using three-stage least squares (3SLS) method.

The structure of the present research is as follows: following the introduction, we will review the literature and historical researches, then in the third section, methodology and the data are discussed. The fundamental model and variables contrive the next two parts. Finally, model estimations discussion and conclusions are presented in the latter sections.

2. Literature Review

A review of the literature and previous studies reveals that there have been studies to document the effect of oil shocks on different sectors of the economy. There are two different viewpoints regarding the impact of oil shock or its volatility on stock price and GDP growth. One argues that there is a direct relationship between these two, while the other claims that there are weak and even probably no relationship and at the best state, there is an indirect relationship. The first theory is known as linear/symmetric relationship and the second one is familiar as asymmetry-in-effects theory. The asymmetry-in-effects theory maintains that there is a trivial relationship and maybe no relationship between crude oil price and economic activities in the US economy (Oriakhi & Osaze, 2013). The asymmetric relationship between oil price and economic growth has already been confirmed in some African countries (Mark, Olsen, & Mysisen, 1994). Federer (1996) distinguished three channels of uncertainty, sectoral shocks and anti-inflation monetary policy as influencing channels, which later was confirmed in the studies conducted in the US. Linear/symmetric

relationship theory (symmetric), assumes that volatility in oil price caused fluctuations in GDP growth. This theory developed around the impacts of the activities of oil market in 1948 till 1972 on the economy of oil exporting and importing countries (Gisser & Goodwin, 1986; Godwin 1985; Hamilton, 1983; hooker, 1996; Laser, 1987). In fact, Laser (1987) confirmed the existence of an asymmetric relationship between volatility in oil price, stock market performance and economic growth. This study showed that an increase in oil price would lead to a decrease in GDP and stock prices, yet the impact of oil price on GDP is vague and defers from country to country.

A review of the previous studies showed that oil price shocks impact the stock price return in ways. The first channel of impact which is called the direct impact of oil shock is a channel that impacts the stocks of a company (or subset of its index). Researchers like Huang et al (1996), Faff and Brailsford (1999), Sadorsky (2001), Hammoudeh and Li (2004), El-Sharif et al (2005), Boyer and Filion (2007), all have studied the way oil price shocks impact the return of a specific industry, which is called direct impact. The review of these types of studies reveals that in some studies the industries are not immediately influenced by a change in oil price while in other studies they are immediately influenced. This means that the nature of direct impact is very changing. From the point of view of Huang et al (1996), this difference is due to the fact that price volatility impacts only the stocks of certain industries. According to research by Gogineni (2010), this issue is related to the energy consumption structure of the industries. He showed that if we divided the industries into two parts of high energy consuming and low energy consuming, the impact of the daily volatility in oil price on stock return would be different. Most of recent studies like Scholtens and Yurtsever (2012), Broadstock et al (2012), Narayan and Sharma (2011), Elyasiani et al (2011), Mohanty et al (2011), Arouri and Nguyen (2010), Kilian and Park (2009), have examined a specific sector or the specific subsets of an industry. The general consensus of opinion in these researches is that oil and gas sectors as well as the mining sector, are positively impacted by the increase in oil price. The order is vice versa in other sectors.

The second impacting channel that has been pointed out by researchers is the impact of oil shocks on the whole stock market, which is called indirect

impact. Oil shocks impact the whole market and consequently impact individual stock values. In general, most of the existing studies imply the negative relationship between oil shocks and stock market returns. As examples of these studies, we can cite Filis and Chatziantoniou (2013), Ciner (2012), Lee and Chiou (2011), Chen (2010), Miller and Ratti (2009), Driesprong et al (2008), O'Neill et al (2008), Park and Ratti (2008), Henriques and Sadorsky (2008).

While both mechanisms have been accepted in the literature and are discussed, the experimental researches that consider the direct and indirect impact of oil shocks on stock returns of a company or stock portfolio have less been on the focus of attention.

Empirical Review

A historical review of theoretical literature and previous studies shows that there have been influential studies on the impact of oil shocks on different sectors of the economy. The first research, on the way that oil shocks impact economic activities, is conducted by Hamilton (1983) and Mork (1989). In that study, they attempted to show two issues; the first was that oil impacts the economy and the second was that there is a considerable asymmetry in positive and negative oil shocks. Chen et al (1986), were among the firsts to explore the pure effect of oil shocks on the stock market and asserted that the oil price changes will influence the market index. Aftermath, various researches have been conducted that there have been different in terms of temporal framework, industrial and geographical background and estimation methods. (Some of the recent studies are as follows: Filis and Chatziantoniou (2013), Ciner (2012), Lee and Chiou (2011), Chen (2010), Miller and Ratti (2009), Driesprong et al (2008), Nandha and Faff (2008), O'Neill et al (2008), Park and Ratti (2008), Henriques and Sadorsky (2008) Bachmeier (2008). The importance of these researches is that there is no specific consensus in them; though the general tendency is that the impact period in each market was different and probably asymmetric in response to the increase and decrease in oil price. Also, there have been many kinds of research in the field of sectors, subsectors and even special studies on companies. These studies generally have focused on the specific mechanisms and procedures that oil shocks may affect the economy. As two of the well documented researches on the impact of oil on stock market return,

one can cite Huang et al (1996) and Gogineni (2010). Some other researchers had shed light on the specific features of sector under the investigation and also the enterprises that are energy dependent. According to their studies, price shocks are transferred immediately through production costs that are sensitive to oil price shocks.

Narayan and Sharma (2011) analyzed 560 companies in New York Stock Exchange. Their study showed that the impact of oil is different in cross-sector studies among other influential factors on stock returns. It is also showed that in some systems the impact of oil is trivial while it is not so in some others. Also, in some occasions, the impact of the oil shock on a sector may be negative while it may not be so in another occasion. Among other studies conducted, studies like that of Faff and Brailsford (1999), Sadorsky (2001), Hammoudeh and Li (2004), El-Sharif et al (2005), Boyer and Fillion (2007), gained similar results. In these studies that the focus is on sub-sectors, the assumption is that industry classification is a necessity to determine the exact role of oil shocks on the stock market. For this reason, these researches usually pay little attention to the nature of oil shocks on market index (Broadstock et al (2014)).

There is another trend in theoretical literature that pays attention to the relationship between oil price and stock markets from a different perspective. Research by Kilian and Park (2009) is probably one of the famous and influential researches conducted in recent years which provided a new horizon regarding the relationship between oil shocks and stock markets. Using monthly data, they categorized global oil shocks into three sources: Aggregate demand, probable demand, supply-side. The analysis of impulse response shows that these shocks impact the stock return of different industrial sectors of the US in various ways. In another trend, Malik and Ewing (2009), examine the probable impact of oil shocks on volatility in the stock index compared to their impact on price or return of the stock index. Their findings infer the existence of overflow of volatility from oil prices to different sectors of industry in the US. They showed that US stock response to oil price shock is totally different and the difference lies in the fact that whether oil price change is caused by the demand or supply shocks.

Using monthly data from Australia for the period 1983-1996, Faff and Brailsford (1999) found that oil

price has a positive impact on oil-related industry return and negative on paper, packing, and transportation industries. Henriques and Sadorsky (2008), using weekly data from the US for the period 2001-2007, observed that a shock in the technology has far more impact on the stock return of energy companies than an oil price shock. Using monthly data from the UK for the period 1983-2005, Nandha and Faff (2008) showed that an increase in oil price has a negative impact on the return of stock of all sectors except mine, industry, oil, and gas. Using weekly data for China, Broadstock et al (2012) observed that a positive, dynamic and significant relationship exists between global oil prices and stock of energy companies. Cunado and Gracia (2014) examined the impact of oil price on stock market return of 12 European oil importing countries using daily data for the period 1973-2011 by application of VAR and VECM approaches. According to the results, the responses of real stock market of Europe against oil price shock are different depending on the source of shock. The findings show that oil impact on stock market return in most of the countries studied was negative and significant and supply-side shocks had more impact on this market. Using daily data from Nigeria for the period 2007-2014 and application of the EGARCH-3SLS approach, Soyemi et al (2017) found that oil shock has a direct and positive impact on stock return. They also discovered an indirect relationship between oil shocks and stock returns.

Due to the importance of oil price impact on stock market return, it has attracted the attention of most domestic studies. A glance at these researches shows that most of these researches focused on the impact of oil price volatility on aggregate output except a study by Zaroki et al (2018) that analyzes the impact of global oil price on the stock value of petrochemicals industries. Table (1) summarizes recent studies related to the present research.

Table (1) Researches in Iran

Author	Period	Data	Approach	Results/ Findings
Keshavarz Haddad & Manavi (2008)	1999- 2006	Daily	VAR & Granger causality	Stock market responses more when oil price increases and when oil price decreases, oil price has less impact on stock price.
Yahyazadehfar et al (2011)	1995-2009	Quarterly	ARDL	Price and revenue shocks of oil have negative and significant impact on the real return of food industry, chemicals, and non-metal industry.
Hosseini Nasab et al (2011)	1997-2010		Wavelet analysis and MRSH	The impact of volatility on stock market has been positive in prosperity phase and negative in recession phase
Rahnamay Roudposhti et al (2012)	2005-2015	Monthly	OLS	Oil price has positive impact on the return of this index.
Shahbazi et al (2013)	1991-2010	Monthly	SVAR	Oil supply shock does not have significant impact on oil price and only demand shocks and aggregate demand are among the factors influential on stock return in Tehran Stock Exchange.
Mirhashemi Dehnavi (2015)	2008-2012	Daily	SUR	Oil price had significant impact on stock price index in countries studied; and based on the three definitions oil price shocks had asymmetric impact on stock return in Iran, Oman, Qatar, Kuwait.
Fotros and Hoshidari (2016)	2001-2016	Monthly	GARCH	There is a significant negative relationship between crude oil price return volatility and index return volatility of Tehran Stock Exchange; also there is a significant negative relationship between exchange rate volatility and volatility in stock return of Tehran Stock Exchange.
Bordbar and Heidari (2015)	2004-2014		VAR-GARCH	There are mean impacts between oil market and base metals stock market and oil products but this impact is not true in chemicals industry stock market. Impact of volatility does not exist between two markets of global oil price and chemicals industry and base metals. Yet, there is a significant relationship between oil market volatility and volatility in stock return of oil products.
Mamippour and Fe'eli (2016)	2008-2014	Monthly	Markov Switching	Results show that most overflow comes from volatility of oil market to index of base metals industry; and chemicals industry, printing, cement, non-metallic minerals, communication equipment, and tire are at zero regime and metallic minerals, technical and engineering, paper products, oil products, and other mines and extraction are at regime 1 respectively.
Zaroki et al (2018)	2008-2017	Daily	ARDL	Petrochemicals industries can be a channel to transfer global oil price volatility on aggregate index of Tehran Stock Exchange. In short term, the asymmetric impact of oil price on petrochemicals industry is confirmed; in a way that with a decrease in oil price, stock value of petrochemicals industry decreases but with an increase in oil price, increase in the value of petrochemicals industry occurs. This happens where in the long run oil price impacts on petrochemicals industry index asymmetrically.

Source: Examination of different researches

3. Methodology

As pointed out, several studies have been done on the impact of oil shocks on stock return but almost all of them have been conducted in oil consuming countries and they have not considered the direct and indirect impact simultaneously. The present study endeavors to explore the direct and indirect impacts of the oil shock on the stock return of energy-intensive companies of the Tehran Stock Exchange. What makes this study different from others is that besides using up-to-date periods, it uses the Exponential GARCH

approach in CAPM and using the estimation of simultaneous equations in panel data.

A sample of 44 energy-intensive companies accepted in the Tehran Stock Exchange is used in this study. These companies are selected from the chemical products industry, base metals industry, Petroleum products industry, cement, plaster and lime industry, and metallic minerals industry. The data are collected on a monthly basis spanning the interval period starting from March 2009 till July 2019. The data are obtained as follows, oil price from OPEC website,

gold price from World Bank and stock return and stock exchange return from Tehran Securities Exchange Technology Management and Rahavard Novin Software. In this research, panel data and simultaneous equations system are used. These data allow us to analyze the behavior of companies over the period.

Research Model and Variables

similar to the study done by Soyemi et al, (2017), and Gogineni (2010), the direct and indirect impacts of oil shocks on company stock return are estimated in this research. in addition, the aggregate impact of oil shocks on stock return will be calculated.

A) Direct Impact of Oil Shocks on Company Stock Return:

In order to explore the direct impact of oil shocks on the stock market, the capital assets pricing model (CAPM) is used. CAPM shows the relationship between the risk-return of a stock or an asset in relation to the market return. This model supposes that a kind of linear relationship exists between the return of each stock and stock market return. The simple model of CAPM can be illustrated as equation (1) as follows:

$$K_i = R_f + \beta(R_m - R_f)$$

In which, R_f is risk-free return, β is sensitivity coefficient (beta), R_m is for market return rate and $R_m - R_f$ refers to the market risk premium. Based on Sharpe model, beta can be calculated from the following relationship:

$$\beta = \frac{\text{Cov}(R_i, R_m)}{\text{Var}(R_m)}$$

Which is $\text{Cov}(R_i, R_m) = E[(R_i - \mu_i)(R_m - \mu_m)]$ and $\text{Var}(R_m) = E[(R_m - \mu_m)^2]$.

In congruent with the present research, the CAPM model is written as follows:

$$R_{it}^c = \alpha + \beta R_t^m + \mu_t \quad (1)$$

Where, R^c is the monthly return on energy-intensive company stocks and R_m is the monthly return of the market. Following Broadstock et al (2014) and Soyemi et al (2017), that claim stock price is influenced by oil shocks, we have also included oil shocks in the CAPM model to control the impact of oil shocks on the stock

return of each company. So, equation (1) can be rewritten as:

$$R_{it}^c = \alpha + \beta R_t^m + \theta Oilshock_t + \mu_t \quad (2)$$

Where, $Oilshock_t$ is oil price shock and θ indicates the direct impact of oil shock on the stock return of companies. Also, parameter β indicates the direct impact of stock market return on the stock return of each company and μ represents the error term.

B) Indirect Impact of Oil Shocks on Company Stock Return:

To emphasize the indirect impact, it is necessary to discuss some of the major related literature with CAPM. This model which was first introduced by Sharpe (1964) suggests that the value of a stock (individual stock or stock portfolio) is strongly influenced by the aggregate return of the stock market where that stock or portfolio belongs to. So, if the whole market is influenced by oil shocks and moreover that stock or portfolio is influenced by market value, it means that oil shocks are transferred indirectly through market risk. It is easy to infer the dependency between the stock market and stock price; as with the increase in oil price, signs of inflation appear and the Central Bank increases the interest rate to cope with it. This issue, among other things, leads to the formation of a tight monetary environment which will lead to increase in the stock price in all markets. In general, this definition is what we here call indirect impact (Broadstock et al 2014).

To test the indirect impact of oil shocks on the stock return of the company, we applied the same procedure as Broadstock et al (2014) and Soyemi et al, (2017). These researchers also used above mentioned reasoning and claim that the stock market is influenced by oil shocks. As the company stocks are directed by market activities, the impact of oil shocks are transferred to stock return through the stock market. With this in mind that there are other important variables that impact the stock market, these variables can be integrated into the model. In Iran, the stock market responds to the exchange rate and gold price fluctuations in a crucial way. Due to the high correlation between these two variables, only gold can be integrated into the model. To estimate the indirect impact of, we can specify the model as equation (3):

$$R_t^m = \pi + \gamma Oilshock_t + \rho Gold_t \quad (3)$$

To obtain oil shocks, we estimate oil price volatility using the EGARCH model. In the standard EGARCH model, we had to be certain that the impacts and coefficients are positive. The characteristic of EGARCH is that it takes into account the asymmetric state in volatilities. It means positive shocks (positive news) may have a different impact than negative shocks (bad news). This model also brings about a precise forecast regarding the conditional variance (Engle and Ng 1993). The conditional variance in the EGARCH model can be obtained as equation (4):

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \alpha \left(\frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right) + \delta \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| \quad (4)$$

Now, equations (2) and (3) can be estimated simultaneously using instrumental variables. Certainly, simultaneous equations system approaches have more efficiency compared to the single-equation estimation model. They allow us to examine both individual (direct) and joint (indirect) impact of oil shocks on stock return. To estimate the model, a three-stage least squares approach will be applied. The most important advantage of 3SLS is its asymptotic efficiency. Of course, if the model is not specified correctly, the estimation of each of the equations will not be robust enough in the 3SLS approach. By simultaneously solving equations 2 and 3, we will attain indirect impact which is a reciprocal impact of oil shocks on the returns of companies (β) and the impact of the oil shock on stock market return (γ):

$$\frac{\partial R_{it}^c}{\partial R_t^m} * \frac{\partial R_t^m}{\partial Oilshock_t} = \beta\gamma$$

We deduced three relationships from the 3 scenarios mentioned above. First, there is a direct impact if θ significant; second, there is an indirect impact if β and γ are both significant; and finally, the total of direct and indirect effects gives the total effect which is researchers (Soyemi et al,2017):

$$\frac{\partial R_{it}^c}{\partial R_t^m} = \frac{\partial R_{it}^c}{\partial R_t^m} * \frac{\partial R_t^m}{\partial Oilshock_t} = \theta + \beta\gamma$$

Description of Variables

Oil Shocks

There are different criteria for measuring oil shocks. In the present research, two methods that are widespread are used. The first one is using oil price volatility as oil shocks. The exponential GARCH model is used to compute the oil price volatility. This model which is an expansion of GARCH is recently used in some studies (like Lux, Segnon, & Gupta, 2015) to measure the oil price volatilities. The second method to measure oil shocks is oil returns which are computed as a change in the natural logarithm of oil price. This method is also used by some other researchers (Soyemi et al,2017, Broadstock et al,2012 and Park and Ratti,2008).

Stock Market Return

which is defined as the growth of the All Share Index and measured as the change in the natural logarithm of the whole index of all stocks, Broadstock et al, (2014).

Company Stock Returns

It is defined as growth in company stocks that is computed as changes in the natural logarithm of the stock price for the stocks of every company, (Soyemi et al, 2017 and Broadstock et al, 2014).

Fluctuations in gold price

It is computed as a change in the natural logarithm of gold price.

4. Results

Descriptive Statistics

Regarding data collected for the period of March 2009 till July 2019, 5456 observations were gathered; the summary of the descriptive statistics related to the variables is presented in table (2).

Table 2. descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Oil Price	5,456	76.98153	25.48744	26.5	122.97
Market Return (R_t^m)	5,456	64146.25	48251.54	7989	248613.8
Company Stock Returns (R_{it}^c)	5,456	.0320412	.1756782	-	1.55323
Oil price growth	5,456	.0037856	.0847698	-	.2175676
Market Return growth	5,456	.0226807	.1123246	-	.4188057
Gold price	5,456	1311.595	198.028	890.2	1772.14
Gold price growth	5,456	.0011623	.0443774	-	.1184295

Source: Research findings

Identification problem

In a model which comprising G simultaneous equations with G endogenous variables and K exogenous variables, if from an equation with g endogenous variable and k exogenous variable, the number of pre-determined variables, $K - k$, should be more or equal to the number of endogenous variables minus one, $g - 1$, for an equation to be just identified. Namely, the order condition implies $K - k \geq g - 1$. Also, rank condition will be satisfied if and only if matrix Δ which includes all coefficients of excluded variables from an equation, but used in other equations has a rank equal to the number of equations minus one, meaning equation $rank(\Delta) = G - 1$ is formed. (Sadighi, Lavlar, 2017, 282). According to estimation conducted for each two equation it is $K - k > g - 1$ and $rank(\Delta) = 1$. An examination of the two order and rank conditions for doing the identification test indicates that the equation system of the research is just identified and consequently the model can be estimated.

Stationarity test

Before running the model, in order to prevent spurious estimations of regression models, it is necessary to test for stationarity. In the present study, Levin-Lin-Chu unit-root test is used for this reason; results are reported in table (3). As it can be seen, all the variables are stationary.

Table (3). Results of Levin, Lin and Chu tests for the Stationary of variables

Variable name	Adjusted t	Probability
Stock Returns (R_{it}^c)	-23.5147	0.000
Oil shocks (1)	-29.4033	0.000
Market Return (R_t^m)	50.7027	0.000
Fluctuations in the gold price	-20.6170	0.000
Oil shocks (2)	-8.8893	0.000

Source: Research findings

One of the usual tests used in examining the validity of instrumental variables is the Hansen-Sargan test. This test is a test of over-identifying restrictions. The null hypothesis of this test is that instruments are valid; meaning the used instruments in the model does not have a correlation with error term and the instrumental variables excluded from the system are chosen correctly (Aghaei and Rezagholizadeh, 2016).

Sargan test is considered as predetermined restrictions and is used to examine the existence or non-existence of correlation between types of instruments and residual terms yielded from model estimation. According to the procedure of this test, if there is no correlation between the instruments and residual terms, the classical assumptions are satisfied and desirable properties of estimation will attain. So, the instruments used by the correct specification are provided. The null assumption of this test is zero correlation and validity of the instrument. So, there is no need to use or add other instrumental variables to the model. Based on this fact and regarding the test results in table (4) and comparing this by critical values of the chi-square distribution with 3 degrees of freedom, one can infer that the validity of the used instruments cannot be rejected in either of the oil shock scenarios.

To determine the nature of data (Pooled or Panel), the Chow test is applied to test the existence of individual effects. in case that the null hypothesis rejected in favor of the existence of individual effects, Then the Hausman test should be done to determine whether the fixed effects or random effects could better explain the data. Hausman proposed a test in 1987, based on which the existence of a difference between the estimators of methods of fixed effect and random effects are considered as zero assumption. So, by rejecting zero assumption, we can deduct that it is better to use the fixed effects method. According to the results, form the firs scenario (oil shock measured by EGARCH) of the Chow test, the test statistic is computed at 1.48; with regard to the mentioned degree of freedom in the above table, probability distribution tale computed lesser than 5 percent. So, with 95 percents of confidence, we can confirm the existence of individual effects. As a result, in the next stage, the model was estimated by both method of fixed and random effects and the Hausman test was conducted, where finally random effects model was chosen. Applying these tests for the second scenario (change index in the natural logarithm of oil price fixed effects model fixed effect model was selected (see table 4).

Table (4) results of Chau, Hausman and Wald statistical tests for both oil shock scenarios

test	oil shock (1)			oil shock (2)		
	statistic	statistic- Quantity	Probability	statistic	statistic- Quantity	Probability
F-Limer (Chow)	F(43,5410)	1.48	0.002	F(43,5410)	6.79	0.0000
Hausman	H	0.13	0.7183	H	10.96	0.0000
Wald (Sargan)	χ^2	7.41	0.9882	χ^2	6.68	0.9927

* and ** oil price volatilities obtained using the EGARCH model and also change in the natural logarithm of oil price respectively.

Source: Research findings

Impact of Oil Shocks on Stock Return

The estimates of the 3SLS model on the panel data with the random effects model are presented in table (5).

Focusing on the main objective of the research, we can summarize the direct and indirect impact of oil shocks as in table (6). As it can be seen, when an impulse in the oil price volatility (computed by EGARCH), have a negative direct impact on stock return and a positive impact on market return. As market return has a positive impact on stock return, one can state that the direct impact of the oil shock on stock return is positive. Its value is estimated at $\frac{\partial R_{it}^e}{\partial R_t^m} = \beta\gamma = 0.29 * 0.878 = 0.25456$. Regarding the greater

value of indirect impact, the total impact is also positive.

the estimates of the 3SLS model on the panel data with fixed effects model method are presented in table (7). Regarding the second index for oil shock namely change in the oil price natural logarithm, the sign of direct and indirect impacts does not change significantly. As it can be seen, its direct effect is negative and indirect effect is positive, which is: $\frac{\partial R_{it}^e}{\partial R_t^m} = \beta\gamma = 0.00061 * 0.83597 = 0.0005$. Also, the total effects will be positive. It is worth noting that Although being very small, the estimated coefficients are logically acceptable as we the growth of variables are used instead of their level

Table (5) Impacts of oil shocks (oil price volatility) on energy-intensive stock return

First equation dependent variable: Stock Returns (R_{it}^e)		
variables	coefficient	T statistics (Possibility)
Oil shock (1)	-0.0006	-9.1 (0.03)
Market Return (R_t^m)	0.878	27.59 (0.00)
constant	0.0121	6.16 (0.00)
Second equation dependent variable: Market Return (R_t^m)		
variables	coefficient	T statistics (Possibility)
Oil shock (2)	0.29	18.49 (0.00)
Gold price	1.061	35.27 (0.00)
constant	0.02	15.59 (0.00)

Source: Research findings

Table (6) Direct, indirect and total effects of oil shocks1(volatility) on company stock return

	Direct	Indirect	Total
Oil shock (1)	-0.0006	0.25462	.25456

Source: Research findings

Table (7) Oil price shocks effects (oil returns) on energy-intensive stock return

First equation dependent variable: Stock Returns (R_t^f)		
variables	coefficient	T statistics (Possibility)
Oil shock (2) ¹	-0.00018	-2.49 (0.013)
Market Return (R_t^m)	0.83597	23.87 (0.000)
constant	0.01308	6.54 (0.000)
Second equation dependent variable: Market Return (R_t^m)		
variables	coefficient	T statistics (Possibility)
Oil shock (2)	0.00061	0.000051 (0.000)
Gold price	1.18	39.45 (0.000)
constant	0.02138	16.05 (0.000)

Source: Research findings

Table (8). Direct, indirect and total effects of oil shocks (oil returns) on company stock return

	Direct	Indirect	Total
Oil shock (2)	-0.00018	0.0005	0.00032

Source: Research findings

5. Discussion and Conclusions

Considering the crucial role of oil revenue in oil-exporting countries and having a look on Iran's annual budget, it is expected that oil price shocks affect the structure of Iranian economy, specifically the capital market. Energy is among the Factors that are used in the production process of the industry sector. Undoubtedly, some industries have a larger share of the energy in the energy in the industry sector. These industries are considered energy-intensive regarding energy consumption. Taking into account for the importance of oil price volatility on the return of these industries, exploring the effect of oil shocks is necessary in Iran. In this research, we examined the direct and indirect effects of oil price on energy-intensive company stock return using a simultaneous equations system on panel data. To achieve this goal, we used the capital assets pricing model (CAPM). The criteria applied for the measurement of oil shocks were: First, we used oil price volatility as oil shocks. In calculating the oil price volatility, exponential

GARCH (EGARCH) was used. The second oil shock measurement method was oil returns that were calculated as a change in oil price natural logarithm. For this purpose, we gathered the stock information on energy-intensive companies listed in Tehran Stock Exchange, that stands for majority of the total stock value of the capital market. These companies are selected from chemical products industries, base metals industry, Petroleum products industries, cement, lime, and plaster industries and metallic minerals industries.

The stimated coefficients, inline with other studies, show that oil shocks affect the stock return of energy-intensive companies. This effect is both direct and indirect. The results also indicate that the direct effect of oil shocks (for both criteria) on the stock return of energy intensive-companies was negative. Moreover, the indirect effect of oil shocks on stock return found to be positive.

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Note

1. oil price volatilities obtained using natural logarithm of oil price