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Abstract

Crude oil as one of the main sources of energy is also the main source of income for members of OPEC. So, the volatility of crude oil price is one of the main economic variables in the world and analysis of the effect of its changes on key economic factors has been always considered as significant. The reason might be the high sensitivity of oil price to political, economic and cultural issues worldwide and consequently its volatility on the one hand, and the high influence of the volatile prices on macroeconomic variables. On the other hand, for different reasons such as oil price volatilities and income from oil export, economic planners and policy makers in Iran have been mainly focused on the promotion of non-oil exports especially during the last few decades. Therefore, methanol as one of the most commonly used petrochemical products has a high potential for production and export of non-oil products in Iran. For this reason, in the present study there was an attempt to examine the relationship between the prices of Iran's crude oil and methanol using FIGARCH model and based on the weekly time series data related to the research variables. The results of the study showed that the long memory parameter is equal to 0.32 which is meaning the shocks caused by volatility of methanol market and crude oil price to the methanol price were lasting and meaningful and were revealed in the long term.

Keywords: Methanol Price, Crude Oil Price, FIGARCH Model.

JEL Classification: Q43‹C13‹C32.

1. Introduction

The oil market is one of the world's most important financial markets, and it affects the structure of the economy of oil exporting and importing countries (Kang et al., 2011), the process of managing the financial risk of the portfolios of companies, and overall investment in the manufacturing sectors (Delavari et al., 2013). Recent studies on the worldwide oil price (Mostafaei, Sakhabakhsh 2011; Wang et al. 2011; Prado 2011; Zhou & Kang 2011; Wei et al. 2010; Choi, Hammoudeh 2009; Ayadi et al. 2009; Cheong 2009) are indicative of the high importance and the special position of this market in the world economy; the reason may be the high sensitivity of the oil price to political, economic and cultural issues in the world, and consequently, the oil price's volatility and the considerable influence of this volatility on macroeconomic variables (Kang et al. 2011). Due to the influential role of the oil price in the world economy, consumers, producers, governments, and macroeconomic decision makers have always paid special attention to this commodity in modern times (Wang et al. 2011).

Crude oil as one of the main sources of energy is also the main source of income for members of OPEC. This is most noticeable in Iran because income obtained from oil comprises about 60 percent of the Iranian government's revenues and 90 percent of its export earnings (Farzanegan, 2011). Therefore, volatilities in oil price have an important role in creating economic fluctuations in oil-producing countries including Iran (MehrAra and Niki Oskuyi, 2006). The reason might be the high sensitivity of oil price to political, economic and cultural issues worldwide and consequently its volatility on the one hand, and the high influence of the volatile prices on macroeconomic variables (Kang et al., 2011). This is the reason why the Iranian economy is always exposed to receiving blows from foreign currency income and the danger of sudden changes in oil revenues. The continuous and lasting effect of this process on Iran's economy especially during the recent years calls for a pressing need to make correct decisions in macroeconomic policies. Therefore, the dependence of Iran's economy on revenues from selling fossil resources and the instability caused by their price volatility has made Iran prioritize non-oil exports (Mehrara and Mohaghegh, 2012). A remarkable portion of Iran's non-oil exports include petrochemical products; methanol is one of the important petrochemical products. Furthermore, the relative advantage of producing and exporting petrochemical products, i.e., in its potential for creating jobs and increasing current earnings, can mitigate the negative effects of oil shocks (Mehrara and Oskui, 2007).

There is empirical evidence to confirm the important role of oil in the world economy especially in the countries exporting this commodity. Because a sudden increase in the oil price after 1973 had considerable effects on these countries such that it can be stated that during this time the foreign exchange earnings from selling oil considerably increased leading to a rise in the level of prices, wage rates, and imports in the oil-exporting countries (Farzanegan, 2011). The growth of the oil section as an important factor in the national income causes an increase in the overall demand and consequently the prices and profitability in the non-tradable compared to the tradable sector. This leads to the attraction of investment and work force to the non-tradable sector and strengthening of this sector and the weakening of the tradable sector in majority of the single-product economies (Mehrara and Niki Oskuyi, 2006). This phenomenon is referred to as Dutch Disease in the literature. The result of the Dutch Disease in the oil-exporting countries is a considerable increase in the share of the oil sector in the national income compared to other sectors. Under such conditions, the increase in the national income is only the result of an increase in oil revenues and this phenomenon can be observed in the rather large economies such as the Iranian economy (Mehrara and Mohaghegh, 2012). One of the measures to be taken for decrease the consequences of this disease is to turn to oil and petrochemical products inside the country because it not only leads to an increase in the exports but has great effects on inflation, welfare and even non-economic variables as well.

Methanol is one of the most highly used petrochemical products and the industries related to the production of this product have a high added value (Komijani et al., 2013). Another feature of these industries is the variety of the products and their provision of the raw materials for thousands of manufactories and factories in the downstream industries which has a special importance in the economy in terms of employment and foreign exchange earnings and cutting dependence on oil (Masih et al., 2010b). On this basis, this industry as one of the choices for non-oil exports plays an important role in the development and promotion of the country's economy, localizing the technology and development of the side industries. Therefore, improving the level of production and increasing the exports of this product leads to an increase in foreign exchange earnings, an increased economic growth and a decrease in the rate of unemployment.

Furthermore, due to the high importance of forecasting economic variables, different models have been proposed for modeling the relationship between the variables and forecasting them. These models can be divided in different ways as either time series and structural models or linear and non-linear models. The growing importance of forecasting economic factors and the small number of structural models in forecasting has led to the emergence of time series (including linear and nonlinear) models for modeling and forecasting. However, one of the basic points that has been ignored in econometric analyses, which affects the accuracy of forecasts, is the behavior and the type of time series data; this issue is vital because in some cases, a dynamic nonlinear process is estimated using a linear model. Therefore, the forecasts made by linear models that are used to explain nonlinear processes have doubtful validity. Recently, many economists have used nonlinear tests and methods to forecast the process of movements and the volatilities of the variables to eliminate these problems and increase the accuracy of the models for forecasting the variables. One of the models used for explaining the behavior of the mean equation is the Auto-Regressive Fractionally Integrated Moving Average (ARFIMA) model, which was first introduced by Granger and Joyeoux (1980) in econometrics; another such model is the FIGARCH model (Baillie 1996), which is used in forecasting the economic variables' volatilities (Zhou & Kang 2011).

The present study will attempt to address whether crude oil price has a meaningful and positive effect on return volatilities of Iran's methanol price. For this purpose, weekly time series data related to methanol price and Iran's crude oil from the first week of 2005:1 to the third week 2013:5. The relationship between the mentioned variables will be modeled using GARCH models. As an outline, in this study after examining the previous studies in this regard, the theoretical bases of the research will be discussed and the results will be analyzed and interpreted and finally related conclusions and suggestions will be made.

2. Crude Oil Price and Methanol Price

Though all kinds of energy are essential inputs for production processes; crude oil plays a distinguishable role. Oil price whether as an important manufacturing input -for energy importers- or a valuable source of income –for energy exporters- has significant effects on the macroeconomic situation in almost all countries. In particular, oil price not only affects major economic indicators i.e. GDP, unemployment and exchange rate but also has direct and indirect impacts on its rare alternatives like gas (Ji, 2011). Various dependant downstream industries, increasing demand for energy (caused by both rapid population and economic growth rate) as well as technological limits has made oil a strategic substance which hardly can be substituted. As Bachmeier and Grifen (2006) argue, the only substance that may replace oil in the modern economies is natural gas because it not only is more productive but environmentally speaking is less polluting than oil. However, in addition to its applications as a fossil fuel, several petrochemical -including methanol- are derived from natural gas. And more interestingly, the majority of the economic value is related to the role natural gas plays in petrochemicals industry (Liu et al., 2011).

In comparison with other industrial petrochemical products, the very simple chemical structure and its application in producing a great number of goods have made methanol an important product. Though natural gas is the main source for producing methanol, it can be produced from other substances such as wood, crude oil, coal and carbon dioxide. Therefore, considering the global concerns about carbon dioxide emissions, developing CO2-based methanol production technologies is a potential solution for improving environmental quality (Methanex, 2011).

The volume of methanol production doubled in less than 25 years, has increased from 15.9 million tons in 1983 to more than 32 million tons in 2006 (Vora et al., 2009). This demand enlargement proves the rising inclination toward and demand for methanol in the world market. So, determining the factors which affect methanol price has a significant importance. According to Nexant (2009), these factors can be classified to three categories:

- Technological Changes
- Market Condition
- Natural Gas Price (as the main source of methanol)

This paper investigates the relationship between oil price and methanol. So, considering the Nexant (2009) classification, oil through two channels may affect methanol price; market condition and natural gas price.

The first mechanism is elaborately studied in the literature. In fact, numerous researchers have studied the effects of oil price changes on economic activity and discussed the mechanisms through which these effects transmit to other macroeconomic indicators (e.g. Hamilton, 1983, 1996; Pindyck and Rotemberg, 1983; Bernanke et al., 1997; Bernanke, 2004; Devlin and Lewin, 2004; Cologni and Manera, 2007). In addition to these papers which are focused on industrialized oil importing economies, some have studied developing -or recently developed- oil importing countries (e.g. Ziramba, 2010 in South Africa, Bashiri and Manso, 2012 in Portugal, Ghosh, 2011 in India and Ou and et al., 2012 in China) as well as oil exporting countries (e.g. Dibooğlu and Aleisa, 2004 in Saudi Arabia; Mehrara and Oskui, 2007 in four oil exporters; Lescaroux and Migno, 2008 in OPEC members; and Mehrara and Mohaghegh, 2012 in oil exporting countries). All these studies have confirmed that oil price change is an important source of macroeconomic fluctuations both in national and global level. In brief, as He et al. (2010) assert, oil price movements systematically change economic indicators in the world market in both short- and long-run (He et al., 2010). So, evidently oil price affects both supply and demand sides of the methanol world market.

On the other hand, since gas-driven petrochemicals like ethanol and methanol are substitutes for oil-driven fuels such as petroleum and gasoline, there is a mutual relationship between oil price and gas-driven petrochemicals – including methanol. Joets and Mignon (2006) show that oil and gas act as substitutes in the market. Masih et al. (2010a) have investigated the interconnection between oil price and ethylene price in the US and confirmed the existence of such a substitution relationship. Masih et al. (2010b) also, highlight the role of oil price as the major instigator of methanol price movements in Europe, US and Far East. Moreover, some researchers suggest that oil price affect gas price which as a main source for producing methanol affects its price. Stephen et al. (2008) claim that oil price variations are the major source of gas price movements. Highlighting this relationship, Rosthal (2010) confirms that in the US there is a long-run relationship between oil and gas prices. So, we can conclude that oil price -via affecting natural gas price or by determining the price of its substitutes- has a significant impact on methanol price. Though this conclusion seems robust, our literature review showed that no study has investigated this relationship empirically; what we do in this paper. Figure 1 confirms the existence of a relationship between crude oil price and the price of methanol.

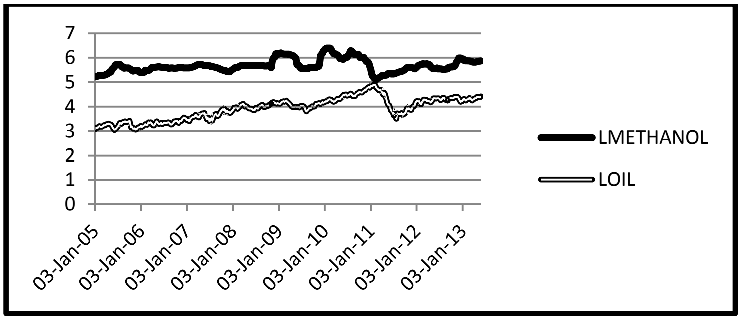

Figure 1: The Study Variables Graph

As shown in the figure above and based on the results of experimental studies and considering the confirmed effect of changes in crude oil on the price of methanol and also the confirmed meaningful and long-term relationship between these variables. The fact that volatilities in the price of crude oil can lead to volatilities in the price of methanol calls for more detailed and systematic investigation.

3. Methodology

After many important studies were conducted on the existence of Unit Roots and Cointegration in time series starting in 1980, econometrics experts examined other types and subtypes of non-stationary and approximate persistence that explain the processes that exist in many financial and economic time series. Today, different studies have been and are being conducted on these processes, including "Fractional Brownian Motion," "Fractional Integrated Processes," and "processes with long memory" (Lento 2009). Hurst (1951) first discovered processes with long memory in the field of hydrology. Then, in the early 1980s econometricians such as Granger and Joyex (1980) and Hosking (1981) developed econometric models with long memory and specified the statistical properties of these models. During the last three decades, numerous theoretical and empirical studies have been conducted in this area. For example, the studies (Mandelbrot 1999; Lee et al. 2006; Kang et al. 2009; Aloui & Mabrouk 2010; Tonn et al. 2010; Belkhouja & Boutahary 2011; Wei 2012; Lin & Fei, 2013; Kang & Yoon 2013) are among the most influential in this regard.

The concept of long memory includes a strong dependency between outlier observations in time series, which means that if a shock hits the market, the effect of this shock remains in the memory of the market and influences market activists' decisions; however, this effect will ultimately disappear after several periods of time. Thus, by considering the nature and the structure of financial markets that are easily and rapidly influenced by different shocks (economic, financial and political), such as the oil market, it is possible to analyze the effects of these shocks and determine the time of their disappearance by observing the behavior of these markets (Los, Yalamova 2004). In addition, long memory can be used to show the memory of a market. By examining this long memory, the ground will be prepared for the improvement of financial data modeling.

Overall, the fact that prices in financial markets (including oil, gas, and petrochemical products) are highly dynamic and volatile is like a general pattern and framework; these types of markets are modeled and forecasted using GARCH model in the literature on econometrics. This model eliminates the problem of volatility clustering and fat-tailed (non-normality) in the time series and takes account of the factors that highly affect the price of properties including sudden shocks, structural changes, responding to domestic demand, world economic conditions, and political events paying special attention to them in modeling (Vo, 2011).

1.1.Different Types of ARCH Models

Auto-Regressive Conditional Heteroscedasticity (ARCH) models were first proposed by Engel (1982) and were later expanded by Borlerslev (1986); these models include the types of models that are used to explain the volatilities of a time series. Subsequently, different types of ARCH models were introduced, and they are divided into two groups: linear (IGARCH and GARCH) and nonlinear models (EGARCH, TGARCH, PGARCH, FIGARCH, etc.).

1.1.1. Linear GARCH Models

Borlerslev (1986) first introduced the generalized model of ARCH, i.e., the GARCH model based on Engel's ARCH model. The distinguishing factor between these two models is the existence of variance lags in the conditional variance equation. In fact, the GARCH model has a similar structure to ARMA. Stipulated forms of this model include the following:

(1)
$$M_t = \mu_t + \varepsilon_t$$
$$\varepsilon_t = z_t \sqrt{h_t} \quad , \quad z_t \sim N(0,1)$$

(2)
$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}$$
$$h_t = \sigma_t^2$$

Equation (1) is a mean equation that includes two sections: μ_t, which should be an appropriate structure for explaining the mean equation, and ε_t, which is indicative of residuals in the above model, which has heteroscedasticity and consists of two normal elements (z_t and the conditional standard deviation ($\sqrt{h_t}$)). In fact, h_t is a conditional variance equation that is estimated along with the mean equation to eliminate the problems related to the heteroscedasticity ε_t. In equation (2), ω is the average of the values of σ_t^2, the ε_{t-1}^2 coefficient indicates the effects of ARCH and the h_{t-1} coefficient represents the effects of GARCH. One of the most important features of this model is the existence of temporary shocks imposed on the time series under investigation (Kittiakarasakun, Tse 2011).

Furthermore, the results of Engel and Borlerslev's (1986) studies show that in some cases, the GARCH equation that is mentioned above has a unit root. The existence of this root means that, for example, in GARCH(1,1) the value of $\alpha_1 + \beta_1$ is very close to one. In this case, the GARCH model is cointegrated, and the result is referred to as IGARCH. In these models, if there is a shock to the time series under investigation, this shock will have lasting effects and become noticeable in the long term (Poon and Granger, 2003).

1.1.2. Nonlinear GARCH Models or the FIGARCH Model

The FIGARCH model was first proposed by Baillie (1996). In this model, a variable has been defined as fraction differencing, which is between zero and one. A general form of the FIGARCH(p,d,q) model is as follows:

(3)
$$(1-L)^d \Phi(L) \varepsilon_t^2 = \omega + B(L) \upsilon_t$$

In equation (3), $\Phi(L)$ is a function of the appropriate lag (q), $B(L)$ is a function of the appropriate lag (p), L is the lag operator, and d represents the fraction differencing parameter.

If $d=0$, the FIGARCH model will turn into GARCH, and if $d=1$, this model will turn into IGARCH. It should be noted that in these models, the effects of the shocks are neither lasting as in IGARCH models nor temporary as in GARCH models. Instead, the shocks' effects are between these two extremes, and thus, these effects will decrease at a hyperbolic rate.

4. Empirical Results

In this research Weekly data from the first week of 2005:1 to the third week 2013:5 related to the price of crude oil and methanol were used. These data were obtained from the website for U.S. Energy Information Administration (EIA) and Fannavaran Petrochemical Company. It should also be mentioned that the abbreviations for the applied variables in thus study include LOIL representing logarithm of heavy crude oil price and LMETHANOL which indicates logarithm of the methanol price.

Before going through the different stages of the modeling, in order to avoid creation of a spurious regression, stationary of the variables of the study should be first considered in the models based on the time series data otherwise the results will not be reliable. Therefore, stationary test was first carried out based on Augment Dickey- Fuller and Philips-Pron tests (see Table 1 for the results).

Table 1: The Study Variables Stationary Tests

Test	**Critical Value**	**Accounting Value**	**Result**
		LMETHANOL	
ADF	-1.94	-0.26	Non-Stationary
PP	-1.94	-0.64	Non-Stationary
		LOIL	
ADF	-1.94	-1.37	Non-Stationary
PP	-1.94	-1.23	Non-Stationary

Source: The Finding of the Study

As shown in Table 1, all the research variables are non-stationary based on the ADF and PP tests. Indeed, all these variables are co-integrated with first order (i.e., I(1)) and in order for a correct modeling of the relationship between these models differencing is required because otherwise the results of forecasts will not be reliable. Therefore, considering the performance of different models of the time series is influenced depending on the different data, before doing anything the descriptive statistics related to differencing the dependent variable, as shown in Table 2, will be examined.

Table 2: Summary Statistics of dLMETHANOL

Stat.	**Return Of Gold Prices Series**	**Stat.**	**Return Of Gold Prices Series**
Mean	0.0014	Kurtosis	25.0406
Max	0.3342	Jarque- Bra	8986.18(0.000)
Min	-0.2586	Box- Ljung Q(10)	179.02(0.000)
S.D	0.0389	ADF	-7.714(0.000)
Skewness	1.2850	PP	-15.400(0.000)

Source: The Finding of the Study

Based on Table 2, mean of the return series of methanol price (differencing of methanol price) in the period under investigation was 0.0014 with the standard deviation of 0.04. Comparing these two it can be found that this time series has been highly volatile during the period under investigation. This implies that there is a possibility of heteroscedasticity of the return series variance. The test of normal distribution of the time series under investigation indicated non-normality of this series and skewness statistics are indicative of leaning to right side of the mean. Based on the Liang-Box statistics (with 10 lags) the null hypothesis about 'lack of serial autocorrelation between series can be rejected. Finally, analysis of the statistics related to the stationary test (ADF and Phillips-Pron) indicate stationary of the related variable. Thus, for eliminating the problem of continuous autocorrelation, ARIMA models can be used. The results of forecasts made by different models have been provided in Table 3.

Table 3: The Estimated ARIMA Models

Model	AIC	SBC	ARCH-TEST
ARIMA(1,0.04,1)	-3.838	-3.792	F(1,434) = 8.88 (0.000)
ARIMA(1,0.04,2)	-3.671	-3.652	F(1,433) = 7.34 (0.000)
ARIMA(2,0.04,1)	-3.666	-3.626	F(1,433) = 7.68 (0.000)
ARIMA(2,0.04,2)	-3.564	-3.523	F(1,432) = 7.54 (0.000)

Source: The Finding of the Study

As shown in Table 3, based on the Akaik (AIC) and Schwarz (SBC) criteria, ARIMA(1,1) model yielded the best forecast among all the ARIMA models. It is worth mentioning that the heteroscedasticity test was examined using the ARCH test and the results, as shown in the above table, were indicative of the existence of the mentioned feature in the residuals of all the models. For this reason, in order to eliminate this problem from White's consistent estimators (Robust) were used for estimation. So in order to eliminate the problem of heteroscedasticity, models of the GARCH family will be used. The results of forecasts made by different models are as follows.

Table 4: The Estimated GARCH Models

Models	ARIMA(1,1)	
	AIC	SBC
GARCH	-8.375	-8.322
EGARCH	-8.430	-8.353
GJR-GARCH	-8.538	-8.506
APGARCH	-8.528	-8.504
IGARCH	-8.579	-8.515
FIGARCH	-8.631	-8.547

Source: The Finding of the Study

Comparing the values of the information criteria related to different types of GARCH models it can be easily found that ARIMA(1,1,1)- FIGARCH model has the lowest value for Akaike and Schwarz information criteria and, thus, gives the best explanation for the behavioral pattern of the existing volatilities in the return series of methanol price. The coefficients of the variables of this model have been presented in Table 5 along with the statistics related to significance of these coefficients. The statistics related to examining the existence of heteroscedasticity in the residuals in this model (statistics related to Liang-Box and McLeod Li and ARCH tests) have been also provided below the table related to forecast made by this model.

Table 5: The Estimated ARIMA(1,1)- IGARCH Model

Variable	**Coefficient**	**Standard Error**	**t-Stat.**	**Prob**
		Mean Equation		
C	0.13	0.04	3.19	0.002
dLOIL	0.64	0.03	17.19	0.000
AR(1)	0.86	0.06	14.22	0.000
MA(1)	-0.63	0.09	-6.89	0.000
Dum	0.72	0.21	3.43	0.002
		Variance Equation		
C	0.18	0.06	3.17	0.002
ARCH	0.67	0.023	29.11	0.000
GARCH	0.32	0.012	26.63	0.000
d-Parameter	0.32	0.02	16.23	0.000
		R^2= 0.78		
Log likelihood	1747.28	Box- Ljung Q(10)	11.15 (0.193)	
Akaike	-8.63112	McLeod-Li Q2(10)	2.426 (0.965)	
Schwarz	-8.54667	ARCH(10)=F(10,2503)	0.083 (0.775)	

Source: The Finding of the Study

Based on the above table, some points can be mentioned. First, the introduced virtual variable in the mean equation of the above model (*Dum*) indicates the unconventional shocks to the time series under investigation as a consequence of the financial crisis worldwide in 2008. The unconventional shocks were selected based on their greatness in the sense that they were four times higher than the standard deviation of the return series. In addition, all the coefficients of this model were significant at 0.95 levels. The results of Liang-Box also show no sign of serial autocorrelation in the residuals of this model. The existence of heteroscedasticity in the residuals is refuted based on the McLeod Li and ARCH tests.

5. Conclusion

In this study, we examined the short-term relationship of changes in oil and natural gas prices and the price of methanol from the first week of 2005:1 to the third week of 2013:5 using the weekly data and FIGARCH model. Analysis of the results of the stationary test of the research variables (ADF and PP test) showed that variables of the crude oil and methanol prices logarithm are non-stationary and integrated with first order and were, therefore, used for modeling differencing of the research variables.

In the next step, diagnostic tests such as Liang-Box were carried out to determine an appropriate model which is consistent with the structure of the data related to the return of methanol price. The results of these tests confirmed the existence of autocorrelation and the likely existence of heteroscedasticity. Then, different ARIMA models were used to eliminate the problem of heteroscedasticity. The results showed that among all ARIMA models, ARIMA (1,1,1) had the best performance based on the Akaike and Schwarz information criteria. What is worth mentioning is that in examining residuals of all the models, the existence of heteroscedasticity was confirmed in all ARIMA models. Therefore, to eliminate this problem (heteroscedasticity) which causes inefficient and skewed forecasts, different models of the GARCH family were used including GARCH, EGARCH, GJR-GARCH, APGARCH, IGARCH and FIGARCH. The best GARCH model for modeling return behavior of methanol price was found to be FIGARCH. It should be mentioned that in this model, the value of the fraction-differencing parameter (d) equals 0.32, which implies that the return series volatilities of the methanol price is not completely stationary. In fact, the methanol volatilities have long memory feature. The nature of the long memory feature can be analyzed such that current shocks will have their effects in part during the same period or after some time lags, and furthermore, a considerable part of the effects of these shocks can influence the future behavior of a time series with this feature. Naturally, being aware of this issue and ignoring it indicates unconcern and indifference. Therefore, investors and macroeconomic decision makers can be advised to use models based on the long memory property to forecast the methanol price.

Furthermore, analyzing the coefficients of the research variables in the best model it can be found that price elasticity of methanol is approximately 0.64 compared to crude oil price. This implies that an increase in crude oil price has substantial effects on methanol. The reason can be sought in the price setting structure of these two products, i.e., crude oil and methanol; the previous is determined in the competitive markets all over the world and has higher volatilities in response to economic and political issues and international changes.

An overall analysis of the results of this study indicates that there are two reasons for the positive relationship between crude oil and methanol prices; first, an increase in crude oil price leads to an increase in demand for alternative commodities such as natural gas (as the most important Main feedstock of methanol production) which naturally leads to an increase in methanol price; second, in an oil-dependent economy an increase in oil price leads to a higher inflation (Arman & Aghajari, 2009) and consequently an increase in the costs of production. In this way, the production costs go higher resulting in an increase in the price of all products including methanol.

The results of this study further suggest that based on FIGARCH model the shocks to the price of methanol are lasting and are revealed as a highly significant relationship and effect on methanol price in the long term. Based on the results, although petrochemical products can replace oil products, due to lack of appropriate infrastructures for using these products (as a production factor) and the fact that making the required technological changes is not cost-effective, they will replace oil products with an increase in oil price (which is possible in the long term). Furthermore, as the price of natural gas which is used as Main feedstock of petrochemical products is reduced as the result of subsides in Iran, the claim about the susceptibility of methanol price to changes in crude oil price through the channel of natural gas seems illogical. Therefore, considering the explanations about the channels of influence of changes in oil price on the methanol price in the theoretical background changes in crude oil price through the channels of market and changes in the price of production factors will influence methanol price and considering the time consuming nature of this influencing process, it can be found that the findings of this study in terms of the lasting nature of the effects of shocks from the crude oil price on methanol price and the existence of a strongly significant relationship between these variables in the long term are totally consistent with the reality.

As petrochemical products form the major part of Iran's non-oil exports and because methanol is one of the most important petrochemical products in Iran, an increase in the price of crude oil leads to an increase in methanol price and consequently a decrease in Iran's non-oil exports based on the findings; therefore, under such conditions due to volatilities in the price of crude oil and consequently instability of Iran's oil revenues, the stability of foreign exchange earnings from methanol as one of non-oil export items will be threatened. This situation will mitigate and reduce the consequences and risks of macroeconomic decisions in Iran.

It should be noted that in the time period under investigation in this study, the price of natural gas used for methanol production was subsidized; therefore, by enacting the law of targeting subsidies and removing subsides for energy carriers, changes in oil price can be expected to influence the price of methanol through the channel of natural gas. Therefore, as a suggestion the results of this study can be reanalyzed after enacting the law of targeting subsides.

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