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Article

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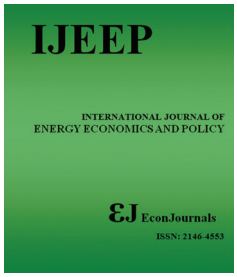

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The Impact of Oil Price Volatility on the Economic Growth in Iran: An Application of a Threshold Regression Model

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ABSTRACT

Oil price volatility (OPV) is one of the main reasons for the economic crisis in the world. Therefore, investigate the relationship between volatility in oil prices and economic growth in an oil-exporting country has special significance. In the present paper, the impact of OPV on the economic growth in Iran has been tested by using the threshold regression model on time series data 1980-2014 extracted from the Central Bank of Iran. Findings of this study show that the OPV equal to 1147.77 acts as a threshold value. Also, due to the fact that the coefficient of OPV has decreased in the second regime compared to the first one, the effectiveness amount of the OPV on economic growth has decreased over time.

Keywords: Oil Price Volatility, Economic Growth, Threshold Regression Method, Economy of Iran
JEL Classifications: C51, E20, O40

1. INTRODUCTION

Crude oil as an energy source since its discovery in the 1800's has been vitally important to the world economy (Nwanna and Eyedayi, 2016). According to Hathaway (2009) the importance of oil has risen to the extent that in a world suddenly without oil, all the major distribution systems that allow economic transactions on a more than local basis would fail and the world economy would collapse. Changes in the price of crude oil will have significant effects on economic growth and the well-being of the population around the world (Mgbame et al., 2015). Oil price changes, volatility have been a very controversial topic among different scholars (Nwanna and Eyedayi, 2016). The impact of oil price volatility (OPV) on the economy has occupied the attention of researchers for almost four decades. Majority of studies support the existence of a negative association while other studies suggest otherwise (Mgbame et al., 2015). Like many other oil exporting countries, Iran's economy has been gradually structured around oil revenues in recent decades (Eltejaei and Afzali, 2012). Achieving high and sustainable economic growth are the most important objectives of economists and policymakers. One of the reasons for this matter can be wide range of transition effects and influence of this variable on economic and non-economic variables. For this reason, checking the effective factors on economic growth is a significant part of economics. In oil-exporting countries, the oil production and price can play a key role in economic growth. In today's World no one can deny the importance of crude oil in global economies. The importance of crude oil and its prices cause to impact almost in all sector of the economy and affects social life and welfare of the society (Mohammad, 2010). Considering that the oil price in both of the oil importing and oil exporting countries affect the aggregate supply and demand, therefore, it is important to evaluate its effect on economic growth. In this regard, this paper investigates the impact of the OPV on macroeconomic variables that depend on the basic conditions of the economic in each country.

2. LITERATURE

2.1. Theoretical

The oil revenues play a key role in the economic structure of the oil exporting countries. In most of these countries, the oil revenues are an important source of financing the budget and the government budget dependence on oil revenues is very high. It is expected that volatility of the oil market influenced economy aggregate demand, because the government budget constitutes a significant portion of aggregate demand (Abrishami et al., 2008).

Iran as a major exporter of oil is not exception about this matter among OPEC countries. On the one hand, Iran's oil exports was rationed by OPEC, on the other hand, the oil price was determined by the global supply and demand. So, the macroeconomic variables were influenced by the change of the oil revenues following the global changes of the oil prices. This dependence of the macroeconomic variables on oil affected the economic growth. So that the impact of declining oil price is reflected much broader on the economic activities.

Increasing in the oil price caused a transfer of income from oil- importing countries to the oil- exporting countries. Since the oil sector is one of the important economic sectors in the oil-exporting countries and it has a major contribution in the economic value added, increasing the oil price caused the development of the oil sector which increases the domestic and foreign investment in these countries, and following that the tide of economic growth has flowed.

Given that the major economic investment doing by the government in Iran, so the government expenditures in construction and infrastructural arising from increases in oil revenue. The gross domestic product (GDP) raising by increase the amount of investment in construction projects, and therefore the government has experienced positive economic growth. In contrast, decline in the oil price, decrease the oil revenues in these countries, so at the same times, the government expenditure reduced as a result of declining in the oil revenues. This problem reduces the GDP and subsequently reduces economic growth.

In addition, the impact of oil price on Iranian economy can be explained by Dutch disease. According to the Dutch disease theory, the oil revenue increases with rising oil price which leads to increase in aggregate demand and subsequent increase in prices and profitability in the non- tradable sector compared to the tradable sector. It causes inflow of capital and labor to the non- tradable sector and accordingly, non-tradable sector becomes stronger than weak tradable sector (Eltejaei and Afzali, 2012). As a result the oil price unexpected shock leads to decline the domestic currency and increase the exchange rate. This problem can reduce production in various economic sectors and the country's competitiveness in the international arena (Jahadi, 2011).

As the oil revenues are in foreign currency in economy, the exchange rate volatility affecting the economic activities. Exchange rate is the value of the foreign currency in terms of domestic currency, which is considered one of the macroeconomic variables and represents a country's economy to compete with other countries in the economic environment, international. On one side, the economic and foreign policies are greatly influenced by the exchange rate. On the other side, the exchange rate can affect a country's economic performance and indicators. Thus, studying the effect of the exchange rate volatility on macroeconomic variables in Iran is important.

Theoretically, the export is function of the exchange rate and domestic price level. The exchange rate can affect the price level through the export, import and thus production channels. Increasing of the exchange rate or decreasing of the national currency makes import become more expensive, thus the government will reduce the amount of imports and instead of imports, domestic production will be absorbed. On the other hand, the cheaper export goods lead to attract the most of the markets of other countries and thus increase the competitiveness and export rate (Hosseini and Mirkazemi, 2010). Of course, the net effect of import and export depend on the elasticity of export and import. According to Marshall Lerner condition, if the sum of the elasticity of export and import are >1, then with depreciation of the currency (increase the exchange rate) improve the trade balance and the GDP consequently, but if the sum of the elasticity of export and import are smaller than 1, then the trade balance is better by increasing the value of money (exchange rate depreciation) (Delavari et al., 2008).

In addition, the investment affects through the cost of imported capital goods. The cost of imported intermediate inputs in production increases with raising the exchange rate (devaluation of national currency) which increases the price of goods and therefore increase the price level in the countries. So, the amount of investment has reduced in the countries and it has a negative impact on economic growth. Overall theoretically, the oil price and the exchange rate volatility have different effects and opposite direction on economic growth and the total effects depend on the outcome of both negative and positive effects.

2.2. Empirical Evidence

Hamilton (1983) examined the impact of the oil price shocks on the America's economy by using Granger Causality test for the period 1949:2 to 1972:4. He obtained a meaningful relationship between oil price changes and real GDP growth for America's economy. The final result of this study shows a unidirectional causality relationship from the produced oil prices toward production.

Cunado and Gracia (2003) studied the relationship between the oil price and industrial production index and inflation by using quarterly data in some European countries during 1960-1999. They concluded that price shocks have permanent effects on inflation but only positive oil price shocks have negative short run influence on the industrial production.

Hadian and Parsa (2006) investigated the impact of the OPV on the number of macroeconomic variables (GDP, the general level of prices and employment) in Iran by using Vector error correction model (VECM) during 1961-2005. Based on the result, the model coefficients were not significant and could not explain the impact of the oil price on the macroeconomic variables. However, examining of the relationship between OPV on the macroeconomic variables showed that the oil price shocks are one of the main sources of fluctuations in macroeconomic variables in Iran.

Olomola and Adejumo (2006) analyzed the effects of oil price shocks on output, inflation, real exchange rate and the money supply in Nigeria over the period 1970-2003.The vector autoregressive (VAR) method was employed to analysis data. Their findings indicated that the oil price shocks did not affect output and inflation but had strong effect on money supply and exchange

rate. The implication is that a high real oil price may give rise to wealth effect that appreciates the real exchange rate. This may squeeze the tradable sector, giving rise to the "Dutch disease".

Sarzaiem (2007) in his paper examined the relationship between oil shocks and behavior of macroeconomic variables (GNP, the real income from oil export, CPI, money supply, exchange rate and the government expenditure) in Iran. The results showed that the oil shocks affected variables in short run, but their impact disappeared in long run. Also, he stated that the oil shocks did not determinate the behavior of the economic different variables, but the economic policies adopted in response to positive and negative shocks, created change in the macroeconomic variables.

Abrishami et al. (2008) evaluated the effects of oil price asymmetric on the macroeconomic variables (the real effective exchange rate, inflation rate, long run interest rate and short run interest rate) in some of the oil importing developing countries such as France, Italy, Japan and USA during 1960-2002 by using VECM method. The results of the study showed that although decreasing of the oil price did not have a significant impact on the GDP growth in these countries but increasing of the oil price had a significant impact on the GDP growth. In other words, the OPV has the asymmetric effect on the GDP growth in these countries.

Delavari et al. (2008) reviewed the relationship between the oil price and the economic growth by using quarterly data from 1989 to 2007 in Iran. They understood that the oil shocks have the asymmetric effect on the economic growth.

Jiménez-Rodríguez (2008) examined the impact of oil price shocks on the output in six OECD countries (France, Germany, Italy, Spain, UK and USA) by using a VAR model. The model is based on monthly data of six industrial sectors and the total industry sector. The results illustrated that the industrial output has decreased by rising of the oil price. Also, the oil price changes have asymmetric effects on the output in these countries.

Lardic and Mignon (2008) studied the long run relationship between the oil price and economic activity on USA, G7, Europe and Euro area economies. The results indicated that the impact on GDP is bigger for rising of the oil price than for declining it.

Samadi et al. (2010) by using the VAR method investigated the relationship between oil price shocks and Iran's macroeconomic variables. The research variables included GDP at industrial sector, the oil real price, the effective exchange rate, the real import and CPI. The impact of oil price positive shock on variables showed that it has a little positive impact on the industrial output in short run but it is more little positive impact in medium and long run. Also, in short run, the real exchange rate decrease but, in long run, the effect is negative. In addition, although it has a negative impact on the CPI in short run, the long run effect is consistently positive. Moreover, it has a strong positive effect on the import in short run but gradually, this positive effect reduce in the long run.

Jahadi (2011) studied the effect of the oil price shock on the economic growth in some oil exporting and oil importing countries covering the period 1970-2008. First, Hodrick-Prescott Filter is applied to extract the oil price shocks and then tested the effect of the oil price shocks on the GDP growth by using structure vector autoregressive (SVAR) model. The estimation of the oil exporting countries suggested that oil price shock has an effect on economic growth. The effect of the oil shocks on the economic growth is negative in all countries except Iran. The results for oil importing countries reflected a negative impact of the oil price shock in all countries except France. The results of asymmetric test in oil exporting countries showed that the oil price positive shock has the positive effect on the economic growth of Iran, Nigeria and Saudi Arabia, and it has a negative effect on the growth of the other countries. Also, the impacts of a negative oil price shock on the economic growth of all countries except Iran and Kuwait are negative. However, the asymmetric effect was confirmed in all countries except Saudi Arabia. Furthermore, the research showed that positive oil price shocks have the positive impact on economic growth in all of the importing countries except Italy. But negative oil price shocks have the negative impact on the economic growth in all of these countries. Also, the absolute value of the effect of negative oil price shocks is bigger than the positive oil price shocks.

Ali-Ahmad and Mokhtarul (2011) examined the impact of the oil price uncertainty on Malaysian macroeconomic activities by SVAR model based on monthly data over the period 1986-2009. In their survey exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model estimates showed an important asymmetric effect of oil price shocks on the conditional OPV. Dynamic impulse response functions were obtained from the SVAR model showed a prolonged dampening effect of OPV shock on Malaysian industrial production. They also found that CPI declines with a positive shock to oil price uncertainty. This is the result of negative demand shock due to the postponement of consumption of big ticket items by individuals, households and other sectors of the economy. Also, the variance decomposition analysis reconfirmed that the OPV is the other most important factor to explain the variance of industrial production after its own shocks.

Ebrahimi (2011) analyzed the impact of uncertainty in oil shocks and exchange rate on the GDP growth in the oil exporting countries including Algeria, Iran, Saudi Arabia and Venezuela, by using VAR method during 1980-2007. Also, the EGARCH model was used for measuring of the OPV. The results of Co-integration test considered that there are long run relationship in all countries. The studying of long run relationship in all countries showed that there are the negative relationship between rising of exchange rate and oil price with production growth. Also, the VECM method was used in short run analysis. The results showed that the uncertainty of the oil price has a significant impact on product growth in Iran and Venezuela, but it does not have a significant effect on the product growth in Algeria and Saudi Arabia. Also, the effect of the exchange rate volatility on Iran and Algeria's product growth is significant, but it is not significant on Saudi Arabia and Venezuela's product growth.

Eltejaei and Afzali (2012) according to their study found that the negative effects of declining oil revenues are significantly greater

than its positive effects on the economic growth in Iran. In other words, declining oil price decrease severely the economic growth, but rising oil price does not increase the economic growth as was expected. The positive and negative oil price shocks increase inflation. Also, the oil positive shock increases the rate of growth of government capital expenditure and inversely it decrease when the oil shock is negative. But the rate of growth of government current expenditures responded positivity to the both of positive and negative shocks.

Oriakhi and Iyoha (2013) examined the consequences of OPV on the growth of the Nigerian economy within the period 1970-2010. Using quarterly data and employing the VAR methodology, the study found that among six variables employed, OPV impacted directly on real government expenditure, real exchange rate and real import, while impacting on real GDP, real money supply and inflation through other variables, notably real government expenditure. This implies that oil price changes determine government expenditure level, which in turn determines the growth of the Nigerian economy. This result seems to reflect the dominant role of government in Nigeria. Considering the destabilizing effects of oil price fluctuations on economic activity and government spending in Nigeria, the study made some recommendations. Some of these include; fiscal prudence, reform in budgetary operations, export diversification, revival of the non-oil sector of the economy, accountability and corporate governance.

Jawad (2013) analyzed the impact of OPV on the economic growth of Pakistan using by data from 1973 to 2011. Linear regression analysis used to analyze the dependency among the dependent and independent variables. All variable oil price, oil supply, oil demand, GDP, public sector investment, private sector investment and trade balance were stationary at 1st difference through ADF test. Results showed that the trade balance, private sector investments have a significant effect on GDP and public sector investment, OPV have insignificant impact on GDP. He believed that the government should make a proper plan and procedure according to Pakistan's economic growth and requirement which would help to maintain the equilibrium of oil demand and supply and decrease the impact of OPV on the economic growth. Meanwhile, the government of Pakistan should focus on trade balance and also tries to increase private sector investment to increase economic growth.

Mgbame et al. (2015) based on the empirical review found that there is a significant and positive relationship between OPV and Nigeria economic growth. He believes that oil price changes determines government expenditure level, rate of inflation, level of unemployment, which in turn determines the growth of the Nigerian economy. Considering the destabilizing effects of oil price fluctuations on economic activity and government spending in Nigeria, the study makes some recommendations which includes that the country should diversify its export revenue base as a means of minimizing reliance on crude oil and petroleum product thereby diversifying to agriculture, operations of budgetary, fiscal prudence, corporate governance, encourage savings and proper accountability. This will further protect the economy from the impact of OPV on the economy, and thus prevent the effect of the shocks from attaining a statistical significance level.

Akinlo and Apanisile (2015) investigated the impact of the volatility of oil price on economic growth in 20 Sub-Saharan African countries from the period of 1986-2012. These countries were divided into Group A and Group B. Group A consists of 10 oil exporting countries, while Group B consists of non-oil exporting countries in sub-Saharan Africa. Panel data were used for the analysis. Panel pooled OLS, panel fixed effect model and generalized method of Moment model were employed in the estimation for both oil exporting and non-oil exporting countries. The estimation of panel A model consisting of the oil exporting countries showed that the OPV has a positive and significance effect on the economic growth of oil exporting countries. The result of panel B consisting of non-oil producing countries showed that the volatility of oil price also has a positive and insignificant impact on economic growth.

Nwanna and Eyedayi (2016) investigated the impact of crude OPV on economic growth of Nigeria during period of 1980-2014. The results revealed that there is a positive and significant relationship between oil price and economic growth. Based on the findings, the researchers concluded that OPV does not have a positive impact on the economy. In the light of the above findings, the researchers recommended that, the country should diversify its export revenue base as a means of minimizing reliance on crude oil and petroleum products, Such as fiscal prudence, reform in budgetary operations, export diversification, revival of the non-oil sector of the economy, accountability and corporate governance.

Benramdane (2017) tried to test the impact of OPV on economic growth in Algeria applying a VAR model using annual data over the period 1970-2012. This study's results indicated that the negative effects of OPV offset the positive impact of oil boom; therefore, it is argued that OPV drives the "resource curse" paradox in Algeria.

3. RESEARCH METHODOLOGY

In the present study, all data related to the variables has been gathered by library method from the Central Bank of Islamic Republic of Iran. Also, with using yearly data of GDP and oil price of Iran, economic growth and OPV of Iran has calculated for years 1980-2014. In order to estimate the OPV the GARCH method has been used.

According to economic theories, the behavior of some time series is nonlinear and it is not stable over the time. Thus, in order to study such time series, nonlinear methods are needed. In the case under our study, we can use threshold regression pattern as a nonlinear pattern. Studies of Beaudry and Koop (1993), Hashem and Potter (1997), Hansen (2001), Koop and Potter (1999), Posedel and Tica (2009), and Aleem and Lahiani (2014) show a widespread use of threshold patterns in empirical economy.

An important statistical issue is testing nonlinearity against linearity, as linearity is a primary assumption among most economists, unless compelling evidence exists in favor of nonlinearity.

In order to examine threshold effects of OPV on the economic growth in Iran, the following pattern is used:

$$d\lg dpt = I_{t-d}\left[\alpha_1 \times \sum_{i=o}^{k}\beta_{1i}OPV_{t-i}\right] + (1 - 1_{t-d})\left[\alpha_2 \times \sum_{i=o}^{k}\beta_{2i}OPV_{t-i}\right] + \varepsilon_t \quad (1)$$

$I_{t-d}=1$ if $OPV_{t-i}\geq\tau$
$I_{t-d}=0$ if $OPV_{t-i}<\tau$

Where economic growth dlgdpt is a function of OPV. The variable I_t is a dummy variable: $I_t=1$ if the OPV is equal or bigger than the threshold τ and $I_t=0$ if the OPV is smaller than threshold τ. STATA13 software is used for estimating such a model.

In this research, first, LM test is used for nonlinearity test. Then, the proposed model (1) will be estimated using a TR.

4. FINDINGS

4.1. The Results of the Kwiatkowski-Phillips-Schmidt-Shin Unit Root Test

The results of the unit root test of variables are presented in Table 1. As it can be seen, the time series of economic growth and the OPV are stationary in level.

4.2. The Results of the Estimate of the Inflation Rate Threshold Model

The specification of model according to the purpose of the research is as follows:

$$dlgdp_t=\alpha OPVt+\varepsilon_t \quad (2)$$

Where, $dlgdp_t$ is economic growth for period t and OPV_t is OPV.

Durlauf and Johnsone (1995) argued that the error ε_t is heteroskedastic in a structure like (2), so they presented their results with heteroskedasticity-corrected standard errors. We follow their lead and use heteroskedasticity-consistent procedures, estimating the nuisance parameter η^2 using an Epanechnikov kernel with a plug-in bandwidth.

In this study, the lagrange multiplier (LM) test (as taken from Hansen, 1996) is used for testing the existence of a threshold. Since the threshold τ is not identified under the null hypothesis of no threshold effect, the p-values are computed by a bootstrap analog, fixing the regressors from the right-hand side of (2) and generating the bootstrap-dependent variable from the distribution $N(0,\hat{e}_i^2)$, Where $\hat{e}_i$ is the OLS residual from the estimated threshold model. Hansen (1996) showed that this bootstrap analog produces asymptotically correct p-values (Hansen, 2000). Using 5000 bootstrap replications, the p-value for the threshold model, using the OPV as threshold variable, is significant at 0.0172.

As shown in Table 2, the value of the LM test is 8.56 and the critical value in the Chi-squared distribution table is 5.99: The null hypothesis (there is no threshold) is therefore rejected, and the rival hypothesis (there is a threshold) is accepted. In other words, the null hypothesis (linearity model) is rejected and the rival hypothesis will be accepted.

In Figure 1, the values of F (Gamma) in the LM test is plotted against the values of Gamma in order to investigate the presence of a threshold (or absence thereof). The 95% critical value of 7.29 is plotted (the continuous line) as well, and this, in accordance to the evidence already seen in Table 2, clearly marks that TR process shows the effectiveness structure of the OPV on economic growth in the examined period to be nonlinear.

Figure 2 displays a graph of the normalized likelihood ratio sequence $LR_n(\tau)$ as a function of the threshold variable. The

Table 1: The results of the KPSS unit root test

Variables	Test for unit root in level		Result
	Intercept	Trend and intercept	
Economic growth (dlgdp)			
LM-statistic	0.126	0.091	I (0)
Test critical values: 5% level	0.463	0.146	
OPV			
LM-statistic	0.451	0.119	I (0)
Test critical values: 5% level	0.463	0.146	

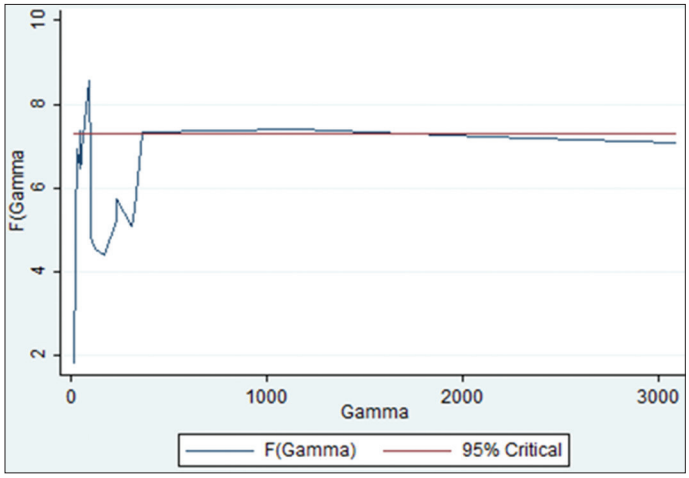
Reference: Research's findings. OPV: Oil price volatility, LM: Lagrange multiplier, KPSS: Kwiatkowski-Phillips-Schmidt-Shin

Table 2: LM test results to investigate the economic growth threshold model

Test of null of no threshold against alternative of threshold allowing heteroskedastic errors (white corrected)	
Number of bootstrap replications	5000
Trimming percentage	0.15
Threshold estimate	1147.77
LM-test for no threshold	8.56
Bootstrap P value	0.0172
Critical value in confidence level 95%	7.29

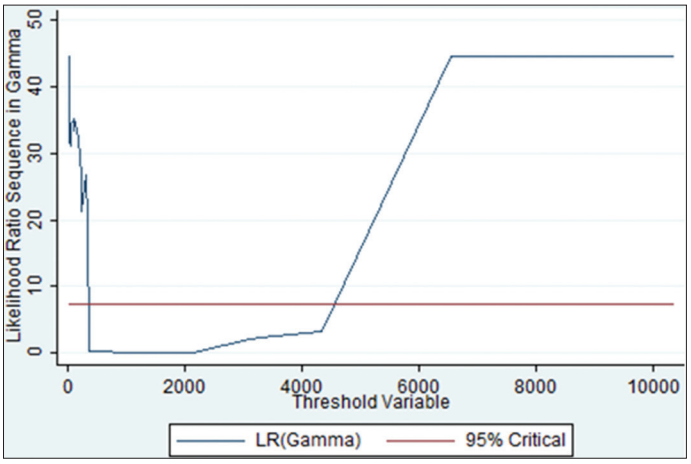
Reference: Research's findings. LM: Lagrange multiplier

Figure 1: F-test for threshold reject linearity if F-sequence exceeds critical value



Reference: Research's findings

Figure 2: Confidence interval construction for threshold



Reference: Research's findings

Table 3: The results of the estimate of the OPV threshold model

Variable	τ≤1147.77	τ>1147.77
Intercept	950902.53	2216956.36
OPV	667.48	18.85
R^2	0.43	0.47

Reference: Research's findings. OPV: Oil price volatility

LS estimate of τ is the value that minimizes this graph, which occurs at the OPV The 95% critical value of 7.35 is also plotted (the continuous line). These results show that there is reasonable evidence for a two-regime specification; therefore, there is considerable certainty about the value of the threshold.

The results of model estimation are shown in Table 3.

As it is shown in Table 3, the estimated threshold value for OPV is 1147.77. According to Table 3 and Figure 2, in the effectiveness process of the OPV on economic growth, a single threshold was observed. Also, due to the fact that the coefficient of OPV has decreased in the second regime compared to the first one, it can be concluded that effectiveness amount of the OPV on economic growth has decreased over time.

5. CONCLUSION

One of the most important driving forces of the global economy is the crude oil and volatility in its price will has significant effects on economic growth and the well-being of the world's people. The volatility of oil price and its consequence on economic growth is an important issue confronting a growing number of world economies. The relationship between the oil prices and the level of economic activity has been the subject of debate for some time as this issue has been extensively discussed in empirical literature for the past decades.

In this study, the impact of OPV on the economic growth in Iran has been investigated. For this purpose, time series data of GDP and oil price during 1980-2014 extracted from the Central Bank of Iran have been used. Also, OPV time series extracted by using the GARCH method. Moreover, the TR method is used to estimate the threshold value for OPV. The results showed that the OPV equal to 1147.77 acts as a threshold. Also, due to the fact that the coefficient of OPV has decreased in the second regime compared to the first regime (667.48-18.85), the effectiveness amount of the OPV on economic growth has decreased over time.

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