

Oil Price Pass-Through into Domestic Inflation: The Case of Iran

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ABSTRACT: Review of economic developments in Iran over the past four decades shows that oil revenues have deep and wide impact on economic indicators. The Two channels which oil price changes directly or indirectly affect inflation as the most important Economic variables are: increase in demand (mainly by government public budget and Influencing the components of monetary base and money supply) and increase in production costs (via the price of factors of production). In this regard, the present paper attempts to investigate the nature and causes of oil price pass-through into inflation in the short-and-long term; analysis of the pass-through and in addition design the necessary policies to control its destructive consequences. For this purpose, the Dynamic Error Correction Model was used and the data were collected monthly from 2003/3 to 2013/3. The findings showed that the oil price pass-through into inflation in both short-and-long term were Positive and incomplete. Therefore, it would be useful in policymaking.

Keywords: Oil Price; Inflation; Pass-Through; Error Correction Model.

JEL Classifications: C13; C22; E31; Q43.

1. Introduction

Crude oil is a major source of fossil energy and is currently considered one of the major sources of energy in the world. Nowadays, crude oil is globally deemed as an important and strategic source, which is of prime importance for both importing and exporting countries (He et al, 2010). The use of huge oil revenues to improve infrastructures by governments has led to dramatic increase in the level of consumption and the improvement of life standards in the exporting countries (Wang et al, 2013). On the other hand, increase or decrease in oil prices, and oil shocks in general, is one of the most important issues discussed in economic circles, because these oil shocks have always influenced the planning and implementation of economic and developmental policies (Kang and Ratti, 2013). The shocks in oil prices can impact a country's economic activities in two ways. On the one hand, it can affect the level of supply, which manifests itself with some delay in influencing the production capacity of a country. On the other hand, oil shocks can exert an influence on the aggregate demand in a country, influencing economic activities in the short run (Emami and Adibpour, 2012). Huge bulks of economic research have indicated that not only negative oil shock but also positive ones are detrimental to the exporting countries (Saif Al-Abri, 2014; Wang et al, 2013; Filis et al, 2011; Dissou, 2010; Mehrara, 2008). Facing fluctuations in oil prices, exporting countries have always implemented two distinct policies. When there is a huge increase in oil revenues, governments' expenses, the supply of money through the foreign reservoirs of the Central Bank, and the amount of importation increases. In contrast, when oil revenues fall, governments face budget deficit, borrow from the Central Bank, and impose further limitations on importing goods and services. Both of these conditions have led to unbridled, double-digit inflation (Mehrara and Niki Oskoui, 2007). It should be noted that the rise of

oil prices would increase production expenditure and the cost of goods and services, negatively influence demand and employment, and leads to stagflation in importing countries (Peersman and Robays, 2012). Many experts are on the belief that most of the structural problems of Iran's economy are chiefly rooted in its one-product nature and dependency upon oil. The great susceptibility of many macroeconomic variables, such as inflation, governmental revenues, and importation to global oil prices and the country's oil revenues attests this claim. There exists a close relationship between inflation and oil revenues. A good number of studies have indicated this association (e.g., Beechey and Osterholm, 2013; Catik and Karacuka, 2012; Subhani et al. 2012; Mohaddes and Williams, 2011; Arinze, 2011; O'Brien and Weymes, 2010). In a similar vein, the current research purports to investigate how much the price of crude oil passes through into the inflation rate from 2003/3 to 2013/3 in light of the dynamic model of error correction.

2. The Position of Oil in Exporting Countries' Economy Based on Macro and Micro Perspectives

Natural resources are a blessing for any country, which can create comparative advantage in production and foreign trade. Among different types of natural resources, crude oil has economic characteristics and special advantages due to the global need to this energy carrier (Miller, 2013). This is of particular importance in economies like Iran where oil has the largest contribution to GDP (Delavari et al., 2011).

In the area of micro-economics, the most important features of crude oil, as a product, are as follows: the suppliers are few but many countries need it, hence it has a monopoly-like market, oil has hardly a substitute and consequently the demand curve has little elasticity, and its supply curve has also little elasticity since its production and distribution are contingent upon specific circumstances (Salehi-Isfahani, 2006). Therefore, the most salient consequence of the little elasticity of the supply and demand curves is that the impacts of supply and demand shocks (or both) are quite manifest in prices (Kolodziej and Kaufmann, 2014). On the other hand, there is often a delay in the supply of crude oil. As result, the oil market is prone to cobweb phenomenon and extreme price fluctuation (Westerhoff and Wieland, 2010).

In the domain of macro-economics, oil revenue is an exogenous variable, the amount of which is determined by factors outside the national economy. This causes national revenues to fluctuate. If oil prices increase, albeit its small contribution to national employment, makes a larger contribution to GDP and hence, makes the distribution of revenues among different sections unbalanced. Since other sections have a low demand of intermediate products and the amount of intermediate production for other sections is rather low (the weak relationship between the oil section and other sections), the increase of final demand for oil leads to a lower intermediate demand for other sections, resulting in an unbalanced growth of the national economy) (Ali Ahmed and Wadud, 2011). Moreover, since a large part of oil revenues is in the form of foreign currencies, the rise of oil prices leads to a rapid positive change in trade balance, exerting a negative effect on domestic production (Anam Hassan and Zaman, 2012). Therefore, due to the specific features of oil shocks, investigating the consequences of these shocks on economic indexes, especially in exporting countries, is of paramount importance.

3. The Theoretical Framework of Oil Prices Pass-Through into Inflation

The pass-through of oil into inflation refers to a rate in which the changes in the oil price are reflected in the general level of prices and their amounts are determined based on the currency of the exporting country (Mandal et al, 2012). The difference between the currencies of the exporting countries (exchange rate devaluation) is an important consequence of the severe rise in oil prices, which can be observed in both floating exchange rate and fixed exchange rate. In floating exchange rate system, foreign currencies lead to the increase of the value of the national currency. In the fixed exchange rate system, the introduction of foreign currencies into the system results in the increase of liquidity, the level of demand, and the general level of prices. Moreover, the increase of the value of the domestic currency increases the prices of importable products, doing a serious damage to the domestic manufacturers because the rise of the inflation rate increases production expenditure, forcing manufacturers to make products that are cheaper than foreign ones. Consequently, the competition power of the country in global markets dwindles, leading to high recession, unemployment, and inflation (Valcarcel and Wohar, 2013).

On the other hand, Iran's economy has experienced a double-digit inflation in the recent years, which has been the subject of scientific investigation from various perspectives. Moreover, a prominent feature of oil-exporting countries such as Iran is that their economic structure is heavily dependent on oil revenues (Barkhordar and Saboohi, 2013). This causes these countries' economies to be affected by global recession or prosperity. In Iran, like other oil-exporting countries, oil revenues, partly or wholly, are controlled by the government imparting these revenues to the economy according to its financial policies. Therefore, the impact of oil revenues on the economy of exporting countries is manifested through fiscal policies. Due to the heavy dependency of the government's budget and the implementation of fiscal policies on oil in oil-exporting countries, oil revenues are of paramount importance in these countries (Farzanegan, 2011). Furthermore, a part of oil revenue entering the economy through budget is sold in the domestic exchange market by the Central Bank and becomes national currency. However, since part of this revenue is not sold in the domestic exchange market, the net foreign assets of the Central Bank will increase, resulting in the rise of the sources of monetary base and liquidity in the economy. This condition is equivalent to the expansionary monetary policy (Waisman et al, 2013). Another influential factor in this regard is the increase of the value of the national currency of the exporting countries, which is the result of Injecting foreign exchange earnings from oil exports to the domestic foreign exchange market. Moreover, the devaluation of the national currency due to negative oil shocks will increase Import prices and the cost of imported inputs. This, in turn, will affect production and domestic prices. Consequently, the increase of import prices due to the devaluation of the national currency is an important factor underlying the rise of domestic inflation rate and the weakening of the terms of trade (Reboredo, 2012).

Although it seems that the Increase of foreign exchange earnings from oil exports and consequently, the rise of the government's expenditure and injection of money, and providing the financial resources necessary for importation of capital equipment, and hence the improvement of the supply part of the economy, production and economic growth will significantly increase, the investigation of economic growth of exporting countries, we observe that the economic growth has been low in the recent decades. One of the theories proposed to account for this low economic growth is the Resource Curse Theory (Bjorvatn et al., 2012). Based on experimental evidence, the relationship between economic evidence and natural resource indexes that the countries heavily relying on the exportation of natural resources have low economic growth on average. This inverse relationship between the abundance of natural resources and economic growth, which has been termed Resource Curse Theory in the development literature, provokes a conceptual contrast; because natural resources are considered as a country's wealth and their exportation increases the purchasing power of imports and it is expected that the abundance of natural resources enhances investment and economic growth. This perspective that stresses the role of noneconomic factors to justify low economic growth, tries to provide reasons for the lower economic growth and hence the higher inflation rate in oil-rich countries in comparison with countries having no natural resources in the recent decades. This approach has been proposed in the framework of theories such as Dutch Disease Hypothesis (Edwards and Aoki, 1983).

4. The Experimental Estimation of the Model

In this research, the time-series data of Iran's crude oil prices and the consumer product index (CPI) from 2003/3 to 2013/3 have been used to investigate the short-term and long-run relationship between these two variables. Due to the use of logarithmic variables in this study, LCPI refers to the logarithm of the consumer price index and Loil refers to the logarithm of oil price. It should be noted that the price of Iran's oil has been taken from the website of the American Energy Information Administration¹ and the consumer price index has been taken from Iran's Central Bank website². Due to the structure of the objectives of the research, the stationarity of the variables should be investigated in the first place which is done by means of Augmented Dickey Fuller (ADF) in this research.

¹ www.EIA.org

² www.CBI.ir

Table 1. The results of stationary test

Series	Accounting Value	Critical Value	P-Value	Result
Level of the Variables				
LCPI	6.827	-1.943	1.000	Non-Stationary
LOIL	5.540	-1.943	1.000	Non-Stationary
First-Differenced Variables				
dLCPI	-1.949	-1.943	0.045	Stationary
dLOIL	-5.698	-1.943	0.000	Stationary

The result of the table 1 indicates that based on the ADF test, the LCPI and Loil series are non-stationary. Therefore, as the results of the stationary test show, both of the main variables of this study are stationary (First order differenced). Hence, in order to avoid the consequences of false regression, the long-run relationship between these two variables should be examined, because in the case of absence of any long-run relationship, the results related to the association between these two variables are not valid, and hence reliable. Consequently, what follows is the investigation of the long-run relationship between oil price and CPI, and if such a relationship exists, the dynamic pattern of these two variables will be modeled.

4.1. Examining the Long-Run Relationship

In general, when the variables of a regression model are first-order-differenced stationary, in the first the long-run relationship between these variables should be explored in order to devise the model accurately, have a correct estimation of the coefficients of variables, and avoid spurious regression, because if no long-run relationship exists (or the variables were co-integrated), their estimation by means of conventional econometric methods (OLS) will not be correct. Therefore, the Engle-Granger method and Johansen-Juselius methods are common methods for examining the existence of long-run relationship among a set of variables. A pitfall of the Engle-Granger method is that if there are more than one co-integration vectors among the research variables, the results will not yield asymptotically efficient estimates. In this case, we should use Johansen-Juselius method to examine the long-run relationship among the research variables. However, since the maximum number of the possible co-integration vectors between the variables equals the number of variables minus one, there is just one co-integration vector between the variables of this research (there are just two variables in this study). Therefore, the long-run relationship between the variables of this research can be investigated by means of Engle-Granger method. In Engle-Granger co-integration test, a regression such as $y_t = \beta x_t + u_t$ is estimated by OLS method. Then, residuals are measured and their stationarity is tested based on ADF test. If the residuals are stationary, the research variables are co-integrated. At this stage, a linear regression between the research variables is estimated, and if the residuals of that model are stationary we can conclude that there is a long-run relationship between the variables. Equation (1) deals with this relationship:

$$\begin{aligned}
 LCPI &= 1/112 + 0/753 LOIL + u \\
 t: & \quad (4/149) \quad (14.546) \\
 R^2 &: 0/92 \qquad F - Statistic : \quad 1647/233 \\
 DW &: 0/0272 \qquad Prob(F - Statistic) : 0/000
 \end{aligned}
 \tag{1}$$

After analyzing the above equation based on the two-step Engle-Granger test, the above-mentioned equation indicates the long-run relationship between LCPI and Loil if the residuals of that model are stationary. Therefore, we will examine the stationarity of the residuals of this equation in Table 2.

Table 2. The results of stationary test of long-run equation's residuals

Series	Accounting Value	Critical Value	P-Value	Result
<i>u</i>	-4.019	-1.943	0.000	Stationary

As Table 2 illustrates, based on ADF test the residuals of Equation (1) are stationary. Consequently, the above-mentioned equation reflects the long-run relationship between LCPI and Loil. We can also point to the positive and significant coefficient of the oil price variable. Due to the fact that this relationship is long-run and research variables are logarithmic. The coefficient of the oil price variable indicates the elasticity of CPI towards positive changes in oil price. Moreover, this coefficient shows the long-run pass-through of oil price into this price index. In fact, the elasticity of CPI towards the oil price shows the degree of oil price pass-through into this index. The coefficient of determination for this model indicates that oil price accounts for 0.75 percent of the behavior of CPI in the long run. Considering F-statistics and its possibility, we can argue that the entire model is reliable and significant. The important point is that Durbin-Watson statistics show that serial auto-correlation exists in this model. Since we cannot use interrupts in dependent and independent variables and residuals in a long- term relationship, New-West fixed method was used to solve this problem. In this method, the variance- covariance matrix is calculated in a way that solves the problems of serial auto-correlation and heteroskedasticity are solved without entering the lags of dependent variable into the model. As a matter of fact, this method enables us to have a correct estimation of the coefficients and their Significant without entering the lags of dependent variable or the residuals into the model.

4.2. Investigating the Dynamic Relationship (ECM Model)

The general framework for the error correction pattern investigates the return to balance in the system when it deviates from the long-run relationship. In the error correction mechanism, the information related to the data in addition to economic theories is used in order to efficiently model short- and long-run relationships. Therefore, in spite of many definitions proposed for error correction models, they are widely used in applied econometrics (Komijani et al, 2013).

The relationships between variables are examined with the aim of analyzing short-term, mid-term, and long-term relationships. Consequently, we cannot solely determine long-run relationships in economic models. The estimation of dynamic short-term relationship between the variables of the model is also essential. Therefore, we can reach this aim through the error correction mechanism because if there is no mechanism readjusting unbalanced variables, the long-run relationship between the variables will not be established or will not be maintained.

As a matter of fact, this pattern examines the balancing and long-term role of variables in balancing short-term fluctuations. In the co-integration literature, the equation $Y = \beta X + U$ and the parameter β is referred to as co-integration parameter and the vector $[1 - \beta]$ is considered as the co-integration vector. After demonstrating the long-run relationship between the variables by means of the above-mentioned tests and estimating the long-run relationship coefficients of the model, the second stage is regressing the difference of the first level of the dependent variable on the difference of the first level of the descriptive variables accompanied by the error sentence with a delay (the error conduction model), which is the residuals of the regression of the first stage with a delay that is referred to as the error correction sentence. This relationship is shown in Equation 2.

$$dLCPI = 0.012 + 0.68dLOIL - 0.053ECT(-1) + 0.37 AR(1) + u$$

t:	(8.96)	(2.94)	(-2.12)	(4.74)	
R^2 :	0.81			F – Statistics:	9.875 (2)
DW :	2.06			prob(F – Statistics):	0.000
ARCHT Test prob:	0.0364			McLeod – Li Test prob:	0.354
Lejung – Box Test prob:	0.466				

The above error correction model suggests that the changes of the dependent variable are a function of deviation from the long-run equilibrium relationship (expressed by the error correction element) and the changes of other descriptive variables. This model relates the short-term and long-term behavior of the two variables by dint of the balancing error correction element. The error correction coefficient shows that if a shock causes the variables to go out of the long-run equilibrium, the effect of this shock will fade away in around 19 periods. Just like the long-run relationship, the coefficient of the oil price variable demonstrates that the short-term elasticity of the CPI variable towards the changes in oil price or suggests the pass-through of oil price into CPI.

On the other hand, the result of a model suffices when diagnostics tests confirm the correct estimation of the model. Therefore, ARCH, McLeod-Li, and Ljung-Box tests were applied to the residuals of Equation 2 and the results are shown in Table 3.

Table 3. The result of the some diagnostics tests

Test	Accounting Value	P-Value	Result
ARCH Test	0.828	0.364	Reject
McLeod-Li Test (Lag: 5)	7.741	0.171	Reject
Ljung-Box Test (Lag: 5)	4.573	0.334	Reject

Due to the probability (P-Value) of ARCH test, we can conclude that the null hypothesis of this test stating the absence of variance heteroskedasticity in the residuals of the model is rejected. Therefore, this model does not suffer from variance heteroskedasticity. The results of McLeod-Li also confirm this conclusion because the null hypothesis of this test indicates the absence of autocorrelation in the squared residuals, which is rejected in this series. In other words, there is no autocorrelation between the squared residuals. In a similar vein, the findings of Ljung-Box indicate that absence of autocorrelation between the residuals of the model.

5. Conclusion

The evidence from Iran’s economy shows that the analysis of the impact of oil shocks on economic variables such as inflation is of huge importance because understanding the accurate and quantitative relationship between oil prices and inflation rate is crucially important for economic policy makers trying to reduce inflation and control oil shocks. Previous studies have also confirmed the effects of oil shocks on a good number of economic variables such as inflation rate, economic growth, trade balance, etc. Therefore, the fact that the increase of oil prices leads to the decrease of global economic growth is unquestionable. The main reason underlying this trend is that oil is not considered as a final product, but is regarded as a production input affecting all economic activities. Consequently, a change in the price of this input will directly or indirectly influence the price of other products. It may be asked what the theoretical basis of this assumption is.

In order to achieve the objectives of this research, monthly time-series data regarding the consumer price index and the price of Iran’s crude oil have been utilized. First, the stationary nature of the data and the recognition tests were dealt with. The results of Augmented Dickey–Fuller test revealed that the time series of LCPI and Loil are first-order-differenced stationary. Therefore, in order to avoid the consequences of spurious regression, the long-run relationship between the mentioned variables was investigated. The results of this investigation showed that there exists a long-run relationship between oil price and CPI. Due to the logarithmic nature of the variables of this research, the coefficient of the oil price variable indicates the elasticity of CPI in the long run or the pass-through of oil price into CPI in the long run. This coefficient in the long-run relationship suggests that oil price accounts for 0.75 percent of the behavior of the consumer price index in the long run. After the long-run relationship between these variables was confirmed, the dynamic short-term relationship between the variables was demonstrated. The result of the dynamic model was also in line with the long-run relationship, indicating the significant and positive relationship between oil price and inflation. The short-term pass-through of the growth rate of oil price into inflation was 68%. As a matter of fact, the pass-through of oil price into consumer price index in both a short-term period and a long-run period is not complete. Moreover, the ECT coefficient shows that if a shock causes the variables to be out of the equilibrium in the short run, the effect of this shock will fade away after around 19 periods.

The theoretical foundation of the pass-through of oil price into inflation rate is the fact that increasing oil prices may lead to a higher inflation rate at least through three inter-related channels. First, the changes of the oil price may directly influence the price of oil products such as gasoline. This will raise the transportation expenses and will directly impact CPI because of being a part of families’ consumption per capita. Moreover, the increase of oil price may also have a direct impact on CPI (rather than on producer price index), because changes in the oil price, as a production and final services input, will influence CPI. Finally, another mid-term consequence of the rise of oil prices is

that the expected inflation rate increases leading to the minimum increase of families' level of income. This increases the demand for products and services, resulting in further increase in the inflation rate.

The results of this study highlighted the role of the changes in the oil price in inflation rate. Therefore, in order to control the inflation rate and make purposeful changes in it, we should devote close attention to oil price and the roots of its change. The increase of oil price leads to the rise of the inflation rate through increasing production expenses and through the channel of the exchange rate, increasing the price imported products. These products are either consumer products or intermediate or organizational products. The rise in the price of consumer products has a direct influence on inflation, and the rise of the price of intermediate or final products affects inflation through increasing production expenses. In order to have a deeper analysis of the pass-through of oil price into the inflation rate, we should pay attention to the reasons underlying the increase of oil price and classify the short-term and long-term effects of changes in oil price on inflation. This analysis will have political implications for decision makers. In the end, we may present the political solutions to reduce the pass-through of oil price into inflation, which is quite manifest in Iran's economy, in two groups that are as follows:

1. In the short run, in which we cannot make the government independent of oil revenues, the government can make the best use of its political tools to control the budget. In order to avoid constant budget deficit, the government should carry out some measure. First, it should enforce financial discipline in both revenues and expenses to prevent the effect of severe changes in oil prices in global markets on the budget and hence, the level of prices. Therefore, the government should let a certain percentage of oil revenues enter the domestic economic cycle, reflected in the idea of forming National Development Fund. Secondly, the government should pave the way to be independent of oil revenues as much as possible. The best suggestion to reach this end is to reconstruct the tax system according to modern and efficient methods, so that the self-regulating system of the national economy will be activated. Finally, the government should do its best not to borrow from the Central Bank in case of budget deficits, because this has a strong effect on inflation.

2. In the long run, we can remove the government's dependency on oil by means of a well-prepared plan. This can be done by taking the management of oil revenues from the government and reducing the association between the budget and oil revenues. Furthermore, optimizing the size of the government and benefiting from its positive consequences and making the Central Bank independent in managing the national currency to adopt appropriate policies to avoid the negative effects of the overvaluation of national currency.

Based on these suggestions that are in light of the current situations in Iran's economy, we can establish relative consistency in our economy and reduce the negative effects of severe fluctuations in oil revenues on inflation and national economy (the Dutch Disease and budget defect).

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