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The survey of Impact of Oil Price Fluctuations on Real Exchange Rate in the Selected OPEC Countries

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Abstract

One of the most significant discussion and challenges propounded in the macroeconomics is the effects of fluctuations of exchange rate on the macroeconomic variables (production, employment, inflation and … etc).In this direction, the important and noticeable point is the factors which lead to fluctuations in the exchange rate which, from amongst these factors as an example, is fluctuations in the oil price. For this reason, relationship between oil price fluctuation and exchange rate seems to be important and necessary. Time period used in this study relates to the years from 1990 to 2010. Also, Autoregressive Distributed Lag Model (ARDL) has been used to study relationship among the variables. Results obtained from this study show the negative and significant effect of oil price fluctuations on the exchange rate. A negative and significant quantity was obtained from ECM coefficient, and this problem represents activeness of the model from short-term to long-term. The oil price changes have left asymmetrical effects on the countries in the short term, and these effects will continue in the long term as well. Of course, direction of short term effects, contrary to the long term effects, is in each level.

Keywords: Oil Price Fluctuation, Real Exchange Rate, Auto-Regressive Distributed Lag Model (ARDL).

1- Introduction

Fluctuations of oil price and exchange rate are from amongst the most important factors affecting the gross domestic production (GDP) of

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countries, especially oil exporter countries. Available statistics and information in some such countries suggest this fact that exportation of the crude oil has been lead to dependence of economy of these countries on the exchange rate incomes resulted from sale of this material for many years so that the entire economical activities, including activity of parts of industry, agriculture and services have been related to the export and revenue of this product directly and indirectly. In addition, oil revenues constitute a remarkable part of the government's income which this dependence is to be intensified considering the role of governments in developing countries.

Since price and quantity of oil sale in these economies are construed as an exogenous variable and determination of their rate is beyond the scope of national economy and, on the other hand, macro-economic activity, national economy can be affected by any sort of fluctuation in it. A study of fluctuations in the countries production and its causes has ever been one of the subjects taken into consideration in the economical analyses. One of the factors effecting the fluctuations in the production, particularly in the oil exporter countries, is oil prices and their fluctuations. Changes and fluctuations of the oil price influence on the macroeconomical variables through various ways. Of course, oil price shocks influence on the economy through various channels. In addition, effectiveness of oil price on the economy can be studied from different aspects. One of the aspects of effectiveness is symmetry and asymmetry of effect of the oil shocks on the economical variables, and another one of dimensions of influence of the oil price is effectiveness of unreliability caused by oil price fluctuations on the economical variables. One of the ways through which oil price fluctuations can influence on the country's economy is via influence on the exchange rate because highest rate of exchange rate revenues of the oil exporter countries is the revenues resulted from oil sale, therefore, impression ability of exchange rate from oil price fluctuations can effect directly and indirectly on the macroeconomic variables out of which the most important ones, are for example, production, employment, balance of payments and inflation. (Ebrahimi-2011). Given the importance of oil price fluctuations on the exchange rate from the side of currency incomes, therefore in this paper, the influence of oil price fluctuations on the exchange rate is examined. At the first of this paper, we provide an introduction and in the second of this paper the literature review will be provided. In the third part, the theoretical and

empirical evidences (Domestic studies & Foreign studies) will be provided and in the fourth part, theoretical basis (Econometrics method) and Empirical part (Estimation of model) is provided. Finally, in the last part, the results are presented.

2- Oil Revenues and Real Exchange Rate

Revenues obtained from oil exportation are regarded as the greatest resources of income in the budget of the oil exporter countries and influence on their gross domestic product. With regard to importance of oil in the economy of the oil exporter countries, fluctuations of the oil price, in addition to influence on the economy of the importer countries are considered to be the greatest source of disturbance in the economy of dependence-on-oil countries. Principle role of the incomes obtained from oil sale in the major countries of oil exporter countries (Organization of Petroleum Exporting Countries-OPEC) leads to this subject that fluctuation of these revenues influences on the macroeconomic variables. Considering that exchange rate, as an intermediary between foreign and domestic prices plays a key role and, on the other hand, it is counted as an effective tool in order to persuade the exportation, it is taken into consideration through a special attention.

Real exchange rate suggests level of capability of competitiveness of one country in the global markets. It is evident that fluctuations of real exchange rate can be attributed to non-monetary shocks at the first step. In the countries relied on the oil incomes one of the factors which can influence on the real exchange rate is real oil price. Through effectiveness on the price of trading commodities and, subsequently, the government's budget deficit, this variable influences on the exchange rate. Awareness of existence of a relationship between these two variables in order to make the macroeconomic decision can guide the policy makers and planners because the oil revenue, through real exchange rate, has the highest influence on the macroeconomic variable. Meanwhile, due to possession of a key role as an intermediary between foreign and domestic prices and, basically, as the most efficient tool to encourage and expand the exportation and economizing and threat of importation simultaneously, the real exchange rate is exposed to the change and transformation more than other variables. Thus, in this article

kind of relationship between these two variables based on importance of problem is to be studied for mentioned countries.

3- A Review of Carried- Out Studies

As yet, several experimental studies (based on economy assessment methods) regarding effects of oil shocks on the exchange rate have been accomplished. Since oil is an important consuming commodity for global economy as well as a vital material for industrial countries, and the shocks resulted from it are effective on the rate of countries foreign exchange, especially the countries which have oil economy, a review on the carried-out studies (Domestic and Foreign Studies) has been dealt with in this part of paper.

3-1- Domestic Studies

In 2009, Bazzazan, Alinezhad and seydizad dealt with studying of the long term relationship between crude oil price and real rate of U.S.D. foreign exchange through two Johanson Joecelius and ARDL methods and reached this conclusion that there exists a long term relationship between U.S.D. price and crude oil price but this relationship is in the not-so much-powerful and reliable level of confidence.

In 2010, Sajad Ebrahimi studied effect of the oil price shocks and exchange rate fluctuations and unreliability resulted from them on the economic growth of the selected oil countries and drew conclusion that there exists a long-term relationship between oil price , exchange rate and production in the these countries. These long-term relationship between oil price and production growth is positive and between exchange rate and production growth is negative.

In 2010, in a study under topic of “Estimation of long-term relationship between actual price of the crude oil and real value of U.S.D., Hooshmand and Fahimi doab have dealt with existence or lack of existence of a stable long-term relationship between these two variables in the level of global economy using the cointegration test and causality tests for a time period from 1985 to 2008. Results show that 10% increase in real value of dollar and, also, direction of causality is from variable of crude oil to U.S.D. dollar.

3-2- Foreign studies

In 2008, Koderet etal dealt with studying the stability of relationship between oil price and real exchange rate of dollar in long term. Their results showed that causality is from direction of oil price to rate of dollar foreign exchange. Secondly, real rate of dollar foreign exchange is reinforced up to 4.3% by increase of 10% of oil price's logaritm.

In 2004, benasi et al dealt with studying of long term relationship between factual variables of oil price and dollar. Using the statistics of years from 1974 to 2004, they showed that 10% increase leads to reinforcement of value of dollar up to 4.3% in the long term and direction of causality is from oil price to dollar.

In 2010, in order to survey the relationship between crude oil price and exchange rate for India during sever fluctuations of oil price, Ghoosh used the daily data related to 2007, July up to 2008, November. This study indicates that increase of oil price leads to decrease of value of Indian money compared to U.S.D. Also, these studies show that the positive and negative shocks of the oil price have similar effects on the fluctuations of rate of foreign exchange, and these oil price shocks will have a permanent effect on the instability of the foreign exchange rate.

In 2012, Dogan et al engaged in surveying the relationship between real oil price and real exchange rate in Turkey. They concluded that increase of oil prices influences on the real exchange rate negatively.

4- Theoretical Basis

4-1- Econometrics Method

Usage of traditional methods of economy assessment for empirical studies is based on supposition of reliability of the variable. But, the studies carried out in this field show that this supposition is incorrect regarding several time series and these variables are often reliable. This problem may lead to appearance of the forged regression and eliminates the trust in the estimated coefficients. According to the cointegration theory in the modern econometrics. It is necessary that, while using the time series, the methods are to be used which pay attention to problem of reliability and cointegration.

In the method presented by Engl-Grenjer, the obtained estimations in the samples with small volume are turesh due to not taking the short term

dynamic reactions available among the variables into consideration. On one hand, limit distribution of estimators of minimum square roots is abnormal; therefore, performance of test of hypothesis using the usual statistics is invalid. Also, Angel-grenjer method is founded on the presupposition of existence of cointegrational vector and, under conditions which there exists more than a cointegrational vector, usage of this method will be led to back of effectiveness (Pesaran and Smith, 1998). In order to obviate these complications and difficulties, Johansen and Juselius suggest maximum likelihood ratio for cointegration test and extraction of cointegration vectors (Johansen and Juselius, 1992). For the reason that all variables of model may have not equal reliability degree, cointegration of Johansen-Juselius cannot be useful (Zaranezhad and Saadatmehr, 2007). In this article, since international degree of variables was in different form, Autoregressive Distributed Lag Model (ARDL) has been used.

In ARDL method, by use of the criteria such as Schawrz-Bizin, Akaike and Hannan-Quinn, optimum lags are selected for each one of the variables (Pahlavani and Dahmardeh, 2007). This method estimates the short-term and long-term relationships between dependent variable and other descriptive variables of the model simultaneously. In the usage of this approach, equality of cointegration degree of variables which is necessary in the Angel-Grenjer method- is not required. In a state in which the variables are a combination of I(1) and I(o) variables, ARDL methodology is usable again.

4-2- Presentation of Autoregressive-Distributed Lag Model-ARDL

Generally, dynamic model is a model into which lags of variables are entered like relation (1):

$$Y_t = aX_t + bX_{t-1} + cY_{t-1} + u_t \qquad (1)$$

In order to decrease turesh related to estimation of coefficients of the model in the small samples, it is better, as much as possible, to use a model which considers a lot of lags for vriables such as relation (2):

$$\phi(L,P)Y_t = \sum_{i=1}^{k} b_i(L,q_i)X_{it} + c'w_t + u_t \qquad (2)$$

In the above relations, Y_t is dependent variable and X_{it} is independent variable. Term L is operator of lag and W_t is a vector of $S\times 1$ which

suggests the predetermined variables in the model, including width from origin, figurative variables, time process and other exogenous variables. P is the lags applied for dependent variable and q is the lags used for independent variables (X_{it}).

Above model is known as an Autoregressive-Distributed Lag Model (ARDL) in which we have:

$$\phi(L,P) = 1 - \phi_1 L - \phi_2 L^2 - .... - \phi_P L^P \tag{3}$$

$$b_i(L,q_i) = b_{i0} + b_{i1} L + ... + b_{iq} L^q \qquad i = 1,2,3....,K \tag{4}$$

Number of optimum lags for each one of the explanatory variables can be determined with one of the Akaike criteria (AIC) or R-Bar Squared (corfficient). Usually, in the samples lower than 100, Schowrz-Bizin criteria is used so that much freedom degree is not eliminated. This criterion economizes in determination of the lags and, thus, estimation will be of more freedom degree(Pesaran and Shin, 1996). In order to calculate the long-term coefficient of the model, the same dynamic model is to be used. The long-term coefficients related to X variables are to be obtained from this relation:

$$\theta_i = \frac{\hat{b}_i(L,q_i)}{1 - \hat{\phi}(L,p)} = \frac{\hat{b}_{i0} + \hat{b}_{i1} + ... + \hat{b}_{iq}}{1 - \hat{\phi}_1 - \hat{\phi}_2 - ... - \hat{\phi}_p}, i = 1,2,....,k \tag{5}$$

From the relation (5), quantity of t statistic related to the long-term coefficient is also calculable. Inder (1993) shows that these types of t statistics have common limit normal distribution, and t test based on usual critical quantities is the good ability. Therefore, with aid of θ_i, reliable test can be executed regarding existence of a long-term relationship. In the ARDL method, in order to estimate long-term relationship, two step methods can be used as following. In the first step, existence of long-term relationship between the studied variable is tested (Pesaran and et al, 2001). In this step, there are two ways to study that the long-term relationship resulted from this method is not spurious:

In the first method, after estimation of dynamic model of ARDL, following hypothesis is to be tested:

$$H_0 : \sum_{i=1}^{p} \phi_i - 1 \geq 0$$

$$H_a : \sum_{i=1}^{p} \phi_i - 1 \prec 0 \qquad (6)$$

Zero hypothesis suggests lack of existence of cointegration or long-term relationship. In order to carry out the desired test presented by Banerjee, et al (1993), the number (1) must be deducted from total coefficients with lag of dependent variable and divided by total standard deviation of the mentioned coefficients, which statistic of test, being of t statistic type, is obtained.

$$t = \frac{\sum_{i=1}^{p} \hat{\phi}_i - 1}{\sum_{i=1}^{p} S_{\hat{\phi}_i}} \qquad (7)$$

If absolute value of statistic (t) obtained from absolute value of critical quantities-presented by Banerjee, Dolado and Mestre - is higher in the confidence level of 95%, the zero hypothesis based on lack of existence of cointegration is rejected and existence of the long-term relationship is accepted.

In the second method presented by Pesaran and Shin, existence of the long-term relationship between studied variables, through calculation of statistic (F), is studied in the correction-of-error form in order to test significance of levels with lag of variables (Pesaran and Shin, 1996).

5- Empirical part

5-1- Estimation of model

In this section, test of reliability performs firstly, and if the variable is I(2), quantity of calculating F statistic cannot be trusted. Therefore, results obtained from this test are presented in Table 1:

Table 1: Unit Root Test Result

Variable	t-statistic	Prob	Results
Re	27.942	0.005	Stable
D(po)	111.254	0.000	Non stable

Source: Results of Research

As it is observed from Table , the real exchange rate is stable at level values, but real oil price is not stable at level values and it is stable in the first difference. Therefore, since variables of this research are I(1) and I(0), Autoregressive-Distributed Lag Model(ARDL) is used to study the relationships among the variables.

In this step, study of long-term relationship is dealt with between the variables firstly.

Table 2: Unit Root Test Result in the First Order Difference Without Trend

Variable	t-statistic	Prob	Results
D(re)	51.438	0.000	Stable
D(po)	100.676	0.000	Stable

Source: Results of Research

Also, in order to obtain the optimum lag, Hannan-Quinn and Schwarz Critters have been used whose results are presented in Table 3:

Table 3: Obtaining the Optimum Lag

Lag	HQ	SC
0	18.44788	18.48412
1	16.26143	16.37014
2	16.07174*	16.25293*
3	16.15209	16.40576
4	16.14357	16.46971
5	16.20875	16.60737
6	16.18566	16.65675

Source: Results of Research

As it is noted from Table 3, these criteria have specified the lag 2 as the optimum lag. In order to get oil price fluctuations, we have regress this variable on it's first and second lag according to following model and saved the residual obtained from this model suggesting the fluctuations under the name of **npo** and used this variable in order to measure the effects of fluctuations on the variable of the foreign exchange. Results of regression of the oil price on the lags are as following:

Table 4: Regression of the oil price results

Variable	Coefficient	t-statistic	Prob
C	3.362719	1.857	0.0659
PO(-1)	0.607760	6.605	0.0000
PO(-2)	0.411252	4.290	0.0000

Source: results of research

As it is observed, critical quantity suggest the perfect significance of the coefficients and rejection of the zero hypothesis based on ineffectiveness of coefficients. Residual diagram of this regression is presented in fFig.1.

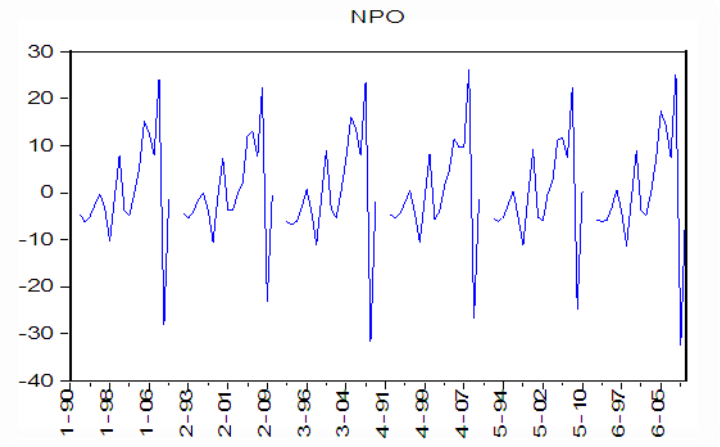

Figure 1: Oil Price fluctuation

In order to study existence of cointegration vector and establish long term relationships, quantity of calculating statistic of Banerjee, Dolado and Mestre using the test of model lags, has been calculated and determined as following:

$$t = \frac{0.84 - 1}{0.03} = \frac{-0.16}{0.03} = -5.333$$

Considering that quantity of statistic of table presented by Banerjee et al. is in confidence level of 95% and, for the model with width from origin, it is -5.333, existence of the long term relationship between the variables is to be confirmed.

Now, with awareness of this subject that there are long-term relationships, we deal with estimation of following equation according to ARDL model:

$$re_{it} = \beta_0 npo_{it} + \lambda_1 \Delta npo_{it} + \lambda_2 \Delta re_{it} + v_{it} \qquad (8)$$

which, in this equation, re_{it} is the same exchange rate in the level for time period (t) (from 1990 to 2010), Δre_{it} is difference of the exchange rate in the i th level for time period (t) and Δnpo_{it} is fluctuation of oil price i th level for

time period (t). Results of long term effects of oil price fluctuation on the exchange rate are presented in Tableb5:

Table 5: Long- Term Estimation Results

Variable	Coefficient	t-statistic	Prob
β_0	-0.590822	-2.918095	0.0044
λ_1	0.286807	2.573943	0.0115
λ_2	0.517222	6.853996	0.0000

Source: Results of research

With the result that, the estimated equation is as follows:

$$re_{it} = -0.59npo_{it} + 0.28\Delta npo_{it} + 0.51\Delta re_{it} \quad (9)$$
$$(t) \qquad (-2.91) \qquad (2.57) \qquad (6.85)$$

With regard to the results obtained from long-term cointegration vector, it can be concluded now that:

Variable of oil price fluctuation has had a negative and significant effect on the exchange rate. In other words, increase of oil price fluctuation leads to decrease of exchange rate in the long term.

In this step, in order to be able to trust in the results of long-term relationship among the variables, study of the classic hypotheses has been dealt with. Results obtained from classic test suggest lack of existence of consecutive correlation between the components of innovation and corrected and stipulated correct equation, components of innovation have normal distribution as well as homologous variance. In order to study error correction model, we estimate the following model:

$$re_{it} = \beta npo_{it} + u_{it} \rightarrow u_{it} = re_{it} - \beta npo_{it} \quad (10)$$

$$\Delta re_{it} = \alpha_0 + \alpha_1 npo_{it} + \alpha_2 u_{it-1} \quad (11)$$

In Equation (10), coefficient α_2 represents rate of annual modification. Results acquired from estimation of model of error correction have been presented in Table 6:

Table 6: Short-term Estimation Results

Variable	Coefficient	t-statistic	Prob
α_0	1.461504	4.893240	0.0000
α_1	-0.293062	-4.447148	0.0000
α_2	-0.630513	-2.060959	0.0419

Source: Results of Research

With the result that, the estimated equation will be as follows:

$$\Delta re_{it} = 1.46 - 0.29 npo_{it} - 0.63 u_{it-1} \quad (12)$$
$$(t) \qquad (4.8) \quad (-4.4) \qquad (-2.06)$$

Results achieved from estimation of the model in the short-term suggest the negative and significant effect of oil price fluctuation on the exchange rate.

ECM coefficient was obtained to be a negative and significant quantity and this problem represents dynamic model from short term to long term. In other words, process of error correction is from short term to long term with a speed being equal to 0.6.

In order to study the symmetric and asymmetric effects of oil shocks in each level, Table 7 has been estimated.

Table 7: Short- Term & Long- Term Effects

levels	Countries	Short-term effects of oil price	long-term effects of oil price
1	Iran	6.697628	-14.84637
2	Saudi Arabia	-4.898077	6.059774
3	Algeria	-8.895572	12.17579
4	Venezuela	-1.315568	11.45442
5	Ecuador	4.677551	-11.25642
6	Nigeria	3.734039	-3.587195

Source: Results of Research

As it is noted from Table 7, changes of oil price have left asymmetrical influences on the countries in short term, and these influences will continue in long term. Of course, direction of short-term affects, contrary to long term effects, is in each level. In the short term effect of oil price fluctuation exchange rate in Iran is symmetric. Also in the long term, effect of oil price fluctuation on the rate of exchange rate in Iran is asymmetric.

6- Conclusion and Suggestions

In this paper, first, an introduction of oil price and real exchange rate are discussed. Then, theoretical and empirical evidences are provided and in the next part, literature of econometric model and then empirical model according to evidences, are presented. In the last part, the conclusion and suggestions are provided that are as follows:

Results obtained from this study suggest the negative and significant impact of oil price fluctuation on the exchange rate. Coefficient of Error Correction Model (ECM) was obtained to be a negative and significant quantity, and this problem represents the dynamism of the model from short-term to long-term. Therefore we can say, the oil shocks on the real exchange rate finally will be damped and the exchange rate variable will return to estimated long-run trend. In other words, the trend of error correction is with the speed of 0.6 from short-term to long-term.

Findings related to the survey of effects of short-term and long-term changes in oil prices on exchange rates in different countries show that the oil price changes have left asymmetric effects on the countries in the short-term, and these effects will continue in the long term as well. Of course, direction of short-term effects, contrary to the long-term effects, is in each level.

Also in the short-term, the greatest effect of oil price changes on the exchange rate is related to Iran country and the less effect is related to Algeria country.

In the long-term, the greatest effect of oil price changes on the exchange rate is related to Algeria country and the less effect is related to Iran country.

Following approaches are suggested by this research in order to control the exchange rate fluctuations in the country:

- **Decrease of in Stability and Appropriate a Management of the Revenues Obtained from Oil Export**

Since oil price fluctuations and instability resulted from it are exogenous and instability of the oil price cannot be controlled, the most significant policy development to which can be referred is to control the oil shocks resulted from oil price in effective through successful experiences of other oil countries. Oil countries must take measures to establish an institution like saving and investing fund so that direct entrance of the exogenous shocks and fluctuations into domestic economy is to be prevented and the negative impacts of instability of oil price on the governments incomes which are foreign exchange incomes resulted from oil sale mainly are to be decreased. This institution must have relative legal and economical independence so that it is of the required stability. Here it is required to remind that, in addition to decrease instability and paper management of incomes resulted from oil export, other supplement measures regarding strength and authority of financial and monetary policies to manage direction of expenses and demand are to be carried out.

- **Diversification and Development of Non-Oil Export**

One of the influential ways to control exchange rate fluctuations is that we avoid a single-product economy and decrease the fluctuations of exchange rate reserves through diversification of exports, particularly non-oil exports.

- **Accurate Prediction of Real Oil Price in the Compilation of Annual Budgets**

It is suggested that, in order to save the economic variables from negative oil price fluctuations in the compilation of annual budgets, an accurate prediction of real oil price is to be carried out, and the budget is to be compiled according to this real price.

- **Paying Attention to Macroeconomic Policies and Change of Reformation of the Country's Productive Structure**

Although foreign exchange rate policies can be effective on the non-oil exports, but this effect is not determinant and befitting the importance of non-oil exportation. Change of the exchange rate has not the chance of success in setting up a balance in the foreign part of economy and

development of non-oil exports spontaneously. Therefore, it is necessary that, while using the foreign exchange policies to support and encourage the non-oil exports, other macroeconomic policies and change of reformation of the country's productive structure are taken into consideration.

- **Decrease of dependence of budget on oil and its product**

One of the other basic approaches to decrease impressionability of economy from oil price and set up the economic growth is reduction of dependence of budget on oil and its products which it appears that this policy in a country like Iran whose economic structure is based on this product is not feasible in short term, but this policy can be effective in long term.

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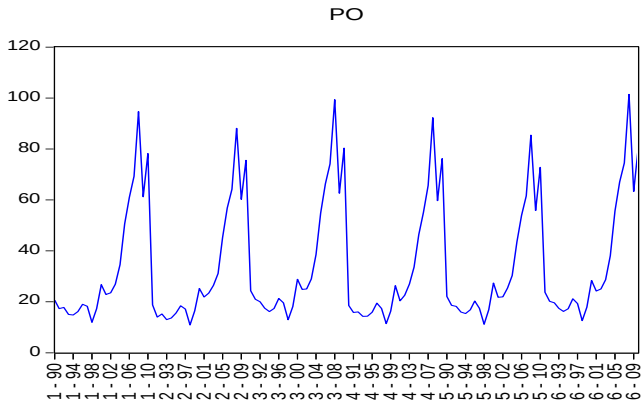
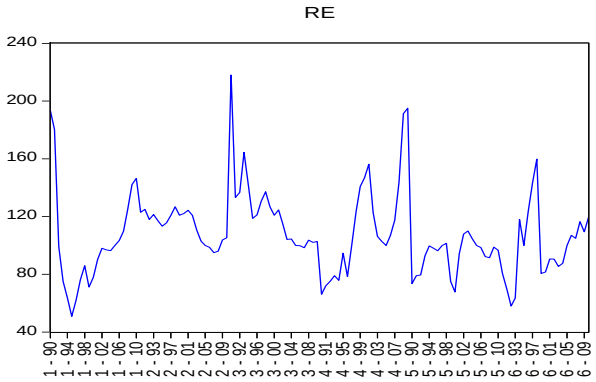
Appendix



The Trends of Oil Price



The Trends of Real Exchange Rate