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The Impacts of Oil Price and Selected Macroeconomic Variables on Consumer Price Index in IRAN (1971-2010)

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Abstract
This study investigates the impact of oil price fluctuations and selected macroeconomic variables on the consumer price index of the Iranian economy. Time series data are used for the period 1971 to 2010. This study applied the Johansen-Juselius cointegration procedure, the FMOLS estimation technique, the Granger causality tests based on the VECM, and carried out analysis for detecting any multicollinearity problem among the regressors. The variables in the model are cointegrated, indicating the existence of long-run relationships among them. The oil price seems to have a negative and statistically insignificant relationship with the consumer price index, contrary to some other studies that found a positive relationship between the two variables. The exchange rate coefficient in the model is positive. This study also found positive long-run relationships between the CPI and GDP, money supply, interest rate and sanctions.
Key Words: Macroeconomic variable, oil price, inflation, VAR Model, Iranian economy

1. Introduction

Oil price fluctuation has become one of the most important issues for both oil-importing and oil-exporting countries because of its impact on their macro economy. Oil represents the backbone of industrialization in the oil-importing countries and a major source of revenue in the oil-exporting countries. As such, oil plays an important role in achieving economic growth and development in both oil-exporting and importing countries. Oil price fluctuation can have a significant effect on various macroeconomic variables such as GDP growth, inflation, interest rate, unemployment, real exchange rate, trade balance and foreign direct investment.

The Islamic Republic of Iran is one of the richest countries, not only in the Middle East but also in the world. Iran's economy is largely dependent on oil and is highly susceptible to oil price shocks. It is the second largest oil producer in the Organization of the Petroleum Exporting Countries (OPEC) and its oil and gas reserves rank among the world's largest. It is also one of the major oil-exporting countries in the world and an important member of OPEC (Bradley et al., 1995).

During the last four decades, Iran has witnessed a rapid increase in inflation. The Iranian government's official estimate of inflation was 11.7% in 2006. The IMF estimated that inflation reached 17.2% in 2007 and is projected to surpass 20% in 2008. High inflation is widespread among the oil-exporting countries in the Middle East and Central Asia, where inflation averaged an estimated 10% in 2007. Among the oil exporters, Iran's inflation level was second only to Iraq (30.8%) in 2007. Because of inflation, Iran's currency, the Rial, has depreciated in real terms against the U.S. dollar (CRS Report for Congress 2008).

Iran is witnessing a high increase in its inflation rate which has a negative effect on its GDP growth, employment, domestic investment, trade and other macroeconomic variables. Basically, a high inflation rate can have a negative effect on Iran's economic development. In addition, Iran is a major oil exporter and most of its revenues come from oil. Thus, fluctuations in the oil price may have huge impact on the Iran macro economy, especially inflation. Despite the large number of studies that have investigated the factors affecting inflation there are only a few studies that have investigated on Iran.

The main purpose of this study is to find out the major factors that have caused the high inflation rate in Iran and to make recommendations to help Iran reduce its high inflation. Thus the impact of oil price on the inflation rate in Iran will be investigated. In particular, this study will examine the impact of the money supply, nominal exchange rate, GDP growth, interest rate and sanctions imposed by the United Nations and the U.S. government on the consumer price index and inflation rate in Iran. For this purpose an empirically testable model of the consumer price index will be developed.

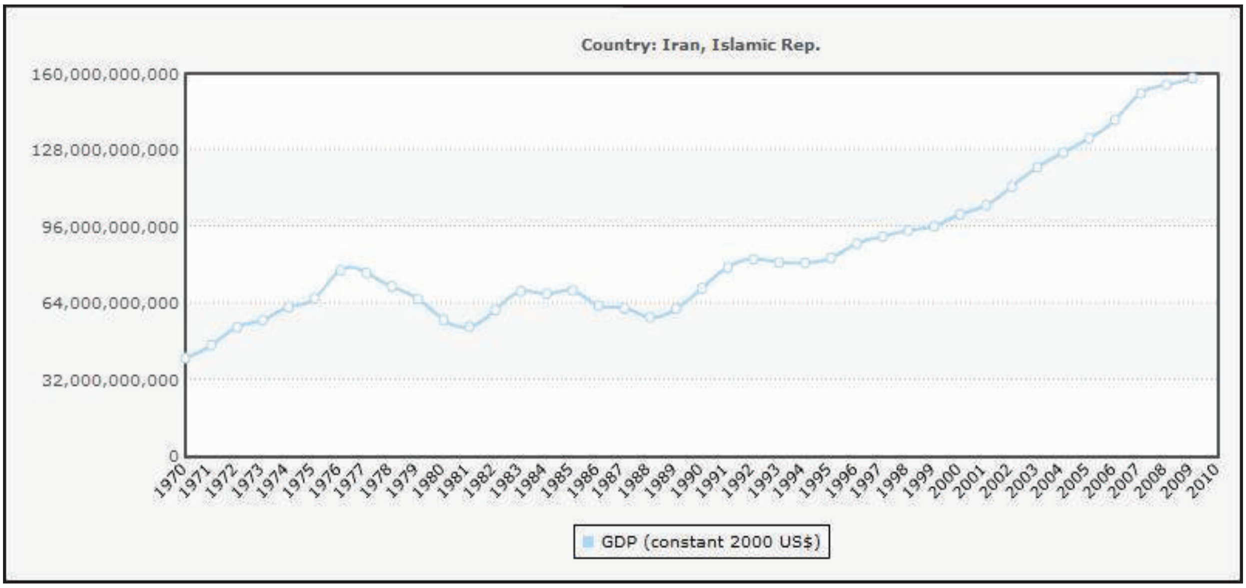
The rest of this paper proceeds as follows: section 2 is introduces history of GDP fluctuations and its influence in Iran. Section 3 presents some literature in previous researcher about oil price and some selected macroeconomic variables in different countries. Section 4, presents some explanation about factors affecting price level, section 5 present the theoretical model of the paper. Section 6 focuses on collection data, period, and methodology used in this paper. Section 7 presents empirical results and discussion and finally, section 8, provide a summary and conclusion.

2. GDP fluctuations in Iran

Iran's economy is very unstable due to fluctuations in oil prices. The major part of its income and gross domestic product are related to oil prices, before and also after the Iranian revolution. By 1997, oil revenue had reached US$20 billion per year (79 percent of total government revenue). Due to the high dependence on oil revenues, oil price fluctuations have strong impacts on the Iranian economy. Economic growth in the 1970s was largely dependent on oil revenue.

The GDP increased from US$41,224 million in 1970 to US$158,089 million in 2010 as shown in Figure 1. Before the Iranian revolution, the Iranian economy had recorded sustained growth from 1970 to 1978. As Figure 1 shows, the Iranian economy experienced increase in its GDP after the Iranian revolution in 1979.

Figure 1 Gross Domestic Product of Iran, 1970 - 2010



Source: World Bank data

The idea that there is a relationship between oil price and the exchange rate has been around for some time. We know that the majority of oil trade is conducted in US dollars. International trade is mostly conducted in US dollars. So any changes of the US dollar can affect other currencies. It is so important for economists to know how oil price movement can affect exchange rates. A change in the nominal exchange rate may not give a complete picture of how much a country's international competitiveness is changing. For example, if the rate of nominal currency depreciation is less than the rate at which the price level is raising relative to that another country, the country's international competitiveness could be declining despite the depreciation of the nominal exchange rate. The concept of the real exchange rate is used to cope with this type of the problem. The real exchange rate is the nominal exchange rate weighted by the relative price levels (various measures of the latter may be used, including relative wage levels). Thus, if inflation is rising faster in the home country, the nominal exchange rate will have to rise just to stabilize the real exchange rate (Hallwood and Donald, 2000).

3. Literature Review

The idea that rising oil prices and oil price volatility serve to stifle economic activity and reduce assets values have by now become widely accepted in the literature and seems virtually axiomatic. For example, Yang, Hwang and Huang (2002) states that "Higher oil prices yield subsequent recessions in oil consuming nations, as oil prices are negatively correlated with economic activities". The negative relationship between oil prices and asset values suggests that the financial risk of oil price fluctuations should be observable.

Considerable empirical research finds that oil price shocks have affected output and inflation and have been an important source of economic fluctuations (e.g., Hamilton (1983, 1988, 1996, 2000); Hooker (1996, 1999, 2002); and Mork (1989, 1994)).Hamilton (1983) stated that the correlation between oil prices and economic output was not an economic historical coincidence for the 1948-72 periods. Increasing oil price was followed 3-4 quarters later by slower output growth with a recovery beginning after 6-7 quarters. These results also apply to the period 1973-1980. The negative effect is more distinct in inflationary times. This means that, nominal oil price increase could be expected to lead to a minor output effect during inflationary times than noninflationary times. In general, Hamilton's results have been confirmed by several subsequent studies.

Gisser and Goodwin (1986) indicated, for the analyzed period from 1961 to 1982, that the oil price had not lost its potential to predict GNP growth. Moreover, they presented two interesting results concerning the relationship between oil price change and macroeconomic variables. First, they showed that monetary and fiscal policy measures alone cannot explain the effect of oil price shocks on the macro-economy after oil market disruptions. Thus, oil shocks also have an impact on economic output through cost-push effects. Second, oil price effects on the U.S did not change after 1973 when the OPEC period began.

According to Hamilton's (2003) calculations with data from 1949 to 1980, a 10% increase in oil prices will result four quarters later in a 1.4% lower GDP growth than it would actually be. Regarding Hamilton's analysis, more data was added in further investigations until 1989 including the oil price collapse in 1996.

Instead of using the producer price index (PPI) for crude oil, which merely reflects controlled prices of domestically produced oil, Mork (1989) operated with the refiner acquisition cost (RAC) for domestic and imported crude oil since 1974. The study verified Hamilton's result as to a negative correlation between output growth and oil price increase. The correlation is even stronger than expected. A supposedly linear relationship between oil price changes and economic growth would imply a stimulation of economic growth by an oil price decline. However, in the 1980s, economic growth was slowed down by oil price changes although oil price declines occurred as well. Thus Mork (1989) examined possible asymmetric effects of oil market. Mork (1989) examined the asymmetric response to oil changes by decomposing oil price changes in to real price increases and decreases. The analysis showed for the U.S economy that "the correlation with price decreases is significantly different and perhaps zero."

In order to explain the so-called "asymmetric puzzle", the asymmetric mechanism between the influence of oil price changes and economic activity, Ferderer (1996) focused on three possible ways: counter inflationary monetary policy, sectoral shocks, and uncertainty Originally, otherwise, three other models were also supposed to have the potential to explain the oil price macro economy relationship, but were excluded due to the fact that they presume a symmetric relationship between oil price changes and output growth. These are: the real balance model (suppose that oil price increases would lead to inflation which lowers the quantity of the real balances in the system), the income transfer model (describing income transfer between oil exporting and oil importing countries) and finally the potential output model (suggesting oil and capital are complements, so that an increasing oil price decreases the economy's productive capacity).

Ferderer (1996) found a significant relationship between oil price increases and counter inflationary policy responses. Nevertheless, the analysis shows that oil price increase helps predict output growth irrespective of monetary policy variables. In addition, Ferderer showed that monetary policy, in response to decreases in real oil prices, closely resembles those for oil price increases. Therefore, asymmetric monetary policy responses can only explain a part of the asymmetric oil price-output relationship. He suggests that sectoral shocks and uncertainty channels could account for part of the asymmetry effects but this would need additional research.

Moreover, Chaudhuri (2000) showed another important relationship between oil prices and real prices of primary commodities. The analysis indicated that the non-stationary behavior of real commodity prices is due to the non-stationary behavior of real oil prices. Of course, this impact varies depending on the commodities. This is also the case even if oil is not being used directly in the production of commodities. Changes in the oil price may affect the prices of primary commodities through the impact of price changes on real exchange rates.

Gounder et. al (2007) showed a direct connection between the net oil price shocks and New Zealand's economic growth, as well as indirect linkages. Schmidt (2007) showed that oil price shocks have relatively small effects on the real economic activity and inflation in Germany compared to the experiences of the seventies and early eighties. They showed that oil price shocks are more closely related to global economic activity since the early nineties. The small effects of the recent oil price shocks (2003 - 2006) on the German economy can be explained by a combination of reduced energy cost share and good luck in terms of a strong growing global economy.

Hooker (2002) provides formal evidence of the change in the relationship between oil prices and inflation for the period 1962-2000. Statistical tests find a break at the end of 1980. Thus, he investigated two sub-periods, namely, the period from 1962 to 1980 and the period from 1981 to 2000, and found that oil prices have a significant impact on inflation in the earlier period, but not in the later period.

In addition, Roger (2010) analyzes the short-term and long-term quantitative impact for a permanent oil price increase for output and inflation in the European region. The results showed that there is no severe inflation risk, but there is a short-run trade-off between inflation and output, i.e. the oil prices at least play an important role in the short run for the European region.

Furthermore, Cunado and Perez (2003) studied the impact of oil price shocks on both economic activity and consumer price indices for six Asian countries. The evidence suggests that oil prices have significant effects on both economic activity and the consumer price indices. We summarize their results as follow; First, they obtained different results depending on whether their using on world real oil price (expressed in USD) or a local real oil price for each of the countries measured in the domestic currency (or local currency). In fact, the impact is higher when oil prices are measured in local currency, which could be due to the role of exchange rates or national price variations on macroeconomic variables. Second, there is no cointegrating long-run relationship between oil prices and economic activity, which suggests that the impact of oil price shocks on these variables (economic activities and CPI) is limited to the short run. They found no evidence of a long-run relationship between these variables. Third, and as far as the inflation rates are concerned, they found that oil price shocks expressed in local currencies have a significant effect on inflation in all analyzed countries. As mentioned before, the oil prices–consumer prices relationship appears to be limited to the short run and it is more significant when oil price shocks are defined in local currencies.

Jacquinot et al. (2009) explored the link between oil price and inflation in the euro area, and focus on its impact on inflation in the short and medium run. The results showed that changes in oil prices are of vital importance for the understanding of inflation in the short run, but that their impact on inflation is much more complex and depends on the initial shock for the long run. Castillo et al. (2005) also analyzed the relationship between average inflation and oil price volatility, and they found that higher oil volatility induces higher levels of average inflation. Their model showed that the average inflation rate will rise due to increasing the volatility of the oil prices.

The Iranian economy is much more vulnerable to the negative shocks of oil prices. Farzanegan and Markwardt (2009) found that the real effective exchange rate falls significantly (domestic currency depreciates) until the end of the period. This is a warning sign of a potential currency crisis after negative price shocks in oil markets. This depreciation increases the price of imports, and despite the traditional approach, which welcomes this event because of improving non-oil exports. Their analysis for the case of Iran shows the opposite effects. The real output, which depends heavily on imported raw and intermediary materials, will be forced to downsize. Inflationary effects are much more pronounced during negative shocks. This is mainly because of increased import prices and the mechanism of financing budget deficits in Iran. Government expenditures initially fall significantly but increase beyond the base line after five quarters of initial shock. This demonstrates the sticky structure of government expenditures in Iran. The reduction of government expenditures following negative oil shocks cannot be permanent.

4. Model

Based on the literature review in chapter three, we have created a multivariate time series regression model to examine the determinants of the price level in the Iranian economy, which is shown in equation (1) below. The model in this study has seven variables: the consumer price index (CPI) is the dependent variable, while the oil price (OP), nominal exchange rate (NER), money supply (MS), gross domestic product (GDP), interest rate (IR) and the economic sanctions imposed by the United States and the United Nations and are the independent variables. All the variables are in the logarithmic form except for IR and sanction. The econometric model is presented as follows:

$$LCPI = \alpha + \beta_1 LOP + \beta_2 LMS + \beta_3 LNER + \beta_4 LGDP + \beta_5 IR + \beta_6 SANCTION + \varepsilon_t \qquad (1)$$

where

α = the intercept

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ = the slope coefficients of the model

LCPI = log of the consumer price index in Iran (1995 = 100)

LOP = log of the oil price (Iranian rials per barrel)

LMS = log of the money supply (M2) (billions of Iranian rials)

LNER = log of the nominal exchange rate (Iranian rial per U.S dollar)

LGDP = log of the gross domestic product (billions of Iranian rials)

IR = interest rate (%)

SANCTION = sanctions imposed by the United States and the United Nations on Iran with SANCTION = 1 for the years 2003 – 2010, and 0 otherwise.

ε_t = random error term

5. Methodology

The methodology that we will be using for this study includes the Johansen multivariate maximum likelihood estimation procedure and the fully modified OLS cointegration test to determine any long run impact of the independent variables on the CPI. Before running the Johansen cointegration procedure, we need to examine the order of integration of the variables first using the Augmented Dickey-Fuller test so as to avoid the spurious regression problem. The Johansen procedure requires that all the variables must be I(1). After having established cointegration via the Johansen cointegration test, we will then use the Fully Modified OLS to obtain a single cointegrating equation normalized with respect to the CPI. We will then proceed with estimation of the Vector Error Correction Model (VECM) to determine the short run Granger causality between the variables. If the variables are not cointegrated, the Granger causality tests will be based on the Vector Autoregression (VAR) model instead of the VECM.

6. Data Sources

The research is concerned with the relationship between selected macroeconomic variables (oil price, the nominal exchange rate of the Iranian rial against the U.S. dollar, money supply, gross domestic product, interest rate) and sanctions imposed by the United States and United Nations (as dummy variable) with the consumer price level in Iran. The period covered in this research is from 1971 to 2010 (40 years), and is based on annual data. The data source for the oil price is from the Organization of the Petroleum Exporting Countries (www.OPEC.com). The data source for the consumer price index, the money supply, nominal exchange rate, gross domestic product and interest rate is from the World Bank database (www.databank.worldbank.org).

The main objective in this study is to examine the impact of oil price on the consumer price index in the Iranian economy. Besides the oil price we have tested the effects of some other variables on the consumer price index, such as the money supply, nominal exchange rate of the Iranian rial against the US dollar, interest rate, GDP and economic sanctions. In this chapter we will present some of the important results of our analysis, namely, how the consumer price level in Iran responds to changes in these variables.

7. Empirical Results

The first step in any time series analysis is to determine the order of integration of the variables. So the first stage of the analysis entails the testing of all the variables in the model to see if they are stationary at the levels. To test for unit roots, the Augmented Dickey-Fuller unit root test is used. If the series is not stationary in the level form, the ADF test is performed on the first differenced series.

7.1 The Augmented Dickey-Fuller (ADF) Unit Root Test Results

Table 1 summarizes the results of the ADF unit root test for each variable in our model. As we can see in table 1, the first test equation has only the intercept while for the second test equation we have included the intercept and trend. The results are not significant for the test equation with intercept and also with intercept and trend for all of the variables at levels. This means that none of the variables is stationary at levels. However, all the variables became stationary after first differencing at least at the 5% level of significance. This means that all the variables are integrated of order 1, that is $I(1)$.

7.2 Johansen-Juselius and Fully Modified OLS Multivariate Cointegration Test Results

Cointegration analysis was first introduced by Engle and Granger (1987) in the 1980s, with improvements made in subsequent years. Cointegration is the underlying methodology used in this study to analyze the long run relationship between the CPI in Iran and the specified macroeconomic variables. It allows us to identify the long-run co-movements between the macroeconomic variables if cointegration exists, as well as the short-run behavior of the $I(1)$ variables. The existence of cointegration implies that there is some mechanism that drives the variables to their long-run equilibrium relationship. This mechanism is modeled by an error-correction mechanism, in which the equilibrium error also drives the short-run dynamics of the variables. If we find cointegration between the variables, we can then run the VECM in order to model both the long run relationship and the short-run dynamics. On the other hand, if the variables are found to be not cointegrated, there is no long run relationship among the variables and we will then model the short-run relationships based on the VAR.

To examine whether the time series variables in our model are cointegrated using the Johansen-Juselius procedure, the time series in its level form should be non-stationary and integrated of order 1, written as $I(1)$. Integrated of order 1 means the series becomes stationary after differencing it once. The variables are said to be cointegrated if they are $I(1)$ and a linear combination of them is stationary (Maggiora and Skerman, 2009).

In this section, we have found that all of the variables are stationary in the first difference ($I(1)$) for the test equation with intercept only and for the test equation with intercept and trend. As explained earlier, after having determined that the variables are integrated of order one, we can then run the Johansen test in order to determine whether there exists any long-run equilibrium relationship between the variables in the model. If we find any cointegration among the variables, we can then say that these variables have a long run equilibrium relationship.

The cointegration test is sensitive to the lag length of the VAR. Therefore, before conducting the cointegration test, we need to run the VAR model first in order to determine the optimal lag length. The optimal lag length selection from EViews as given in Table 2 below is 4 lags based on the AIC, LR, FPE, SC and HQ criteria. However, due to the limited number of observations, we are forced to limit the maximum lag to 3 in the lag length selection process. So, the 3 lags are chosen for the cointegration test.

The Johansen cointegration test has two types of test statistics, one based on the trace statistic and the other based on the maximum eigenvalue statistic. Both are utilized in this study in order to make a decision on whether any long run relationship(s) exist between the variables. Table 3 shows the cointegration test results based on the trace statistic whereas Table 4 shows the cointegration test based on the maximum eigenvalue statistic. As is obvious from these two tables, the results of both the trace test and the maximum eigenvalue test indicate seven cointegration equations among LCPI, LOP, LNER, LMS, LGDP, IR and SANCTION at the 5% level of significance.

After having found 7 cointegration relationships between the variables, namely LCPI, LOP, LNER, LMS, LGDP, IR, and SANCTION, the cointegration equation is normalized on log CPI since the objective of this study is to determine whether a long run relationship exists between LCPI and the other variables. Unfortunately, the Johansen cointegration estimation procedure cannot have both $I(1)$ and $I(0)$ variables in the normalized cointegration equation. Thus the fully modified OLS is utilized as it can correct for the bias arising from the different orders of integration of the variables. Table 5 shows the estimated fully modified OLS equation.

From table 5, the long run log CPI equation can be written as:

$$LCPI = -4.806190 - 0.029192\,LOP + 0.418637\,LNER^{***} + 0.170710\,LMS^{**} + 0.315688\,LGDP^{***} + 0.044682\,IR^{**} + 0.219401\,SANCTION^{**} \quad (2)$$

The estimated fully modified OLS cointegration equation given by equation (2) above shows that the CPI of Iran is positively related to the money supply, nominal exchange rate, GDP, interest rate and sanctions.

The coefficient for the money supply variable (LMS) is positive and statistically significant and indicates that for every one percent increase (fall) in the money supply, the CPI will increase (decrease) by 0.17 percent, ceteris paribus. This means that when the money supply is increased, liquidity will rise in the economy, so people become richer in nominal terms and as their desire to buy goods and services increase, this leads to an increase in the price level of goods and services. Changes in the money supply are often used by the monetary authority of Iran to control for inflationary conditions. When the country is trying to lower the rate of inflation, the central bank reduces the money supply.

From equation (2), the CPI is also positively related to the nominal exchange rate, as expected. It means that when the value of the local currency (Iranian rial) depreciates against the foreign currency (US dollar), the price level in Iran will increase. As world trade progresses, more goods and services are exchanged between countries in different regions. So if the local currency is less valuable relative to another currency, other things remaining equal, the price of imported goods and services will be more expensive in the local currency. The regression result indicates that for every one percent increase in the nominal exchange rate (depreciation of the rial against the U.S. dollar) this will lead to an increase in Iran's price level by 0.41%. This result is expected as the weaker Iranian rial against the US dollar will lead to imported inflation and a higher price level in the Iranian economy.

There is no significant relationship between the oil price and CPI in Iran, contrary to our expectations. The Iranian economy is largely based on oil revenue. Our expectation is that when oil price is increasing, oil revenue receipts increase and government expenditure increases and it leads to more spending of goods and services. So the price level should increase due to higher oil prices. But the results show no significant relationship between the oil price and CPI and the sign of the relationship is also wrong, negative instead of positive.

The main reason for our unexpected result is effects of oil price on US dollar. Because the transmission channel through which oil price and oil revenue shocks affect price level is depreciation of US dollar against Rial currency (rising log NER). With increasing oil price, oil revenue will increase usually. With increasing oil revenues and government expenditure, petro dollars have to be exchanged for the local currency; therefore the central bank should sell them at the domestic exchange market; selling all of them will cause depreciation of foreign exchange rate (US dollar). Otherwise we found much correlation between oil price and nominal exchange rate in the model. It is means that we have multicollinearity problem in the econometrics analysis. The multicollinearity problem leads to the effects of oil price on CPI become insignificant. However with increasing oil price we can found that fall of price level. For every one percent rise in the price of oil, the CPI falls by 0.021%.

Another variable that we tested is the gross domestic product, which is the primary measure of the economy's performance. The GDP includes all goods and services produced by either citizens-supplied or foreign-supplied resources employed within the country (McConnel, 2005). When the GDP increases employment as well as private and public spending will increase. Increases in the price level are often caused by an excess of total spending beyond the economy's capacity to produce. When the GDP rises and the economy is already at the full employment level of income, this development causes the price level to increase due to excess demand beyond the production capacity of the economy. In our estimated model, for every one percent increase in the GDP, the CPI increases by 0.32%.

The interest rate has a positive relationship with the CPI because when the interest rate increases, the cost of borrowing increases and local producers will pass on the higher cost to the consumers. The increase in the price of local goods in turn increases the domestic price level. For every one-percentage point increase in the interest rate, the CPI will increase by 4.5 percent in the Iranian economy.

Based on the FMOLS results, this study found that sanctions have a positive long run effect on Iran's CPI. One of the most pressing problems in Iran today is inflation. Inflation is not a new problem in Iran but has been much aggravated due in part to economic sanctions imposed by the United States and the United Nations in recent years, which have resulted in disrupted supply chains and higher operating costs. The value of the Iranian rial, which had already fallen in value by about half against foreign currencies since last year (2011), has depreciated even more rapidly since the beginning of sanctions in (2003). The sanctions have the effect of raising the CPI by approximately 22 percent compared to a situation of no sanctions. The exact percentage difference in the CPI with economic sanctions as compared with no sanctions is 24.53 percent.

7.3 Results from the Granger Causality Test

In this section, we will examine to the long-run and short-run relationships between variables. After having found the existence of a long run relationship between the consumer price index and the nominal exchange rate, money supply, gross domestic product, interest rate and sanctions. In this section we will discuss the results of the short-run dynamics between the variables based on the Vector Error Correction Model (VECM). First, we ran the Granger causality test with log CPI as the dependent variable and log oil price, log nominal exchange rate, log money supply, log gross domestic product, interest rate and sanctions as the independent variables. The F-test is used to test the joint significance of the right hand side variables on the left hand side variable. A significant F-test result indicates significant short run causal effects, while the significance of the lagged error correction term (ect(-1)) in the VECM shows the long- run causal effect. The results of the Granger causality tests are summarized in six tables.

It is clear from table 6 that log OP, log MS, log NER and IR Granger causes log CPI in the short run. But log GDP and SANC have no causal short-run relationships with log CPI. In addition the coefficient of the ect(-1) term is also insignificant even at the 10% level. It means that there is no long-run Granger causality from log OP, log NER, log MS, log GDP, IR and SANC on log CPI.

Table 6: Granger Causality Results with LOG CPI as the Dependent Variable

	∑DLOG OP	∑DLOG MS	∑DLOG NER	∑DLOG GDP	∑D IR	∑D SANC	Ect(-1)
Fstats.	3.234724*(1)	3.207012*(1)	2.646832*(2)	0.924640(1)	4.09.5167**(1)	0.209282(1)	-1.217419

*Note: ect(-1) represents the error correction term lagged one period. The number in the brackets shows the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) term the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.*

From Table 7, four variables namely log CPI, log NER, log GDP and IR are found to Granger cause log OP in the short run. However, there are no short-run causality from log MS and SANC to log OP. The ect(-1) term is significant at the 5 percent level, which indicates long run causality running from log NER, log MS, log GDP, IR, SANC and log CPI to the oil price.

Table 7: Granger Causality Results with LOG OP as the Dependent Variable

	∑DLOG CPI	∑DLOG MS	∑DLOG NER	∑D LOG GDP	∑DLOG IR	∑D SANC	ect(-1)
Fstats.	4.853166**(1)	0.612927(1)	9.868163***(4)	5.007309**(2)	5.907826**(1)	1.618226(2)	2.834825**

*Note: ect(-1) represents the error correction term lagged one period. The number in the brackets shows the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) term the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.*

In Table 8, the results show that log CPI, log OP and log GDP Granger cause log MS in the short run. However, the other variables have no causal relationship with log MS in the short run. The coefficient of the ect(-1) term is not significant. This means there is no long-run causal relationship from the right hand side variables to log MS.

Table 8 Granger Causality Results with LOG MS as the Dependent Variable

	∑DLOG CPI	∑DLOG OP	∑DLOG NER	∑DLOG GDP	∑D IR	∑D SANC	ect(-1)
F-stats	3.080041*(1)	3.174702**(2)	2.420846(1)	2.614449*(1)	1.940320(1)	0.055248(1)	-0.163553

*Note: ect(-1) represents the error correction term lagged one period. The number in the brackets shows the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) term the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.*

Table 9 below shows that only log OP and log GDP have short-run causal relationships with log NER. The coefficient of ect(-1) term is not significant, thus log CPI, log MS, log GDP, IR and SANC have no long run causal relationship with log NER.

Table 9 Granger Causality Results with NER as the Dependent Variable

	∑DLOG CPI	∑DLOG OP	∑DLOG MS	∑D LOG GDP	∑D IR	∑D SANC	ect(-1)
F-stats	0.257691(1)	2.806108*(1)	0.546467(1)	2.653089*(1)	0.341430(1)	0.107697(1)	1.1440885

*Note: ect(-1) represents the error correction term lagged one period. The number in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) term the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.*

In table 10, it is obvious that log OP, log NER and SANC have short-run causal relationships with log GDP. On the other hand, log CPI, log MS and IR do not Granger cause log GDP in the short run. The coefficient of the ect(-1) term is significant at the 5% level, indicating long run causality from log CPI, log OP, log MS, log NER, log CPI, IR, and SANC to log GDP.

Table 10 Granger Causality Results with log GDP as the Dependent Variable

	∑DLOG CPI	∑DLOG OP	∑DLOG MS	∑D LOG NER	∑D IR	∑D SANC	ect(-1)
Fstats	0.525057(1)	4.028109**(1)	1.634712(1)	3.125264*(1)	1.658245(1)	0.428195*(1)	1.969161**

*Note: ect(-1) represents the error correction term lagged one period. The number in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) term the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.*

Finally, it is clear from Table 11 that log OP, log MS, log NER, log GDP, and SANC have no causal relationship with IR in both the short run and the long run. Only log CPI was significant indicating that log CPI Granger causes IR in the short run.

Table 11 Granger Causality Results with IR as the Dependent Variable

	∑DLOG CPI	∑DLOG OP	∑DLOG MS	∑DLOGNER	∑DLOG GDP	∑D SANC	ect(-1)
F-stats	3.252168*(1)	0.709340(1)	0.732813(1)	0.864221(1)	1.304049(1)	0.106045(1)	-0.031934

*Note: ect(-1) represents the error correction term lagged one period. The number in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) term the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.*

8. Conclusion

In summary, we found six bi-directional and five unidirectional Granger causality relationships between the variables in the short run. However, there is no short run causality between nine pairs of variables. This research shows bi-directional short-run Granger causality or feedback effects between oil price and consumer price index, money supply and consumer price index, interest rate and consumer price index. We also found short-run bidirectional Granger causality between GDP and oil price, nominal exchange rate and oil price, and between GDP and the nominal exchange rate.

However this study found five uni-directional Granger causality in the short run. The gross domestic product and oil prices Granger cause the money supply in the short run. However, the interest rate Granger causes the oil price, the nominal exchange rate Granger causes the CPI, while the sanctions Granger causes the CPI in the short run. There are no short-run causal relationships between sanctions and oil price, nominal exchange rate, money supply and interest rate. The consumer price index and GDP, interest rate and GDP, and interest rate and money supply also do not portray any short-run causal relationships. The nominal exchange rate and the money supply, as well as the nominal exchange rate and the interest rate have no short-run causal relationships.

References

Bradley, M. D. (1995), "Government Spending or Deficit Financing: Which Causes Crowding Out", *Journal of Economics and Business*, August, 203-214.

Castillo, P. and Carlos, M. (2005), "Non-homothetic preferences and the asymmetric effects of monetary policy", *mimeo, LSE and Banco Central de Reserva del Perú*.

CRS Report for Congress, 2008. Iran: U.S. Concerns and Policy Responces.

Chaudhuri, K. (2000), Long Run Prices of Primary Commodities and Oil Prices, Working Papers, The University of Sydney.

Cuñado, J. & Pérez, F. (2003). Do Oil Price Shocks Matter? Evidence for Some European Countries. *Energy Economics, 25*(2), 137-154.

Farzanegan, M. R., & Markwardt, G. (2009). The Effects of Oil Price Shocks on the Iranian Economy. *Energy Economics, 31*(1), 134-151.

Ferderer, J. P. (1996), Oil Price Volatility and the Macroeconomy, *Journal of Macroeconomics,* (18), 1-26.

Gisser, M. & Goodwin, T.H. (1986), Crude oil and the macroeconomy: Tests of some popular notions. *J. Money Credit Banking* 18 1, pp. 95-103.

Gounder, R and Bartleet M. (2007): "Oil Price Shocks and Economic Growth: Evidence for New Zealand, 1989-2006" *Paper Presented at New Zealand Association of Economist Annual Conference,* Christchurch, 27th to 29th June, 2007.

Hamilton, J. D. (1983). Oil and the Macroeconomy Since World War II. *The Journal of Political Economy*, 228-248.

Hamilton, J. D. (2003). What is an Oil Shock? *Journal of econometrics, 113*(2), 363-398.

Hamilton, J. D. (2009). Causes and Consequences of the Oil Shock of 2007-08: National Bureau of Economic Research.

Hamilton, J. D. (2011). Historical Oil Shocks: National Bureau of Economic Research.

Hallwood, C. P., & Donald, R., (2000), "International Money and Finance," Blackwell Publishers, Malden MA.

Hooker, M. A. (1996). What Happened to the Oil Price-Macroeconomy Relationship? *Journal of Monetary Economics, 38*(2), 195-213.

Hooker, M. A. (2002). Are Oil Shocks Inflationary?: Asymmetric and Nonlinear Specifications Versus Changes in Regime. *Journal of Money, Credit, and Banking, 34*(2), 540-561.

Jacquinot P., Kuismanen M., Mestre R., and Spitzer M., (2009). An Assess-ment of the In°ationary Impact of Oil Shocks in the Euro Area. *The Energy Journal, International Association for Energy Economics*, vol. 30(1), pages 49-84.

Maggiora. D, Skerman. R. (2009) 'Applied Econometrics'. pp.156

McConnell, B. (2005), 'Economics'. pp.178

Mork, K. (1989), Oil and the Macroeconomy, When Prices Go Up and Down: An Extension of Hamilton's Results, *Journal of Political Economy*, vol. 97, No. 51

Mork, K., Olsen, O., & Mysen, H. T. (1994). Macroeconomic Responses to Oil Price Increases and Decreases in seven OECD countries. *The Energy Journal, 15*(4), 19-36.

Roger, S. (2010). Inflation Targeting at Twenties: Achievements and Challenges, Twenty Years of Inflation Targeting: Lessons Learned and Future Prospects. Cambridge, UK: *Cambridge University Press*, pp. 25-56.

Sargent, T. J., & Wallace, N. (1985). Some Unpleasant Monetarist Arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review, 5*(3), 1-17.

Schmidt, T. & Zimmermann, T. (2007) Why Are the Effects of Recent Oil Price Shocks so Small? *Ruhr Economic Paper.*

Yang, C.W.; Hwang, M.J. and Huang, B.N. (2002), An analysis of factors affecting price volatility of the US oil market, *Energy Economics* 24, 107-119.

APPENDIX: Tables

Table 1 Augmented Dickey-Fuller Unit Root Test Results

Variables	Level		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
LCPI	-0.164556	-2.032840	-4.254212***	-4.140798**
LOP	-1.185975	-2.117136	-6.013802***	-6.206817***
LNER	-1.412149	-1.264989	-3.625630***	-3.782989**
LMS	-1.319867	-3.091074	-5.192174***	-3.283353***
LGDP	-0.152440	-1.857271	-2.944386*	-2.853705**
IR	-0.141884	-1.871058	-6.200306***	-6.256379***

Note: *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 2 Selection of the Optimal Lag Length

VAR Lag Order Selection Criteria
Endogenous variables: LCPI LOP LMS LNER LGDP IR SANCTION
Exogenous variables: C

Sample: 1971 2010
Included observations: 36

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-116.4429	NA	2.24e-06	6.857939	7.165845	6.965407
1	140.9707	400.4212	2.22e-11	-4.720594	-2.257343	-3.860853
2	189.7006	56.85156	3.11e-11	-4.705589	-0.086992	-3.093575
3	261.0638	55.50471	2.48e-11	-5.947989	0.825953	-3.583701
4	593.9946	129.4731*	6.54e-17*	-21.72192*	-12.79264*	-18.60536*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 3 Johansen-Juselius Cointegration Test Results Based on the Trace Statistic

Sample (adjusted): 1975 2010
Included observations: 36 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: LCPI LOP LMS LNER LGDP IR SANCTION
Lags interval (in first differences): 1 to 3
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999935	800.3361	134.6780	0.0001
At most 1 *	0.990453	453.2399	103.8473	0.0000
At most 2 *	0.953492	285.7835	76.97277	0.0000
At most 3 *	0.911760	175.3307	54.07904	0.0000
At most 4 *	0.736484	87.93363	35.19275	0.0000
At most 5 *	0.523265	39.92248	20.26184	0.0000
At most 6 *	0.307996	13.25389	9.164546	0.0080

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4 Johansen-Juselius Cointegration Test Results Based on the Maximum Eigenvalue Statistic

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.999935	347.0962	47.07897	0.0001
At most 1 *	0.990453	167.4564	40.95680	0.0001
At most 2 *	0.953492	110.4528	34.80587	0.0000
At most 3 *	0.911760	87.39708	28.58808	0.0000
At most 4 *	0.736484	48.01115	22.29962	0.0000
At most 5 *	0.523265	26.66859	15.89210	0.0007
At most 6 *	0.307996	13.25389	9.164546	0.0080

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5 The Fully Modified OLS Test Results

Dependent Variable: LCPI
Method: Fully Modified Least Squares (FMOLS)
Sample (adjusted): 1972 2010
Included observations: 39 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOP	-0.029192	0.045816	-0.637164	0.5286
LMS	0.170710	0.072006	2.370761	0.0239
LNER	0.418637	0.059423	7.045060	0.0000
LGDP	0.315688	0.091593	3.446631	0.0016
IR	0.044682	0.021883	2.041838	0.0495
SANCTION	0.219401	0.088718	2.473017	0.0189
C	-4.806190	0.164022	-29.30215	0.0000

R-squared	0.998088	Mean dependent var	3.696805
Adjusted R-squared	0.997730	S.D. dependent var	2.030758
S.E. of regression	0.096758	Sum squared resid	0.299590
Durbin-Watson stat	0.877228	Long-run variance	0.011253