The Effects of Oil Price Shocks on real GDP in Iran

Mohammad Taghi Khosravi Larijani
Department of Management, Islamic Azad University Jouybar branch, Jouybar, Iran
mkhosravilarijani@yahoo.com

Abbas Rezazadeh Karsalari
Department of Management, Islamic Azad University Tafresh branch, Tafresh, Iran
Rezazadeh296@yahoo.com

Mehdi Aghaee
Department of Management, Islamic Azad University Tafresh branch, Tafresh, Iran
mehdi.aghai@yahoo.com

Abstract: *In this paper, the asymmetric effects of oil price shocks on GDP have been investigated by co-integration analysis in Iran economy during the period 1960-2010. We used Hodrick-Prescott filtering to separate positive shocks from negative shocks. The results showed that in long run the negative shocks have stronger effects on output than positive ones that can have damaging repercussions on economic growth. The findings have practical policy implications for decision makers in the area of macroeconomic planning. The use of stabilization and savings funds and diversification of the real sector seems crucial to minimize the harmful effects of oil booms and busts.*

Key words: Lead, Real GDP, Iran economy, asymmetric effects, oil price shocks, Johansen cointegration test

JEL classifications: C13, C22, E31

1. Introduction

Oil production usually accounts for a large share of the GDP of oil-exporting countries and oil price increases directly increase the country's currency value (total oil production increases because the value of oil production increases: the income effect). However, the total effect of oil price shocks on economic performance mostly depends on what the oil producers (mostly governments) do with this additional revenue. High oil prices increase real national income through higher export earnings (Kornonen et al., 2007). As a result, wealth will be transferred from oil-importing countries to oil-exporting countries, leading to greater purchasing power for economic agents of oil-exporting countries (M. Hakan, 2010). Oil price is very instable. Instability is very costly, as economies and budgets adjust asymmetrically. (Mehrara and Oskoui, 2007) Oil price fluctuations are a major source of disturbance for the economies of oil-exporting countries given the relative importance of the oil sector in production and exports and uncertainty in the world oil markets (Mehrara, 2008; Behbudi and et.al, 2010). Oil revenue is the major part of government income and it recently has played an important role in reimbursing government expenditures in Iran. The Iranian economy is heavily dependent on oil revenues, with about 15 percent of nominal GDP originating in the oil sector during the period 2000-2009. Moreover about 50 percent of the government's revenues and 70-75 percent of exports are derived from the oil sector (Mehrara et.al, 2010). Although the topic is the same for oil exporting and importing countries, theoretical model and effecting mechanisms in oil exporting countries are completely different from those in oil importing countries. This paper studies the asymmetric effect of oil price shocks on Iran economic growth during 1960-2010 using Johansen cointegration test. The paper is organized in five sections. Section two discusses the methodology and the mechanisms through which oil price or revenues influence asymmetrically economic activities in oil exporting countries. Section three reviews the empirical literature in brief. Section four presents the econometric model and empirical results. Finally section five concludes.

2. Literature Review

Increases in the level of oil prices have a positive effect on GDP in the short run, but increased volatility in oil prices reduces the short-run growth in real GDP. In contrast, real GDP has a positive short-run impact on the other three endogenous variables with an increase in GDP driving up government revenues, government consumption and investment. Thus, changes in oil prices have an indirect effect on these three variables through their impact on real GDP. In addition, oil prices have a direct dynamic effect on government revenues. An increase in oil prices raises government revenues, but an increase in the variance of oil prices actually reduces government revenues. Finally, investment is positively affected by an increase in oil price volatility. (Anshasy, 2006; Cunado and Fernando, 2004; Farzanegan and Markwardt, 2009; Hui and Kevin, 2005; Keqiang, 2009; Sandrine and Valerie, 2006).

Oil prices have a positive effect on government consumption in the long run. In addition, in the short run, oil prices will have an indirect effect on government consumption, through their direct impact on real GDP. Higher oil prices induce higher growth rates and the latter leads to higher government consumption. Higher variance in oil prices has a negative impact on short-run economic performance. Both real GDP and government revenues are negatively influence by a higher conditional variance in oil prices. This is partially offset by a positive response in investment to a higher conditional variance in oil prices. (Anshasy, 2006; Cunado and Fernando, 2004; Farzanegan and Markwardt, 2009; Hui and Kevin, 2005; Keqiang, 2009; Sandrine and Valerie, 2006). If appreciation of currency hurts the competitiveness of non-energy sectors, appreciated local currency that stems from higher oil revenues may stimulate investment and provide lower-priced imported intermediary products, which may stimulate production. Lastly, higher oil prices will also likely increase the profitability of the energy sector. This provides an opportunity for the investment and business sectors, with increased demand for labor and capital (Hilde, 2008; M. Hakan, 2010).

However a large literature suggests that there is a ‘resource curse’: natural resource-abundant countries tend to grow slower than resource-scarce countries. The literature offers six candidate explanations for the resource curse effect: Dutch disease, governance, conflict, excessive borrowing, inequality, and volatility. (Devlin and Lewin, 2004; Mehrara, 2009; Mehrara and et.al, 2008; Mehrara and Oskui, 2007; Gaskari and et al, 2005).

The oil price volatility can be transmitted to the economy through the large fluctuations in government revenues. The uncertainty about future oil revenues and the variability of such revenues would result in changes in spending. Therefore, the resulting pro-cyclicality of government spending can ultimately lower growth rates. Carefully looking into some of the potential expenditure mechanisms, one can identify the following: (Anshasy, 2006). A positive revenue shock that is perceived as permanent typically leads to higher government spending, especially on non-tradable, creating incentives to shifting resources away from the (non-oil) tradable sector to the non-tradable sector. Such resource movements would lead to higher unemployment, output losses, and ultimately the de-industrialization of the economy; a phenomenon known as the “Dutch disease”. (Anshasy (2006)) In an oil-dependent economy, the variability of the oil rent will, in the absence of countermeasures;

spill over into the real exchange rate. An oil price boom will lead to a real appreciation and a decline in non-oil exports. This is often taken as the main symptom of the Dutch disease, but is not in and of itself a cause of reduced welfare (Mehrara and Oskoui, 2007; Mehrara, 2009; Mehrara and Sarem, 2009). Government budget and expenditures are one of the most important channels through which oil shocks affect aggregate demand, and without devising some mechanisms to stabilize government budgets; oil shocks would have serious effects on government budgets. One of the important reasons for asymmetric effect of positive and negative oil price shock on economic growth is related to the major role of government investments in oil exporting countries and the way it responds to these shocks. When a positive shock occurs, the welfare and consumption expenditure as well as less productive investments rapidly increase. Increase in government expenditures will lead to decrease in quality of spending and economic efficiency, increase in unfinished projects, and rent seeking (Ricardo and Roberto, 2002; Mehrara and Oskoui, 2007; Delavari and et.al, 2008). If a positive shock is perceived as temporary, accumulating the budgetary surpluses in developing economies is politically unpopular and the government will be subject to pressures to increase spending, especially on public projects. Many studies found that most of the large surges in public capital spending during boom times are non-productive and typically have a very low return (Talvi and Vegh, 2000; Anshasy, 2006).

But when a negative shock occurs, long term investments and economic activities shrinks first, due to non-refunding of a major part of a productive spending with useful impacts on growth, and immediate decrease of intermediate and capital imports. Because of, negative oil shocks might be responsible for decrease of economic growth than positive ones (Mehrara and Oskoui, 2007; Delavari and et.al, 2008). A negative shock, on the other hand, typically induces downward adjustments in government expenditures. This adjustment could be very costly. On the one hand, cutting current expenditures is usually unpopular because of its negative social consequences. On the other hand, cutting capital expenditures would disrupt public projects, reducing the productivity of the initial investment and causing high social costs (Anshasy, 2006).

If the government spends more on investment when oil prices rise, then, theoretically, it can increase growth – assuming that the implementation capacity exists and the investments are indeed productive. Governments will also typically increase consumption, such as wages and salaries, and outright subsidies and transfers, as well as expenditures on health and education. This could have permanent impact, in terms of raising public expectations and ratcheting up current and future expenditure commitments limiting the government's ability to amend fiscal policy when revenues decrease. In the smaller exporting countries in particular, government expenditure will constitute a large share of total spending and have a profound influence on aggregate demand (Devlin and Levin, 2004).

The positive development in oil prices, which is resulted in higher levels of government expenditures and income per capita, pushes the effective demand upward. Furthermore, the limited capacity of domestic supply and inefficiencies as well as time lags in response to increased demand may push the general consumer prices upward, fueling inflation (Farzanegan and Markwardt, 2009; Frzanegan, 2011).

When oil revenues fall because of negative oil price shocks, the level of imported raw and capital intermediaries, which is mainly financed through oil revenues, will decrease. Thus, domestic production will decrease. This means a shift of the supply curve to the left. Because of deficit spending through borrowing of the government from the central bank (or recently withdrawals from oil stabilization account), which raise the base money and money supply, the demand curve shifts to the right. A combination of these two shifts in demand and supply curves leads to increased prices and to a reduction of the production level in the economy (Farzanegan and Markwardt, 2009; Frzanegan, 2011). Lower oil rents resulting from an oil price shock cause a temporary shift in the production function, leading to decrease in real output. The decrease in output, ceteris paribus, leads to an excess demand for goods and an increase in the interest rate. This decrease in output and interest rate lead to decrease in the demand for real cash balances, and given a nominal quantity of money, the price level increases. Therefore, we would expect an oil price shock lead to decrease in GDP and increase in price level (Gordon, 1984; Philip and Akintoye, 2006).

In other side some researchers believe that oil revenues could be positive until a certain level. But after this level the effect turns to be negative. During the oil busts, with the low (or negative) growth rate of oil revenues, the oil-dependent economies suffer from under-capacity with their access to capital and intermediate imports restricted, particularly in the presence of capital market imperfections (Ricardo and Roberto, 2002). So, more oil revenues can be a blessing during the busts or moderate booms. But when oil revenues are excessively high, the real exchange rate becomes highly overvalued. So, too much oil revenues exert a negative effect on growth, turning to be a curse (Mehrara, 2009).

3. Empirical Results and Model Estimation

In this section empirical model of asymmetric effects of oil price shocks on production, is specified and estimated. In production growth equation, in addition to positive and negative oil price shocks, the effect of other variables, including investment are considered. In this study, growth equation is specified as follow:

$$\Delta \log y_t = a_0 + \sum_{j=0}^{n} d_j pos_{t-j} + \sum_{j=0}^{n} g_j neg_{t-j} + bX_t + e_t$$

where Δ indicates the first difference, log is natural logarithm, Y_{it} is gross domestic output (without oil), pos is positive oil price shock, neg is negative oil price shock, X is explanatory variables and e is error term. In addition, asymmetry hypothesis implies:

$$H_0 : d_j = g_j \quad j = 1,...n$$

In growth model, various variables are used as control variables in vector X. Some of these variables are: physical investment, human capital, free trade, inflation rate, population, government expenditures, geographical variables, foreign direct investment, exchange rates premium, abundant natural resources, institutions and the quality of macroeconomic policy. In this study, due to the limited sample size, availability of data and diagnostic test, different combinations of variables, such as government expenditures growth, (Δ ln G), Liquidity growth, (Δln M2), inflation rate, (Δ ln P), real money supply growth (Δ lnM2/P), the percentage changes in real exchange rate, (Δ ln EX), investment to GDP ratio (inv/y) or investment growth (Δ ln inv), as control variables in vector X are used. In fact, government expenditures, money balance and inflation variables as the demand side factors and investment ratio as the supply side factor affect the production.

One of the important and considerable factors in this model is estimation method of positive and negative oil price shocks. The methodology of estimation of positive and negative oil price shocks is as follows.

3.1. Positive and Negative oil price Shock

In empirical studies, any unanticipated change is considered as the shock. Researchers used different techniques for differentiation between positive and negative shocks. For example, Mishkin (1982), Cover (1992), Karras (1996) considered the residual of the money supply growth equation (M2) as monetary shocks. In fact, in these studies money growth is divided into anticipated and unanticipated ones, and the residual from the estimated equation of money growth is used as unanticipated monetary shock.

Another method of decomposing positive and negative shocks is using univariate filtering of Hodrick- Prescott (1997). This smoothing filtering is widely used in real business cycle theory to separate the cyclical component of a time series from raw data. Let Xt denote the logarithms of a time series variable. The series Xt is made up of a trend component, denoted $t_{x,t}$ and a cyclical component given an adequately chosen, positive value of a , there is a trend component that will minimize

$$Min\sum_{t=1}^{T}(X_t - t_{x,t})^2 + a\sum_{t-2}^{T-1}[(t_{x,t+1} - t_{x,t}) - (t_{x,t} - t_{x,t-1})]^2$$

The first term of the equation is the sum of the squared deviations which penalizes the cyclical component. The second term is a multiple a of the sum of the squares of the trend component's second differences. This second term penalizes variations in the growth rate of the trend component. The larger the value of a , the higher is the penalty. Hodrick and Prescott advise that, for annual data, a value of a = 100 are reasonable. In this article we use Hodrick Prescott technique (Figure1).

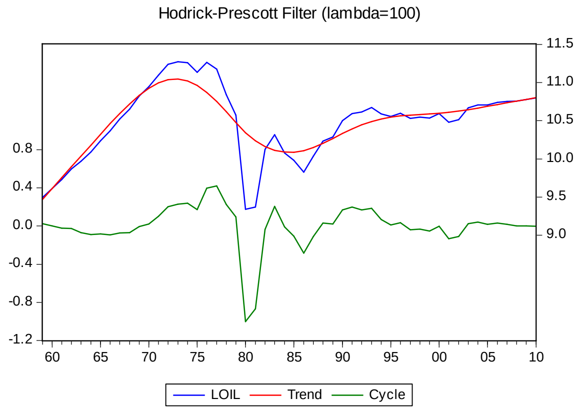

Figure1: Hodrick Prescott (HP) filtering

3.2. Data and unit root tests

Time series data required to this research include non-oil GDP(Y), real oil revenue (OILREV), money supply(M2), aggregate price level(P),exchange rate(EX), government expenditures(G) and fixed capital formation or investment to GDP ratio (INV/GDP). The sources for data are balance sheets of the Central Bank of Iran during the period 1960-2005. The cointegeration analysis is subject to the integration order of time series. The integration orders of variables are examined by Augmented Dickey – Fuller (ADF) and phillips-Perron (PP) unit root tests.

According to ADF and PP tests in Table (1), it can be seen that all variables except the investment to GDP ratio, INV/GDP, are integrated of order one so that when first differenced, all would be stationary.

Table 1: PP and ADF test statistic variables in level and 1st difference

Variable	**ADF test statistic**	**1% Critical Values**	**PP test statistic**	**1% Critical Values**
Dlog y	-4.11***	-3.57	-4.15***	-3.57
Dlog oil	-5.45***	-3.57	-5.05***	-3.57
Dloginv	-4.66***	-3.57	-4.37***	-3.57
Dinv/y	-5.20***	-3.57	-4.95***	-3.57
DlogG	-2.56	-3.57	-4.27***	-3.57
DlogM2	-3.72***	-3.57	-3.71***	-3.57

DlogP	-2.22	-3.57	-2.11	-3.57
DlogM2P	-3.48***	-3.57	-3.38	-3.57
Dlogex	-5.17***	-3.57	-5.31***	-3.57

Notes: *** respectively show the significance in 1% level

3.3. Cointegration test

As the level variables are non-stationary, the cointegration among the levels of the variables should be tested. It is expected that the real oil revenue, investment, and GDP have an equilibrium relationship. If there is long run relationship between these variables, the residuals from the cointegrating relationship will be considered as non-oil GDP imbalance affecting GDP symmetrically or asymmetrically. Therefore, the cointegration among these variables is tested by using the Johansson methodologies. The test results are presented in Table (2). As it can be seen in the table, Johansson test confirms one long run equilibrium relationship between these three variables. According to Granger representation theorem, a long run equilibrium relationship implies error correction mechanisms. The error correction mechanism ensures the long run relationship. Thus at least one variable in the relationship should react to non-oil GDP imbalances or the residuals of long run relationship, namely ECM. In the next section we examine the importance of non-oil GDP imbalances along with other variables on the production growth. Also, these imbalances may affect the production linearly (symmetric) or nonlinearly (asymmetric).

Table 2: Maximal eigenvalue and trace test for cointegration vectors

Variables in long-run relationship: ln(oil), ln(y), ln(i)							
A: cointegrating space							
Maximal eigenvalue test				**Trace test**			
Null	**Alternative**	**LR statistic**	**95% critical value**	**Null**	**Alternative**	**LR statistic**	**95% critical value**
r=0	r=1	35.97	25.82	r=0	r≥1	64.37	42.91
r≤1	r=2	20.76	19.38	r≤1	r≥2	28.40	25.87
r≤2	r=3	7.63	12.51	r≤2	r=3	7.63	12.51
B: cointegrating vector							
		Loil		**ly**		**li**	
ECM		-1		0.06 (3.11)		0.06 (2.71)	

Notes: Trace test and Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level and t-ratios in parentheses.

3.4. Estimating the short run non-oil GDP and asymmetric test

In this section, the effects of positive and negative oil shocks as well as the supply and demand side factors on the production growth in Iran economy will be studied. For this purpose, we estimate various specifications according to the Table (3). The estimates in columns one to eight are based on linear or symmetrical specifications. In other words, in these equations it is assumed that the effects of positive and negative oil shocks on real production are symmetric so that the relationship is linear.

Table3: Estimation of model with different specification

Variable	1	2	3	4	5	6	7
c	0.03 (0.91)	0.00 (-0.01)	0.01 (1.38)	0.03 (3.23)***	0.03 (4.20)***	0.00 (0.28)	0.00 (0.28)

$D(LY(-1))$	-0.04 (-0.33)	0.07 (0.73)	0.05 (0.60)	-0.03 (-0.30)	-	0.01 (0.14)	0.01 (0.13)
$D(LOIL)$	0.06 (2.32)***	0.03 (1.67)*	0.03 (1.62)*	0.03 (1.79)**	0.04 (1.85)**	0.05 (2.38)***	0.05 (2.38)***
$D(LG)$	-	0.13 (2.35)***	0.13 (2.32)***	-	-	-	-
$D(LI)$	-	0.199 (6.59)***	0.20 (6.54)***	0.20 (6.56)***	0.20 (6.49)***	0.21 (6.94)***	0.21 (6.94)***
IY	0.45 (3.71)***	-	-	-	-	-	-
$IY(-1)$	-0.38 (-3.47)***	-	-	-	-	-	-
$D(LEX)$	0.01 (0.23)	0.05 (1.75)*	0.06 (1.99)**	-	-	0.05 (1.45)	0.05 (1.45)
$D(LM2)$	-	0.19 (2.65)***	-	-	-	0.25 (3.37)***	0.25 (3.37)***
$D(LP)$	-	-0.12 (-1.78)*	-	-	-	-0.17 (-2.64)***	-0.17 (-2.64)***
$D(LM2P)$	-	-	0.15 (2.30)***	0.17 (2.89)***	0.15 (2.36)***	-	-
$ECM(-1)$	0.08 (4.45)***	0.03 (1.72)*	0.03 (1.99)**	0.04 (3.05)***	0.04 (3.28)***	0.04 (2.92)***	0.04 (2.93)***
$\overline{R}^2$	0.63	0.83	0.83	0.79	0.76	0.81	0.81
AIC	-3.51	-4.21	-4.22	-4.11	-4.04	-4.13	-4.13
SIC	-3.24	-3.87	-3.91	-3.88	-3.85	-3.82	-3.82
DW	2.08	2.14	2.06	2.08	2.05	2.22	2.22
$ARc^2(2)$	1.08	1.08	1.32	1.31	1.10	2.46	2.46
$RESET$	1.39	3.10	6.03 **	6.25 **	5.54 **	2.18	2.18
HET	7.40	6.12	5.34	5.78	10.93	5.49	5.49
$NORM$	0.68	1.31	1.39	0.29	1.21	1.99	1.99

Notes: t-ratios in parentheses and ***, **and * respectively show the significance in 1%, 5% and 10% levels.

Table3: Estimation of model with different specification (continued)

variable	8	9	10	11	12	13	14	15	16	17	18	19	20
c	0.02 (2.43)***	0.02 (0.74)	0.01 (0.75)	0.02 (2.50)***	0.01 (1.31)	0.01 (1.60)	0.01 (1.38)	0.02 (2.76)***	0.01 (1.45)	0.01 (1.12)	0.01 (1.05)	0.03 (2.60)***	0.01 (0.29)
$D(LY(-1))$	0.23 (2.09)**	0.07 (0.64)	0.03 (0.42)	-0.02 (-0.25)	0.18 (1.57)	0.06 (0.63)	0.03 (0.40)	0.07 (0.85)	0.05 (0.57)	0.03 (0.48)	0.19 (1.62)*	0.05 (0.44)	-0.00 (-0.00)
POS	0.26 (3.16)***	0.20 (2.34)***	0.13 (2.15)**	0.09 (1.43)	0.27 (3.26)***	0.19 (2.62)***	0.14 (2.34)***	0.13 (2.08)**	0.12 (2.53)***	0.09 (2.58)***	0.27 (3.29)***	0.28 (3.01)***	0.25 (2.55)***
$POS(-1)$	-0.26 (-3.00)***	-0.09 (-1.08)	-0.05 (-0.89)	0.03 (0.44)	-0.26 (-3.11)***	-0.10 (-1.24)	-0.06 (-0.90)	-0.05 (-0.78)	-	-	-0.26 (-3.00)***	-0.27 (-3.12)***	-0.27 (-3.12)***
NEG	0.05 (1.49)	0.06 (2.18)**	0.05 (2.63)***	0.05 (2.40)***	0.04 (1.35)	0.06 (2.29)***	0.06 (2.66)***	0.06 (2.48)***	0.07 (2.89)***	0.07 (3.34)***	0.05 (1.50)	0.04 (1.29)	0.05 (1.36)
$NEG(-1)$	0.04 (1.30)	0.03 (1.11)	0.03 (1.36)	-	0.03 (0.96)	0.03 (1.30)	0.03 (1.39)	0.04 (1.71)*	-	-	0.03 (0.84)	-0.07 (-1.10)	-0.07 (-1.16)
$D(LG)$	0.32 (6.33)***	0.22 (4.2)***	0.18 (4.17)***	-	0.25 (4.11)***	0.22 (4.29)***	0.18 (4.22)***	0.24 (6.32)***	0.21 (4.04)***	0.17 (3.98)***	0.26 (3.59)***	-	-

$D(GY)$	-	-	-	0.30 (1.30)	-	-	-	-	-	-	-	-	-
$D(LI)$	-	-	0.20 (6.76)***	0.22 (6.69)***	-	-	0.20 (6.86)***	0.20 (6.37)***	-	0.21 (8.09)***	-	-	-
$D(IY)$	-	-	-	-	-	0.38 (3.89)***	-	-	0.44 (5.04)***	-	-	-	-
IY	-	0.37 (3.38)***	-	-	-	-	-	-	-	-	-	-	0.08 (0.77)
$IY(-1)$	-	-0.40 (-3.67)***	-	-	-	-	-	-	-	-	-	-	-
$D(LEX)$	0.07 (1.68)*	0.09 (2.38)***	0.09 (2.95)***	-	0.08 (1.84)*	0.09 (2.47)***	0.09 (3.07)***	0.07 (2.05)**	0.07 (2.88)***	0.03 (0.73)	0.08 (1.85)**	-	-
$D(LEX(-1))$	-	-	-	-	-0.01 (-0.29)	-	-	-	-	-	-	-	-
$D(LM2)$	-	0.18 (2.19)**	0.15 (2.41)***	-	-	-	-	-	-	-	-	-	-
$D(LP)$	-	-0.19 (-2.22)**	-0.14 (-2.44)***	-	-	-	-	-	-	-	-	-	-
$D(LM2P)$	-	-	-	0.21 (3.80)***	0.15 (1.90)**	0.17 (2.67)***	0.15 (2.80)***	-	0.19 (2.89)***	0.16 (3.01)***	0.15 (1.89)**	0.22 (2.64)***	0.20 (2.21)***
$ECM(-1)$	-	-	-	-	-	-	-	-	-	-	-0.00 (-0.07)	-	-
$ECM1(-1)$	-	-	-	-	-	-	-	-	-	-	-	0.03 (1.09)	0.02 (0.50)
$ECM2(-1)$	-	-	-	-	-	-	-	-	-	-	-	0.07 (1.74)*	0.08 (1.89)**
Asymmetric test statistic	2.36***	1.27	1.14	0.55	2.44***	1.60*	1.25	1.06	0.81	0.63	2.48***	2.23**	1.83*
$\overline{R}^2$	0.70	0.80	0.88	0.82	0.73	0.80	0.88	0.85	0.79	0.88	0.73	0.65	0.65
AIC	-3.69	-3.94	-4.44	-4.15	-3.70	-4.02	-4.48	-4.34	-4.03	-4.50	-3.70	-3.46	-3.44
SIC	-3.38	-3.49	-4.02	-3.84	-3.32	-3.64	-4.10	-3.99	-3.73	-4.19	-3.32	-3.12	-3.06
DW	2.03	2.06	2.26	2.22	2.08	2.04	2.26	2.10	2.15	2.36	2.12	1.96	1.83
$ARc^2(2)$	0.08	0.67	2.98	3.10*	0.44	0.45	2.98	0.79	1.47	4.96**	0.97	0.11	0.61
$RESET$	2.92	9.12***	7.65***	4.56*	4.32*	7.67***	7.77***	6.73***	2.48	3.03	4.19**	4.32*	2.23
HET	3.42	3.57***	3.04***	4.09	6.11	2.50***	3.01**	3.64*	1.45***	2.43**	6.05	13.23*	16.68**
$NORM$	8.53***	8.57***	1.31	0.77	4.33*	6.81***	1.36	0.62	3.17	0.25	4.42*	0.67	0.55

Notes: t-ratios in parentheses and ***, **and * respectively show the significance in 1%, 5% and 10% levels.

In all linear specifications, according toR^2, explanatory variables explain 63 to 83 percent of real non-oil GDP changes. The coefficients for the investment growth, Δloginv, in all the specifications are significant and of the expected sign (positive). Show that, the investment enter positive and significant in the real non-oil GDP growth equations with the size of coefficient changing between 0.19 to 0.21. Using the investment to GDP ratio instead of the, Δloginv, renders the similar results. The investment to output ratio (INV/GDP) also raise the economic growth rate significantly by 0.45, but the effect will decrease fairly in the next period. Real oil revenue in symmetry specification increases the GDP by coefficient of 0.03 to 0.06. Thus the results show the positive relation between real oil revenue and investment with GDP. The government expenditure enters positive and significant in the real non-oil GDP growth equations with the size of coefficient 0.13, the exchange rate enter positive and significant in the real non-oil GDP growth equations with the size of coefficient changing between 0.05 to 0.06, the Liquidity enter positive and significant in the real non-oil GDP growth equations with the size of coefficient changing between 0.19 to 0.25, the inflation enter negative and significant in the real non-oil GDP growth equations with the size of coefficient changing between -0.12 to -0.17, the real money supply enter positive and significant in the real non-oil GDP growth equations with the size of coefficient changing between 0.15 to 0.17. Error correction coefficient $ecm(-1)$ reflects the adjustment speed of output with respect to the oil revenue disequilibrium. Considering the size of coefficient of error correction term (estimated between0.03 to 0.08) it can be concluded that non-oil GDP responds significantly to its disequilibrium ($ecm(-1)$). Among the linear specifications, the third one outperforms the others based on the R2, Akaike (AIC) and Schwartz (SIC) information criteria.

Diagnostic test results are presented at the bottom of the Table (3) for each specification. c^2 AR (2) stand for the Lagrange multiplier test statistic for autocorrelation in error terms (with two lags), RESET is Ramsey's RESET test statistic for functional form misspecification based on the squares of fitted values, NORM is test statistic of normality of residuals based on the skewness and kurtosis and HET is Heteroscedasticity test statistic. As it can be seen, the obtained results are generally satisfactory.

The first to seventh specifications reflect the symmetric effects of positive and negative oil shocks on production. But if oil effects are asymmetric, the results of these models may be misleading. As it was explained in previous section, to examine and test the asymmetric effects of oil shocks on real production, oil revenue changes are divided into positive and negative ones and added as two explanatory variables to the growth model using Hodrick Prescott technique. Specifications 8 to 20 in Table (3) are estimated decomposition of oil shocks to positive (pos) and negative (neg) ones.

As it can be seen by adding positive and negative shocks to the growth equation, the coefficient of determination significantly increases (from65 to 88 percent). In all cases, the negative oil shocks are much more effective than the positive oil shocks contemporaneously according to the size and statistical significance.

Although in most equations positive oil shocks have positive and significant effect on GDP, in the next period (based on the coefficient $pos(-1)$) they have a negative effect on GDP with the same amount. In the other words the positive effect will be neutralized in the next time. Negative oil shocks have negative and significant effect on GDP in most equations (-0.04 to -0.07). The lag of negative oil shocks is not significant (based on the coefficient $neg(-1)$) in any of the equation.

The estimation results from the above mentioned specifications indicate that long-run positive (ecm1) and negative (ecm2) imbalances also have asymmetric effects on economic growth. The size of coefficient of (ecm1), ranging from 0.02 to 0.03 is much less than the coefficient of (ecm2) which is estimated between0.07 to 0.08. In addition, coefficient of (ecm1) is not significant in any equation, while the (ecm2) has important effects on (decreasing) economic growth.

Among asymmetric specifications, equation 17 enjoys the best base on$\overline{R}^2$, Akaike (AIC) and Schwartz (SIC) criteria. In most of the equations, the coefficients of the variables of the investment, are significant and of correct sign.

The estimated growth equation 17 passes through all diagnostic tests (Heteroscedasticity, Ramsey's RESET test, autocorrelation and normality). In addition, the preferred specification is able to explain 88 percent of changes in GDP growth. Thus 12 percent of production changes are yet attributable to factors that are not included in the model. Due to severe structural changes in the sample period (especially Iran-Iraq War and Islamic Revolution) stability of structural coefficients based on the plot of cumulative sum of recursive residuals (CUSUM) and plot of cumulative sum of squares of recursive residuals (CUSUMSQ) have been used. The plot of CUSUM and CUSUMSQ statistics together with the 5% critical lines clearly indicates stability in equation and residual variance during the sample period (Figure 2 and 3).

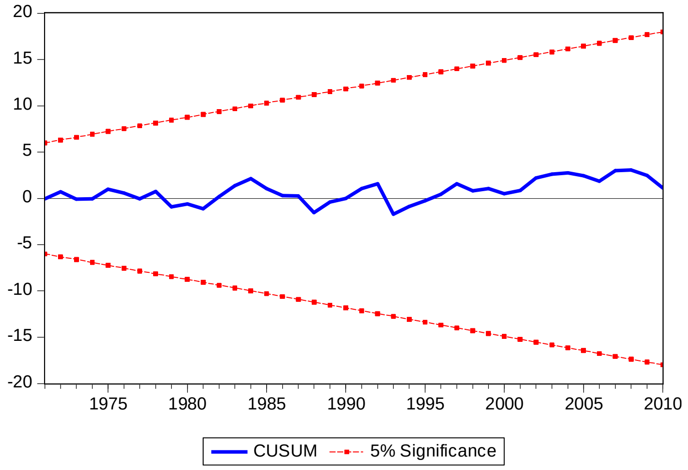

Figure 2: CUSUM test for parameters stability in the growth equation

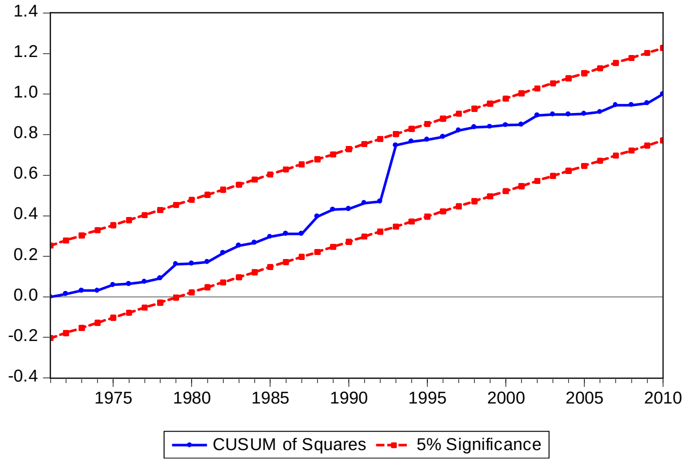

Figure 3: CUSUMSQ test for parameters stability in the growth equation

4. Conclusion

This paper examines the asymmetric effects of oil price shock on Iran economic growth as an oil exporting country for the period of 1980-2010 using Johansen cointegration test. The results from short run estimations indicate that oil shocks have a significant effect on economic growth. But the effects of negative shocks are much stronger than the positive shocks. In other words, the relationship between two variables is asymmetric. It means that production growth responds stronger to the negative shocks than to positive shocks. In addition, the effects of oil revenue on economic growth have opposite signs in long run and short run as being negative and positive respectively. Policy-makers must deploy institutional mechanisms to manage oil booms and busts through expenditure restraint, self-insurance, and diversification of the real sector. To achieve sustainable growth in the future, they must take policy measures that substantially enlarge and diversify their economic base. This should go in tandem with measures needed to enhance their capacity to withstand adverse external shocks and lessen their exposure to the volatility. Moreover, to insulate the economy from oil revenue volatility requires de-linking fiscal expenditures from current revenue. So, an oil revenue fund is one such institutional mechanism for managing the oil revenues. Another way that policy makers could decrease the degree of the asymmetry would be to lower borrowing constraints so that agents could better smooth consumption and so not cut spending as drastically following a negative price shock. Perhaps developing deeper capital markets is one solution.

5. References

[1] Anshasy, A (2006), Oil prices, fiscal policy and economic growth in oil-exporting countries, PhD dissertation, The Faculty of Columbian Collage of Arts and Sciences of The George Washington University.

[2] Cover, J. p. (1992), Asymmetric Effect of Positive and Negative Money- Supply Shocks. Quarterly Journal of Economics, Nov. 1261-1282.

[3] Behbudi, D, Mamipour, S, Karami, A (2010), Natural Resource Abundance, Human Capital And Economic Growth In The Petroleum Exporting Countries, Journal of Economic Development, Volume 35(3).

[4] Delavari. M, Shirinbakhsh. SH, ,Dashtbozorgi Z (2008), "ANALYSING THE IMPACT OF OIL PRICES ON IRAN'S ECONOMIC GROWTH THROUGH USE OF ASYMMETRIC COINTEGRATION", QUARTERLY ENERGY ECONOMICS REVIEW FALL, 5(18):65-80.

[5] Devlin, J. and Lewin, M., 2004. " Managing oil booms and busts in developing countries", draft chapter for: managing volatility and crises. A Practitioner's Guide.

[6] Gordon, Robert J., 1984. "Supply Shocks and Monetary Policy Revisited." American Economic Review, May, 74:2. pp. 38-43.

[7] Hilde C, Bjornland (2008), "Oil Price Shocks and Stock Market Booms in an Oil Exporting Country", Working Paper.

[8] Hodrick R.J. and Prescott E.C. (1997) "Postwar U.S. Business Cycles: An Empirical Investigation" Journal of Money, Credit, and Banking 29 (1):1-16.

[9] Hui Guo and Kevin L. Kliesen, 2005. "Oil Price Volatility and U.S. Macroeconomic Activity", Federal Reserve Bank of St. Louis Review, 87(6), pp. 669-83.

[10] Juncal Cunado and Fernando Perez de Gracia (2004), "Oil Prices, Economic Activity and Inflation: Evidence for Some Asian Countries", Working Paper No.06/04.

[11] Kandil, M. (2000), "The Asymmetric Effects of Exchange Rate Fluctuations: Theory and Evidence from Developing Countries," IMF Working Paper WP/00/184.

[12] Karras, K. (1996a), why are the effects of money – supply shock Asymmetric? Convex Aggregate supply or'' Pushing on a string''?', Journal of Macroeconomics, Vol.18, No.4 pg. 605 619.

[13] Keqiang Hou, 2009. "The Impact of Oil Price Shocks on an Oil-Exporting Economy: A Structural Investigation", Job Market Paper.

[14] Kornonen, L. and T. Juurikkala, 2007. "Equilibrium Exchange Rates In Oil-Dependent Countries.", BOFIT Discussion Papers 8.

[15] Lee, K., Ni, S., and Ratti, R (1995), Oil shocks and the macro economy: the role of price variability, The Energy Journal, Vol.16 (4), pp.39-56.

[16] M. Hakan Berument and Nildag Basak Ceylan and Nukhet Dogan, 2010. "The Impact of Oil Price Shocks on the Economic Growth of Selected MENA1 Countries", The Energy Journal, Vol. 31, No. 1.

[17] Mishkin, F. S.,(1982) "Does Anticipated Aggregate Demand Policy Matter? Further Econometric Results", American Economic Review 72, 788-802.

[18] Mohammad Reza Farzanegan, 2011. “Oil revenue shocks and government spending behavior in Iran”, Energy Economics 33, 1055–1069.

[19] Mohammad Reza Farzanegan and Gunther Markwardt, 2009. “The effects of oil price shocks on the Iranian economy”, Energy Economics 31, 134–151

[20] Mohsen Mehrara, 2008. “The asymmetric relationship between oil revenues and economic activities: The case of oil-exporting countries”, Energy Policy 36, 1164–1168.

[21] Mohsen Mehrara, 2009. “Reconsidering the resource curse in oil-exporting countries”, Energy Policy 37, 1165–1169.

[22] Mohsen Mehrara and Majid Maki and Hossein Tavakolian, 2010. “The relationship between oil revenues and economic growth, using threshold methods (the case of Iran)“, OPEC Energy Review, Vol 34, No 1, pp 1-14.

[23] Mohsen Mehrara and Mehdi Sarem, 2009. “Effects of oil price shocks on industrial production: evidence from some oil-exporting countries”, OPEC Energy Review.

[24] Mohsen Mehrara and Mohsen Alhosseini Seyedmohammadsadegh and Bahramirad, Duman, 2008. “Resource curse and institutional quality in oil countries”, MPRA Paper No. 16456, posted 24.

[25] Philip A. Olomola and Akintoye V. Adejumo, 2006. “Oil Price Shock and Macroeconomic Activities in Nigeria”, International Research Journal of Finance and Economics, Issue 3.

[26] Reihaneh Gaskari and Ali Reza Eghbali and Hamid Reza Hallafi, 2005. “ Oil Export Instability and Economic Growth in Iran“, Iranian Journal of Economic Research, Issue 24.

[27] Ricardo Hausmann and Roberto Rigobon, 2002. “ AN ALTERNATIVE INTERPRETATION OF THE ‘RESOURCE CURSE’: THEORY AND POLICY IMPLICATIONS”, NBER Working Paper No. 9424.

[28] Sandrine Lardic and Valerie Mignon, 2006. “The impact of oil prices on GDP in European countries: An empirical investigation based on asymmetric cointegration”, Energy Policy 34, 3910–3915.

[29] Talvi, E. and Vegh, C., 2000. “Tax Base Variability and Procyclical Fiscal Policy”, NBER Working Paper No. 7499.