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Oil Price Effects on Exchange Rate, Output and Consumer Price: A Case Study of Small Open Economy of Oman

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Sharp fluctuations in global oil prices and their associated impact on global economic imbalances have contributed to the renewed debate among the policy makers regarding the nature and the extent of these fluctuations. This study is designed to investigate the impact of oil prices on the small open economy of Oman. Structural Vector Auto Regressive (SVAR) model has been adopted to trace the dynamic inter-relationships among the key macroeconomic variables. Evidence suggests that changes in crude oil prices significantly affect output, external balances and the monetary and fiscal variables. The external shocks induced by positive changes in global oil prices likely affect the demand management policies in the short and long-run. In the long-run, changes in oil prices determine the output and subsequent fiscal and monetary policy changes, while in the short-run, fluctuations are contained well through demand management policies. Continuation of expansionary fiscal and monetary policies may likely contain the effects of imported inflation. However, in the long run, over reliance on expansionary policies may less likely to be a feasible option.

1. Introduction

Oil price shocks have significantly shifted the wealth of nations; induce huge windfalls and external imbalances for both oil importing and exporting countries (see, for example, Coudert et. al., 2008). The impact of shocks and their associated effects on output, consumer prices and on external balances have been recognized by a number of scholars (Schneider, 2004; Setser, 2007; Roubini and Setser, 2004; Allsopp, 2006, among others).

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Theoretically, in fixed exchange rate economies, oil price shocks are transmitted to exchange rates through terms of trade channel. A typical positive oil price shock induces the consumer prices of imported and non-traded goods in domestic economy and appreciates the real exchange rates. Governments in these situations usually anticipate wage-price spiral cycles. The inflationary expectations are being countered by resorting towards expansionary fiscal policy measures, such as, price subsidies and wage adjustments. Increasing inflationary pressure and appreciation in real exchange rate are usually the compelling conditions for turning the real interest rates into negative zone. This complicates the conduct of fiscal and monetary policies. The use of expansionary fiscal or monetary policies in these situations turns to be a riskier option (expansionary fiscal policy at the times when it requires containing the inflationary expectations, expansionary monetary policy may aggravate the prices). A fall in oil prices may have a reverse effect such as loss in government revenues, lower government spending or a situation of disinflation and a rise in real interest rates. A restrictive monetary policy could put the growth objective in danger.

The small oil-based open economy of Oman is an interesting case study in this context. Oman is known as one of the impressive success stories in the Gulf and in the Arab world, despite possessing relatively smaller resources as compared to its neighbours. With a consistent high growth, lower level of inflation and stable external account surpluses, Oman has achieved a significant progress on the economic front. The economic growth primarily is driven by its hydrocarbon sector. Nominal GDP is roughly 80.5 billion of US dollars in 2014. The current account balance (percentage of GDP) is 10.6 percent with a global rank of 15. Table 1 refers to the average trends in the major macroeconomic variables from 2011-2014. Most economic indicators show impressive trends in last few years. Real GDP growth is 4.4 percent on average for last four years. Consumer price index is around 2.25 percent on average. Fiscal balance is 6.2 percent of GDP and current account balance is around 12.7 percent of GDP on average.

Table 1: Oman's Economic Performance since 2011-2014

Variable	Average 2011-14	2011	2012	2013	2014
Real GDP (annual change, percent)	4.4	4.0	5.7	4.8	3.4
Nominal GDP (billions of US dollars)	57.1	67.7	75.4	77.1	80.5
CPI (year average; percent)	4.0	3.2	2.8	0.3	2.7
Broad Money Growth (annual change; percent)	39.3	36.6	37.2	39.7	43.8
Fiscal Balance (percent of GDP)	6.2	9.4	4.6	8.1	3.0
Government Debt (percent of GDP)	6.8	5.6	6.2	7.3	8.1
Current Account Balance (percent of GDP)	12.7	15.8	13.3	11.9	9.9
Nominal effective exchange rate index (end of the period average)*	101.3	96.5	99.5	103.9	105.3

Sources: International Financial Statistics (IFS), World Development Indicators (WDI) and Ministry of National Economy (MONE) Sultanate of Oman. Central Bank of Oman (CBO) Sultanate of Oman
*https://www.quandl.com/#/data/WORLDBANK/OMN_NEER-Oman-Nominal-Effecive-Exchange-Rate http://mecometer.com/whats/oman/gdp-per-capita-ppp/

Figure 1 indicates that trend in real GDP growth is steep during the last three decades. The GDP per capita (PPP) of Oman is US$29,800 with a global rank of 43.

Figure 1: Real Gross Domestic Product of Oman (1980-2010

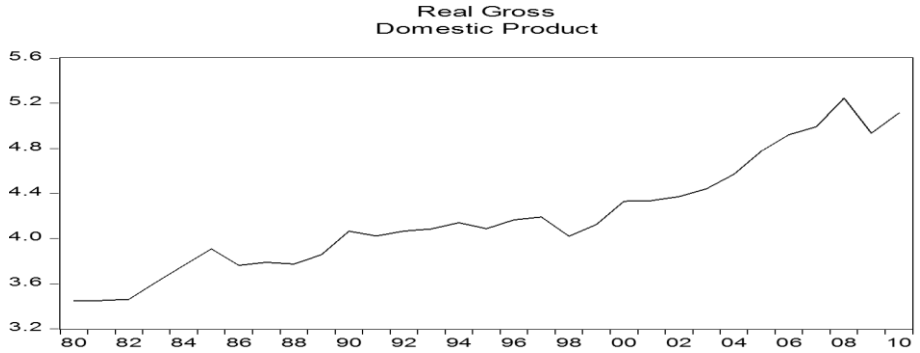
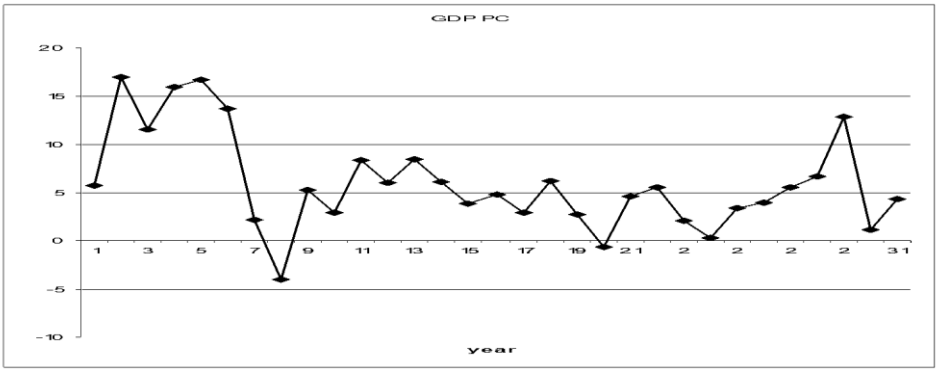


Figure 2 indicates the growth in GDP per capita since 1980. The trend shows that GDP per capita is increasing on average at around 9-10 percent. Oman's exchange rate is pegged with the US dollar and has long been maintained at 0.35 Omani riyal to 1 US $ from 1975 till 1985 and thereafter, at 0.38 riyals to 1 US $ from 1986, and it remains stable since long. The officially declared purpose of the peg is to maintain the price stability in the country, apparently fixed exchange rate regime which is linked to US interest rates[3].

Figure 2: Growth Trend of GDP per Capita since 1980



Year (1980-2010- 31 observations)

However, the global economic trends are changing. In particular, the changes are frequently occurring in the real value of US dollar and real oil prices, which have continuously been affecting the business cycles of both the oil exporting and importing countries as well. In these circumstances, continuation of fixed or pegged exchange rate policy or dollar pegging of Omani riyal has widely been questioned. The continuation of pegging of Omani riyal with dollar may be a suitable policy option to anchor the exchange rate fluctuations in short run, but at least it may be a less feasible option in long run. Since the commodity prices are traded in dollar, it is often noticed when real oil price rises the real value of dollar declines. The oil exporting economies and their dollar pegged currencies are usually appreciated in these situations.

[3] Central Bank of Oman (CBO) has indicated that there are no plans to drop the peg to the US dollar; fiscal policy will remain the main tool to curb inflation (Times of Oman, 16 March 2008).

The divergence and deviations in oil and dollar prices are likely to be persistent in global economic trends in the medium and long run. Therefore, countries with pegged exchange rates, may likely observe fluctuations in their currencies in real terms.

It is, therefore, perceived that short run changes in global real oil prices are likely affecting the domestic economy. These changes have usually been perceived through terms of trade channel. Changes in tradable prices are apparently channelled through real exchange rate appreciation or depreciation, which in turn, affects the real interest rates, government consumption expenditures and the domestic non-tradable consumer prices. It indirectly affects the aggregate demand. If the price shocks remain persistent, Oman economy may likely experience positive terms of trade with exchange rate appreciation. Generally, the oil price shock is assumed to pass-through the channels of real exchange rate, terms trade, commodity prices to fiscal and monetary variables in second round effects.

Consequently, it is very important to investigate the continuation of existing policy options and to understand the impact of oil price shocks on the real exchange rate, output and prices of small open economy of Oman. This investigation aims to examine the relationship of changes in oil prices with domestic economic dynamics of Oman. The study is an attempt to establish the extent of inter-linkages of external and domestic structural variants and their inter relationships in dynamic model.

Rest of the study is organized as follows, section two reviews the relevant literature, section three discusses the methodology, while section four focuses on the model estimation and presentation of results and section five consists of conclusion and policy recommendations.

2. Literature Review

Coudert, Couharde and Mignon (2008) by compiling recent evidences on the link between real effective exchange rate (REER) and commodity terms of trade, establish the long run elasticity between the two, which is

around 0.5 on average[4]. Korhonen and Jurikkala (2007) reveal that the price of oil has a significant and positive effect on real exchange rates for OPEC and three oil producing commonwealth of independent states. Habib and Kalamova (2007) in a study on Russia, Norway, and Saudi Arabia indicate a long run relationship between real oil price and real exchange rate but only for Russia.

Besides the oil price shocks, foreign output shocks also play an important role in business cycle fluctuations in most developing counties. In this context (Mendoza, 1995; Kose, 2002; and Kim et. al., 2005) conclude that most of the business cycle fluctuations in aggregate output are largely explained by external shocks. Hoffmaister and Roldos (1997) and Ahmed and Loungani (1999) conclude that external output and oil price shocks play an important role in business cyclical fluctuations in developing countries. Hahn (2003) results suggest that the size and the speed of the pass through in Euro zone area appear to be robust over the time under different identification schemes. Similar work of McCarthy (2000) indicates that exchange rates have modest effects on domestic price inflation while import prices have stronger effects. Pass-through is larger and has a prominent role in the inflation process in countries with a larger import share and more persistent exchange rates. Bems and Filho (2009) discover strong links between real exchange rates and the terms of trade but with limited explanatory power, while current account variable fits in the data well for oil exporting countries. Authors use the price related methodologies suggested by (Bayoumi, Tamim et. al., 1994; Williamson, 1994; Isard and Faruqee, 1998; Abiad *et. al*., 2009). Bahamani-Oskooee and Kutan (2008) examine the impact of exchange rate devaluation and depreciation on output in context of nine emerging economies of the Eastern Europe. They explain that economies which are relatively small and heavily open depend on export revenues to promote their economic growth, exchange rate devaluations affect their economic growth negatively. Ito and Sato (2006), on East Asian countries after financial crises, suggest that exchange rate depreciation results in higher rates of inflation, especially in Indonesia. These studies establish the channels

[4]The evidences are based on the studies (Amano and Van Norden, 1995; Chen and Rogoff, 2003; MacDonald and Ricci, 2001; Cashin et. al., 2004; Ricci et. al., 2008) .

and pass through links between the global oil price and external shocks with the domestic macroeconomic dynamics of stated economies.

A number of other studies which determine the global oil price shocks related to Middle East and North African (MENA) region countries are also conducted. Hirata, Kim and Kose (2004) recognize a substantial fraction of cyclical fluctuations for MENA region countries. They find that 60 per cent of variation in aggregate output, domestic productivity shocks explain close to 40 per cent of business cycle variation in aggregate output for the region. Spending shocks and world interest rate shocks are important in accounting for the volatility of business cycles in certain macroeconomic variables. Makdisi, Fattah and Limon (2006) suggest that MENA economies are quite vulnerable to exogenous shocks associated with the terms of trade fluctuations, as these economes are heavily dependent on export revenues of their primary products. Shahin and El-Achkar (2010) study the impact of exchange rate policies on price stability in eighteen MENA region countries from 1975-2005. They find exchange rates along with monetary variables such as money growth and lag inflation are the contributing variables to lower inflation[5]. Bhattacharya (2003) study concludes that a lack of evidence to account for the impact of exchange rates on real wage and relative price flexibility and the difficulty in finding the substitute for exchange rates as a nominal anchor. Jbili and Kramarenko (2003) in their analysis clarify those different results that suggest the choice of exchange rates for Lebanon and Jordan. Ghosh, Gulde, Ostry and Wolf (1997) state the relationship between the nature of exchange rate regime inflation and economic growth. The results indicate that inflation is lower and stable under pegged exchange rate arrangements than in floating regimes. Money and output growth are highly significant, whereas the interest rate term is very insignificant. Clarida, Richard, Gali, Jordi, Gertler and Mark (1999) investigate the terms of trade impact on exchange rate for commodity and oil exporters' case and reveal that real exchange rates co-move with commodity prices in the long run and the response to oil

[5] The authors find no significant link between exchange rate regime and inflation of any peg periods for industrialized countries.

prices is somewhat lower than the commodity prices[6]. Coudert, Couharde and Mignon (2008) estimate a long term relationship between real effective exchange rate and economic fundamentals. Their results demonstrate that real exchange rates co-move with commodity prices in the long run and respond to oil prices somewhat less than the commodity prices. Hakro and Omezzine (2010) also measure the global food and oil price shocks and consequent macroeconomic implications for Oman economy. They discover that external oil and food price shocks significantly affect real exchange rate, consumer price index and other macroeconomic variables of Oman economy.

Edward (1989) widely quoted study raises the crucial question about the nature of link between the fluctuation in the exchange rate with the output in short run or long run. By using 12 developing countries data, the study regresses the real GDP on nominal and real exchange rate along with other macroeconomic variables. He finds mixed evidence which indicates that initial contractionary effects could be reversed after some time. Agenor (1991) in a similar study on 24 developing countries reveals surprisingly that real exchange rate depreciation actually boosts output growth while depreciation of real exchange rate has, in fact, a very constructive effect. Morley (1995) on 28 developing countries notes that depreciations in the real exchange rate value at level reduce output over a period of two years. Gala and Lucinda (2006) argue that the productivity differential may have an important role on the impact of real exchange levels on per capita real income growth rates. These results show that 10 percent real exchange rate devaluation given everything else being constant average growth rates could be higher by 0.122 per cent. Rodrik (2008) suggests that undervaluation (a high real exchange rate) estimates result in economic growth. This may be the case particularly in developing countries where tradable goods suffer disproportionately from the distortions that keep poor countries from converging. However, Kamin and Klau (1998) estimate the impact of devaluation on 27 countries and find no evidence of contractionary impact in the long run, contradicting the conventional view that devaluations are expansionary.

[6] Aizenman and Chrichton (2006) evaluate the impact of international reserves, terms of trade shocks and the capital flows on the real exchange rate (REER). The major effect is on the Asian and oil exporting countries.

Apart from the above studies, a large number of other set of studies conducted, support the proposition that exchange rate shocks lead to negative effect on output, Particularly for Latin American countries (for example; Rogers and Wang, 1995; Santaella and Vela, 1996; Copelman and Warner, 1995; and Kamin and Rogers, 2000; Rodriquez and Diaz, 1995). similar results are found for Peru, and in Hoffmaist and Vesh (1996) for Uruguay. There is hardly any study which suggests high depreciation combined with high level of output and high appreciation of exchange rate with high level of depressed output (Kamin and Rogers, 2000).

Most of the studies have used the Vector Auto Regression (VAR) mechanism to find the inter-relationship between exchange rates with output and prices in different countries contexts. Case studies such as Ndung'u (1993, 1997), by estimating a six variable VAR on the data set of Kenya, discover the link between the rate of inflation and exchange rate explaining each other. Montiel (1989) by using VAR model for Argentina, Brazil and Israel observes that exchange rate movements explain inflation. Dornbush et. al. (1990) find that real exchange rate is an important source of inflation in Argentina, Brazil, Peru, and Mexico but not in Bolivia. Inflation seems to be inertial with regard to exchange rate and is being determined through demand shocks. Exchange rate and inflation are also studied in several other countries context (see e.g., Kamin, 1996; Odedokum, 1997; London, 1989; Cannetti and Greene, 1991; Calvo et. al., 1995; Elbadawi, 1990).

The available evidence is quite rich in its content and methodological rigorousness. It addresses and formulates the impact and channels through which the oil price induces the changes in domestic dynamics. To the best of authors' knowledge, hardly any significant attempt has ever been made towards the understanding of these channels in the context of small open economy of Oman. This study fills the gap.

3. Methodology

Structural Vector Auto Regression (SVAR) model is considered a very useful approach to find the link between the oil price shocks and the domestic economy. The SVAR has a number of advantages. It identifies the structural shocks through innovations with identifiable restrictions

and thereafter, generalizes the impact through impulse response functions and variance decompositions, capable to trace out individual shocks and variances on each variable. The study considers the SVAR model initially with 6-7 variables based on theoretical relationship among the set of variables in a VAR system. The choices of variables are based on the procedure adopted to incorporate the vector of endogenous variables used by (McCarthy, 2000; and Hahn, 2003). Supply shocks are identified and derived from changes in global oil prices and through changes in external balances. The demand side effects traced in changes in real output growth, changes in government consumption expenditures. Interest rate, international prices, real effective exchange rate, money supply and interest rate variables are used to allow the effects of monetary policy and fiscal policy responses on inflation and output. Real effective exchange rate is used primarily to avoid bilateral exchange rate vis-à-vis the US dollar. This will give us a leverage to measure the extent to which the country's trade dependence with other countries. The use of this variable shall provide the real currency appreciation or depreciation or a gain or loss in the price competitiveness. It also provides the extent to which the country is facing the inflationary pressure through imports. CPI is used for domestic inflation.

The structural model is identified by imposing zero restrictions on the number of endogenous variables based on the theoretical relationship of the endogenous variables. The changes in oil prices are ordered first because the oil price variable is likely to affect all the other variables in the system. Real output gap is placed second and the interest rate and money supply (M2) is ordered fourth. The use of money supply in place of interest rate turns out to be a better choice. It is more reasonable to measure monetary policy shocks to contemporaneous effects after exchange rate variants or pass through on monetary variables reflected after changes in oil and output variables. The policy reaction function is assumed to flow from the changes in oil prices to GDP gap, subsequently affects the monetary and fiscal variables. Real effective exchange rate variable is placed ahead of government consumption expenditures and domestic prices. This implies that the real effective exchange rate responds contemporaneously to supply and demand management policies of the government towards containing the effects of the shocks.

3.1 The Model

Based on the above interrelationships among the set of variables the vector of economic variables is expressed in a dynamic framework. The framework is expressed on the similar lines expressed by (Vinh and Fujita, 2007; Blanchard and Watson, 1986; Bernanke, 1986; Odusola and Akinlo, 2002; Hen, 2003; and McCarthy, 2006 among others). The methodology indicates the specified and identified restrictions on each equation to estimate the joint behaviour or dynamic nature of interrelationship through time of vectors of economic variables. The set of variables is written;

$$Y_t = \sum_{i=0}^{n} \mathbf{A}_i X_t + \boldsymbol{\beta} u_t \qquad (1)$$

Here, Y_t is defined as a set of vector of observation of dependent in an (n x 1) vector at time t, $\mathbf{A}_i$ is the matrix of coefficients (n x n) X vector of lagged values. The u_t is a disturbance term of (n x 1) vector in the system and $\boldsymbol{\beta}$ is an (n x n) vector of matrix of coefficients of disturbances to the dependent Y_t vector. For reduced term it is expressed as;

$$Y_t = \sum_{i=0}^{N} \mathbf{C}_i X_{t-1} + \varepsilon_t \qquad (2)$$

$$\varepsilon_t = G u_t,$$

Where, vector of $\mathbf{C}_i = (1- A_0)^{-1}$, and vector of $\mathbf{A}_i$ and $G= (1-A_0)^{-1}\beta$ matrices of coefficients and disturbances are estimated. Whereas, the restriction on the structure of coefficient matrices A_0 and β disturbance matrices are imposed in order to derive the policy analysis. The structural disturbances (u_t) are derived from the reduced form equation 2 (εt), β matrices are assumed to be a diagonal matrix and whereas A_0 is always used to be lower triangular. This is a direct causal ordering of the variables. One can directly relate the structural and reduced format in the form of:

$$u_t = \beta^{-1} (1- A_0) \varepsilon_t \qquad (3)$$

When β is an identity matrix, it would be easy to calculate the structural disturbance terms when the system has enough information to estimate the non-zero elements of the A_0 matrix along with the unknown variances of the vector u_t . The available information consists of n n(n+1/2)/2. Distinct sample covariance is derived from the covariance matrix of the residuals of reduced form. Naturally A_0 is a lower triangular matrix and the β is an identity matrix. One can easily considers as an order condition of identification of non-zero elements of A_0 which must not exceed n (n-1)/2, the condition of degrees of freedom when the number of structural disturbances is calculated.

The process involves the estimation of innovations in unrestricted VAR first, and thereafter, the identified postulating structure for A_0 is to be estimated by using the estimation method of moments as suggested by (Bernanke, 1986; Odusola and Akinlo, 2001). This can be expressed as;

$$\hat{S} = (1-\tilde{A}_0)\, M\, (1-\tilde{A}_0)^{-1} \qquad (4)$$

Where $\hat{S} = \mu\mu'$ and $M = (\Sigma \acute{\varepsilon}_{\varepsilon t} \acute{\varepsilon}_{\varepsilon t})/T$ which is an estimated covariance matrix of shocks and sample covariance matrix of the residuals, respectively. The matrix $\tilde{A}_0$ element is diagonal matrix of fundamental shocks of $\hat{S}$. This matrix as earlier defined as an n(n+1)/2 distinct elements of the symmetric matrix M. Therefore, with number of equations variances to estimate in an identifiable system of n (n-1)/2 nonzero elements of the $\tilde{A}_0$ matrix is going to be estimated. To best capture the stylized structure of fundamentals of Oman economy, the necessary identification scheme is identified.

3.2 The Reduced Form Model

The identification scheme in equation 5 table 2 indicates specified restrictions which are adopted in order to capture the joint behaviour of interrelationship among the set of variables and their innovations.

Table 2: Reduced Form Model

$\mathbf{u}_{\mathbf{OCOP}}$		OCOP		1	0	0	0	0	0		ε_{OCOP}	
$\mathbf{u}_{\mathbf{RGDP}}$		RGDP		α_{21}	1	α_{23}	0	0	0		ε_{RGDP}	
$\mathbf{u}_{\mathbf{REER}}$	=	REER	+	α_{31}	0	1	0	α_{35}	0	=	ε_{REER}	
$\mathbf{u}_{\mathbf{M2}}$		Int rate/M2		0	α_{42}	α_{43}	1	α_{35}	0		ε_{M2}	**(5)**
$\mathbf{u}_{\mathbf{GCE}}$		GCE		0	α_{52}	α_{53}	0	1	0		ε_{GCE}	
$\mathbf{u}_{\mathbf{CPI}}$		CPI			0	α_{63}	α_{64}	α_{65}	1		ε_{CPI}	

The specifications are indicated as constants of the six vector variables and α_{ij} represent the coefficients. As reflected in the equation, the innovations in the crude oil prices are entirely due to its own shock innovations and do not necessarily depend upon the innovations from any other variable in the model. Innovations in the RGDP depend on its own innovations and the innovations stem out of oil prices and real effective exchange rate.

Since Oman is a small open economy, its output is largely determined by the strength of its commodity exports. Therefore, any change in output is stemed out of the changes in crude oil price shall reflect through the strength and weakness of its real exchange rate.

3.3 Data Sources and Construction of Variables

International Financial Statistics **(**IFS) annual data series from 1980 to 2010 is used for the estimation. The construction of variables, measurements and data sources are listed in table 3. All variables are taken into logarithm form and measured at lag difference of the actual values and the inferences to be drawn from the VAR. The variables could be sensitive. The particular sensitivities are apparent in the level of first differences or in inclusion and exclusion of time trend. Time series properties are carefully evaluated.

Table 3: Summary of Variables, Measurements and Data Sources

Name of variable	**Variable Measurements**	**Explanation**	**Data Sources**
Oman Crude Oil Prices (OCOP)	Proxy for Real average global oil prices (base year 2005 prices) in $	Crude oil prices are connected with the external balances	International Financial Statistics (IFS) annual data series from 1980 to 2010
Output R(GDP),	Real Gross Domestic Product	Adjusted with normal GDP with deflator base year 2005, Nominal GDP was obtained from IFS 2005 base prices	IFS 1980-2010
Money Supply (M2)	Money Supply, Nominal Money supply in millions of Rials	Monetary variable	IFS 1980-2010
Real Effective Exchange Rate (REER)	The real effective exchange rate is the measure of price adjusted trade weighted exchange rate. The trade weights are calculated from the relative trade share (imports + exports) taken from the direction of trade statistics.	The total weight in particular year is equal to one. REER is constructed by taking the trade weighted share of trade with selected trading partners equal to one adjusted with respective whole sale prices of trading partners with CPI of Oman adjusted by using 2005 base prices (increase in the value of real effective exchange rate shows the real depreciation, decrease shows the real appreciation. REER is defined based on IMF defined methodology.	Direction of trade statistics. 1980-2010
Consumer Price Index (CPI),	Commodity price index is a proxy measure of domestic inflation	Adjusted with 2005 base year. Consumer price index adjusted in order to get the simple index-missing data is adjusted with GDP deflator trend in CPI	IFS 1980-2010
Government Consumption Expenditures (GCE)	Percentage of GDP	Government consumption expenditure is the government consumption expenditure-proxy for fiscal policy	IFS 1980-2010
Short term interest rate	Short-term discount rate end of the period	Short term discount rate/deposit rate as proxy for monetary policy variable.	IFS 1980-2010

4. Estimation and Result Discussion

Augmented Dickey Fuller (ADF) and Philips- Perron (PP) tests at level and first difference are conducted. The first differencing variables are integrated at different orders. Variables such as Real Gross Domestic Product (RGDP), Government Consumption Expenditures (GCE) and Consumer Price Index (CPI) variables are adjusted as rates of change rather levels. Other variables such as Average Oman Crude Oil Price (OCOP), Money Supply (M2) and Real Effective Exchange Rate (REER) are used as level. Since the data series are in annual form, no seasonal trend is observed and this has been verified and checked. Serial correlation test is performed by using Lagrange Multiplier (LM) statistics to check the robustness of ADF tests. Lag lengths are determined by using Akaike Information Criterion (AIC).

The VAR model is estimated with log differences of six variables by using yearly data with two lags in each equation. The two year lag period is estimated over the period 1980-2010[7]. Most of the variables are found to be cointegarated. Therefore, the Vector Error Correction model is used. The model allows the long term behaviour of the set of endogenous variables to converge and cointegrating the long term equilibrium relationship along with their short term dynamics. The cointegration relationship is tested by using Johansen Cointegration Test (1995). Four co-integrating vectors linking each other are found. Cointegrating vectors are tested based on the trace and max-eigen statistics. The cointegration relationship among the variables is presented in the panel of table 4.

[7] Charemza and Deadman (1992) suggest use of cointegrating vector for REER variable, when it is used in long series, in short series, the variable may turns out to be inconsistent in theoretical terms.

Table 4: Summary of the Reduced Form Estimation

Test statistics	**Average Crude Price of Oil**	**RGDP**	**Money Supply M2**	**REER**	**Govt. Cons Exp.**	***CPI***
Co integration equation	-0.04 (-0.34)	-0.171 (-2.45)	0.613 (2.66)	5.796 (3.30)	-0.288 (-2.34)	*-0.005 (-0.06)*
Goodness of fit statistics						
Adjusted R2	0.46	0.21	0.52	0.51	0.64	*0.18*
SEE	0.02	0.00	0.08	4.77	0.02	*0.01*

The coefficient signs indicate the adjustments to the long run deviations. Unlike the oil prices, the domestic prices are adjusted from a long run path in a relatively longer time period than the adjustment in goveronment expenditure which is relatively quick to adjust from its deviations. The adjustment coefficient corresponds -0.04 per cent for exchange rate, while for government consumption expenditure coefficient is -0.288 and for real output, it is -0.171. Coefficients suggest that government expenditure is relatively quick to adjust to the equilibrium path, as compared to real output and real oil prices. However, the real output responds to the external shocks relatively slower than the response to government consumption expenditure. The adjustment process indicates that output is positively responding to the external shocks. Relatively slow adjustment in real oil prices and domestic prices to equilibrium path indicate the long run relationship among the two variables. Oman economy is a small economy, its exportable share of commodities volume is very small compared to the world demand. It seems less likely that oil prices of Oman crude affects the global oil prices.

4.1 The Structural Model and Impulse Response Functions

The SVAR model suggested with structural restrictions in equation 5 and table 2 is estimated by using the VEC model. The results are presented in the table 5. Structural response function of SVAR in a form of coefficients in table 5 and Figure 3 indicates the generalized impulse response functions.

Table 5: Structural VAR Regression Impulse Response Function of SVAR

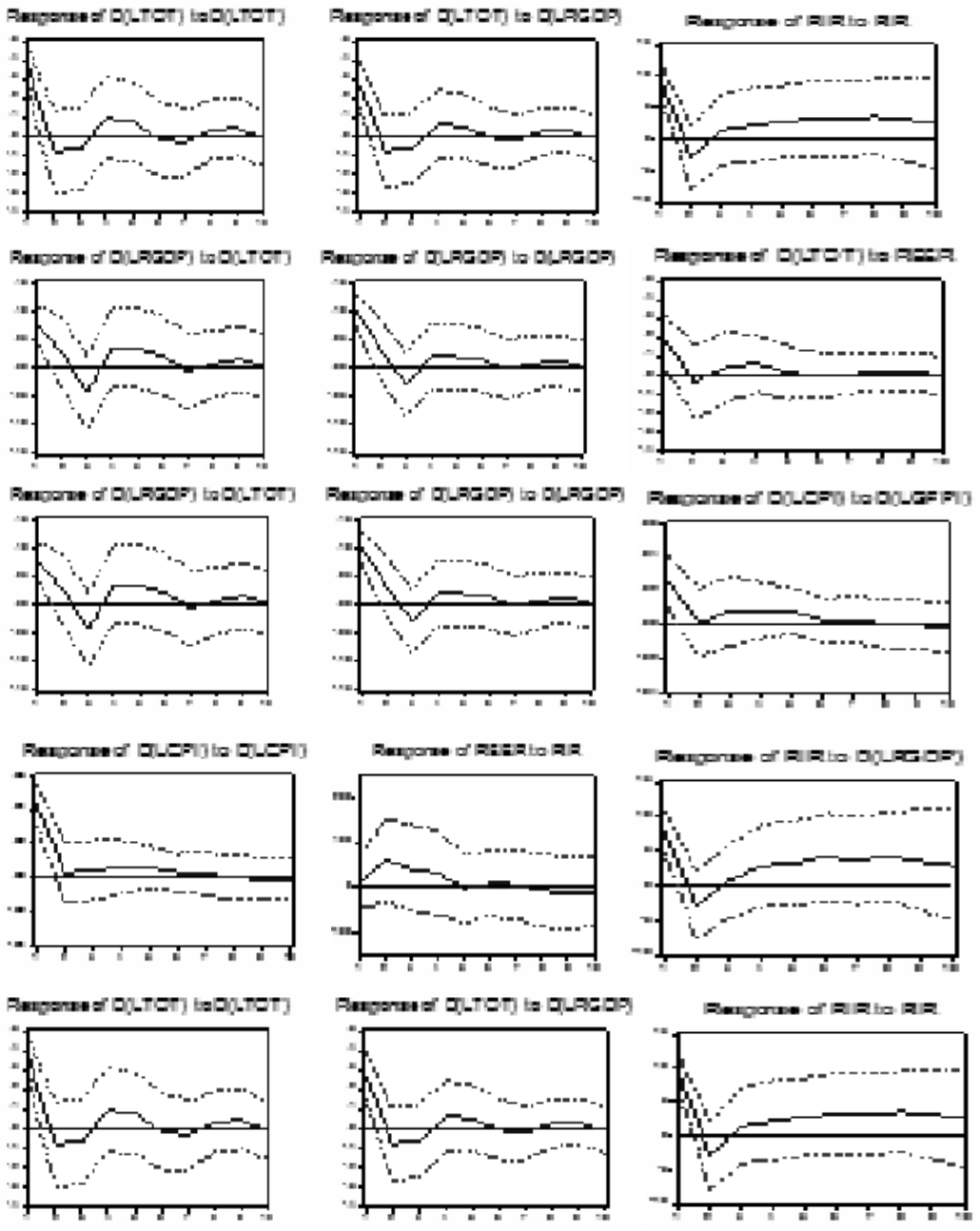
ε_{OCOP}	=	0.05μ COP (7.4)***			*6.1*
ε_{RGDP}	=	0.38 OCOP (4.14)***			*6.2*
ε_{REER}	=	0.09 OCOP (0.02)		*4.50GCE (0.47)*	*6.3*
ε_{M2}	=	-2.67RGDP (7.88)***	-0.02REER (2.09)**	*-0.25GCE (2.1)***	*6.4*
ε_{GCE}	=	+1.89RGDP (3.85)***	-0.04REER (1.51)		*6.5*
ε_{CPI}	=	-1.34RGDP (-3.13)***	-0.002REER (0.88)	*-0.32M2 (-2.4)****	*6.6*

The coefficients in table 5 are structural impulse response functions of SVAR. These coefficients are driven from the vector error correction and cointegrated series with structural restrictions. These coefficients may not appear to be very precise. This may be possible because of the estimation techniques and the nature of standard errors as cautioned by (Bernanke, 1986; Calomiris and Hubbard, 1989, Turner, 199; Kiguel, Lizondo and O'Connell, 1997).

4.2 Discussion

The results suggest that innovations in crude oil prices positively affect the real output innovations (refer equation 6.1 in table 5). One percentage point variation in real crude oil prices significantly impact the real output by 0.38 per cent in the same direction. This means every 10 per cent increase in oil prices positively influence the real output by 3.8 per cent in long run. The innovations in real output also significantly impact the changes in the money supply. However, these changes are inconsistent with changes in real output growth. In the long run, shocks in both real output and money supply become smooth. Changes in output are primarily driven by changes in oil prices, whereas the changes in output induce increase in money supply.

Figure 3: Response to Generalized One S.D Innovations to 2S.E



One percentage point increase in real Oman crude oil prices affects the real exchange rate by 0.09 per cent, but this effect is statistically very insignificant. This suggests that changes in global oil prices, in fact, do affect the real exchange rate, but that effect is a very minor. Innovations in real effective exchange rate affect the government consumption expenditures positively but insignificantly. This result is consistent with the trends in government consumption expenditures which are usually increasing at the time of positive external balances. Innovations in real exchange rates are having a negative and negligible impact on money supply expansion. Changes in real output negatively affect the money supply and it is quite clear that real output growth induces by the external trade revenues but the output is not influenced by the changes in domestic money supply. Innovations in real output infuence the government consumption expenditures significantly and positively. One percentage point increase in real output increases the government consumption expenditure by 1.89 per cent. Innovations in output growth affect the fiscal side of government consumption expenditure positively and significantly. Real appreciation in exchange rate has a negligible effect on prices. It means that real appreciation of exchange rate effect on domestic prices is nominal. Because the domestic prices are not much affected by appreciation or depreciation in real exchange rate. In figure 3 response to generalized one standard deviation innovations to two standard errors suggest consistency with the structural coefficients in table 5. The results suggest negative response of external balances to a real effective exchange rate. While real effective exchange rate has a positive effect on real interest rate.

Pegged exchange rate policy seems to be performing well in anchoring the inflationary expectation in Oman.. However, the changes in real output significantly affect the prices negatively. Monetary expansion has a negative effect on domestic prices. This also suggests that expansionary monetary policy traces the pace of output and balances the inflationary expectations. Oman has relatively stable prices in last few decades. Every one per cent increases in money supply adjust the pace of inflationary expectations by 0.32 per cent. Increase in output is accompanied by decline in prices. This suggests that stabilization policies works well with a mixture of expansion in output growth coupled with monetary expansion accommodating the price changes.

The results are in line with the established theoretical propositions and the evidence discussed earlier. The innovations in real effective exchange rate not necessarily affect the consumer prices. However, innovations to real output affect prices negatively. The relationship of output innovations with government consumption expenditure positively affect output which leads to an expansionary fiscal policy.

5. **Conclusion**

The study has examined the relationship of real oil prices shocks and its channels to domestic macroeconomic dynamics of small open economy of Oman. It has established the extent of interlinks of external and domestic structural variants and their inter relationships. The dynamic structural vector autoregressive econometric model along with stylized structural variants of Oman economy has shed lights on the interrelationship of macro variables and trace out their dynamic moments. The results are consistent with the theory and provide the important insights into the policy directions.

The results imply that crude oil price emerges to be a very significant variable inducing output extends the monetary and government consumption expenditures. In other words, changes in oil prices induce output and consequent response to fiscal and monetary policy responses. Monetary and fiscal policies anchor the global price shock and the long run inflationary pressures. Monetary variables such as money supply responses to changes in output and affects prices. The changes in exchange rate are presumably positive shock to terms of trade or external favourable effect. Results from impulse response functions imply that innovation in output is influenced by oil prices. Exchange rate, in fact, do appreciates due to increase in oil prices; the response to fiscal expansion is derived out of changes in oil prices which is straightforward theoretical result. Structural impulse response coefficients indicate consistency with the earlier results.

Output and demand management policies in Oman economy are largely dependent on the external factors, particularly oil prices. The shocks to oil prices may likely affect the demand management policies. It seems in the long run changes in oil prices determine the output and subsequent fiscal and monetary policies which serve well to contain the inflationary

expectations and maintain positive external balances. In short run fluctuations in oil prices or global imbalances though are contained well in mixture of stabilization policies, continuation of a mixture of fiscal and monetary stabilization policies may serve well the purpose of the domestic dynamics of Oman economy. However, in the long run, over reliance on stabilization policies in days of global imbalances may provide fewer options to contain the external shocks. Therefore, the exchange rate policy of pegging with dollar may be questionable in the longer term.

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