Dynamic relationships between oil revenue, government spending and economic growth in Oman

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Abstract

This paper investigates the short-run and long-run relationships between three main macroeconomic variables in Oman using the Johansen multivariate co-integration techniques as well as the stationary VAR for the period between 1971 and 2013. The results indicate that there is a long-run relationship between these three macroeconomic variables; the real GDP, the real government expenditure and the real oil revenues. The estimated coefficients for the real oil revenues and the real government expenditure are correctly signed and statistically significant at 5% level. Both variables depict positive relationship with GDP which are 0.672 and 0.872 respectively. The impulse response functions and the variance decomposition from the stationary VAR show that these variables are very important to the short-run dynamics of the Omani economy. Overall, government expenditure appears to be the main source for economic growth in long-run, and in short run variations in government expenditure are generally derived by oil revenue shocks. Therefore, the volatility in oil revenue requires public expenditure management reforms and the need to diversify income sources in order to enhance economic stability and growth.

1. Introduction

Oil exporting economies have witnessed multiple oil shocks over the last 50 years. This oil price fluctuating and its impact on output have attracted attention of many economists who attempted to explain the impact of oil shocks and government expenditure behaviour on economic growth (Hamdi and Sbia, 2013). The transmission channels through which oil shocks may affect the overall economy have been investigated deeply in oil importing countries. The research studies of Hamilton (1983), Mork and Hall (1980), Sachs (1981), Rasche and Tatom (1981), Darby (1982), and Burbidge and Harrison (1984) helped to establish the foundation for the nature of relationship between oil prices and macroeconomy effects.

Sachs (1981) argued that oil price shock of 1973 have different effects, while it benefited OPEC countries, it generated increasing deficit in developed countries. The existence of a negative relationship between oil prices and macroeconomic activities become widely accepted since influential paper by Hamilton (1983) who investigated the oil price-output nexus in US over the period 1948-1980 using VAR framework. Hamilton's results showed that oil price changes have a strong causal and negative correlation with future real U.S. GNP growth. After that, there are many studies extended Hamilton's work and confirmed his results. Burbidge and Harrison (1984) used different data and methods for U.S and got the same negative impact of oil and energy shocks on real activity for U.S. Hooker (1996) used data for the period 1948-1972 and confirmed Hamilton's results that oil price changes exert influence on GDP growth.

However, oil prices may have asymmetric effects on economic growth because of other variables not taken into account. More specifically, oil price changes may affect output adversely for oil-importing countries for two reasons. First, as argued by by Pindyck (1991) that oil price changes raise uncertainty and thus causes decrease in private investment. Second, such changes induce resource reallocation from productive to non-productive sectors which is costly for the economy (LIlien, 1982). Thus, Hamilton's (1983) specification suffers from omitted variables problems because it does not take into considerations the impact of volatility. Recent studies have used more sophisticated econometrics models and included the effects of price volatility in addition to oil price changes. The results reveal that price volatility has also a significant negative impact on output. Ferderer (1996) argued that both oil price changes and volatility have a negative impact on economic growth, but volatility has an immediate impact whereas oil price changes effects take longer time to occur. Moreover, the evidence of non-liner relationship between oil prices and output has been supported for OECD countries as reported in Gunado and de Gracia (2003) and Jimenez-Rdriguez and Sanchez (2005) works.

It is clear from related literature that most studies of oil prices-macroeconomy nexus are concentrated on developed oil importing countries. The impact of oil price shocks on economic growth and their transmission mechanism in oil-exporting countries are different from those in oil-importing countries. A few numbers of studies have investigated this kind of relationship for oil-exporting countries. The channels by which oil prices may affect economic performance have not been systematically documented in oil-exporting countries, but several studies have argued that variations in the fiscal behaviour, which in turn reflects changes in oil price driven fiscal revenue have exacerbated output cycles (Erbil 2011). Therefore, some recent researchers argue that fiscal policy and its procyclicality is one of the main channels of natural resource curse. Bleaney and Halland (2009) investigated fiscal policy volatility channel by entering primary product exports and volatility together in a growth regression and run the model for 75 countries over the period 1980-2004. They found that the volatility of government consumption is explained by natural resource exports and greater fiscal volatility acts as a transmission mechanism for the resource curse.

Tazhibayeva et al. (2008) used a panel VAR analysis and associated impulse responses to assess the impact of oil price shocks on the non-oil economic cycle in oil exporting countries. In their model, they capture transmission oil shocks to the economy and found that oil shocks affect economic cycle through fiscal policy. Pieschacon (2009) analysed how oil price shocks affect macroeconomy activity in an oil-exporting economy using DSGE model for Mexico and Norway, tow oil-rich countries with different fiscal policy framework. He found that fiscal policy is a key mechanism in transmitting the oil shocks to economy through influencing the output level, output volatility, and growth. Fasano and Wang (2002) examine the direction of causality between total revenue and total government spending for GCC countries including Oman, over the period1980-2000, using a cointegration and error-correction models. The results show that increase in revenue causes an increase in government expenditure in the first period for all GCC countries which means that government expenditure is pro-cyclical to changes in oil revenue.

Oman as a small oil-exporting country, mostly the policy of public spending linked to oil revenue which accounts for a substantial part of public budget. Therefore, the response of fiscal policy to rising oil prices is expansionary and when the prices fall the government cut the expenditure, and in this context, the role of fiscal policy might be a channel through which the fluctuations in the oil prices or oil revenue transmitted to the rest of the economy. Hence, as it is argued from the Keynesian theories that a reduction in public expenditure causes a fall in total demand, consumption, investment which will adversely affect economic growth. On the other hand, when oil prices increase, public spending, investment and economic growth will rise as a result of spending effect multiplier.

This paper will focus on the effect of oil revenues on economic growth and the mechanisms through which that effect can be transmitted to economic growth through government expenditure. I will use time-series analysis to examine how oil revenues affect economic growth both directly and indirectly through fiscal policy channel. Most literature in this area uses cross-country growth regressions, but as shown in the literature there is some case studies. In contrast with existing cross-country growth regression, using of time series cointegration technique and Granger causality models to examine the causal chain linking oil windfalls to economic performance through fiscal policy channel for specific case study (Oman) would add some contribution to this literature. This chapter therefore is an attempt to empirically examine oil revenue changes and fiscal policy through government spending on the Omani economy.

This paper presents a dynamic model to analyse increasing dependence of government expenditure on oil revenue and measures the extent of the government's ability to afford such continuing expenses in the face of oil revenues decrease. Furthermore, the impact of oil revenue and public expenditure on Oman economic growth is testified in this model.

The rest of the paper is structured as follows. Section 2 reviews historical data on public revenues, expenditures and GDP to illustrate the economic dilemma faced by Oman. Section 3 presents the theoretical and empirical background of natural resources effects in general and more specifically oil revenues on economic performance of oil-exporting countries. Section 4 presents the methodology used to analyse the dynamic relationships between the variables, namely oil revenue, government expenditure and GDP. Section 5 discusses the research findings and Section 5 concludes.

2. Historical Data on Oman Economic Structure, oil revenues and Public Expenditure

Petroleum sector is the main engine of the Omani economy; it represents the largest proportion of GDP compared to other economic sectors over the last forty years. The percentage of its contribution to GDP during the study period ranges from 45% to 51%. Also the contribution of oil exports in total exports ranges from 74% to more than 96% over the same period. Regarding public revenue, oil revenues alone apart from gas rents mostly accounted for more than 75% for most years covered in the sample. Despite this prominent position occupies by petroleum sector in Omani economy, it works as a closed sector, in that it does not contribute to local market factors. It employs small proportion of total local labor force due to capital-intensive investments nature of the sector. Thus, the most serious challenge faced by Omani economy is diversifying with the aim of developing other sources of income so that it can rely less on petroleum sector which faces the threat of depletion.

2.1 Oil Revenues

The public budget structure in most oil abundant countries has followed a similar pattern in that oil revenues constitute the biggest part of public budget and tax revenues is a fragile component. There are a number of factors affecting the development of oil revenues such as nominal crude oil prices, political decision, oil reserves and oil production capacity. All these factors cause evident fluctuations in the size of oil revenue and it is clearly shown in Figure 2 where the highest peak was in 2013 and the lowest was in 1986.

Since the early 1970s oil revenues have increased sharply because of phenomenal rises in oil prices. Figure 1 shows the ratio of oil revenue to total revenues in Oman. Over the whole period, 1980-2012, oil revenues constitute more than 64% of total revenues and the sharp decline was from 1983 to 1986, when oil prices dropped, as a result, this ratio decreased sharply from 90% of total revenue in 1982 to about 75.4% in 1986. However, when oil prices rose after 1986, the ratio went up again reaching about 82% in 1990. Afterwards, it fluctuated dramatically, but with downward trend until it reached the lowest percentage, 64.7% in 2006. The bulk of the increase in oil revenues has been recorded during the period from 2007 to 2013 because of unusual rise in the price of oil, which exceeded $100 per barrel between 2008 and 2009. As a result the contribution of oil revenue in public budget increased rapidly. It is clear from this figure that there is a strong dependence of public budget on oil revenues in Oman.

Oil Revenue Percentage of Total Revenue

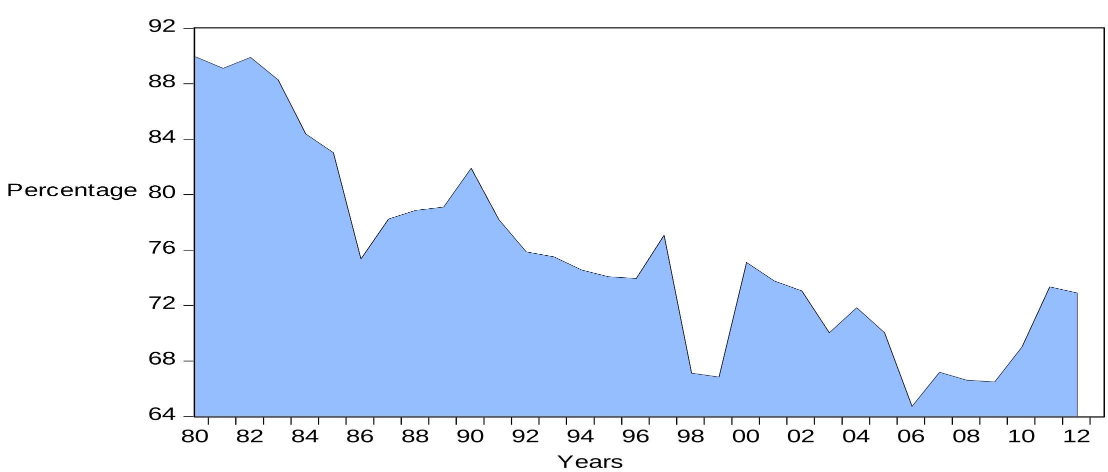

Figure 1

Figure 2 shows the pattern of Oman government revenues for the period 1980 to 2013. From 1980 to 2000, the volume of oil revenues had risen gradually but in small proportions. In 2001 and 2002, the oil revenues have seen a decline as a result of the sharp drop in oil prices because of USA economic recession, which aggravated after the events of September 2001. As the US economy is the key in determining the path of global economic growth due to its impact on the economies of the rest of the world, the rates of total demand in global economy decreased and influenced the global demand for oil causing huge fall in oil prices. However, in Oman the volume of oil revenues headed towards increase in spite of the relative decrease in the level of oil prices that reached about $23 per barrel in 2001. The reason is due to the increase in rate of oil production because of new technologies have been used to extract oil from the ground and so the oil revenue collections increased from Rail Omani (R.O). 1.8 billion in 2001 to more than R.O 2.2 billion in 2002.

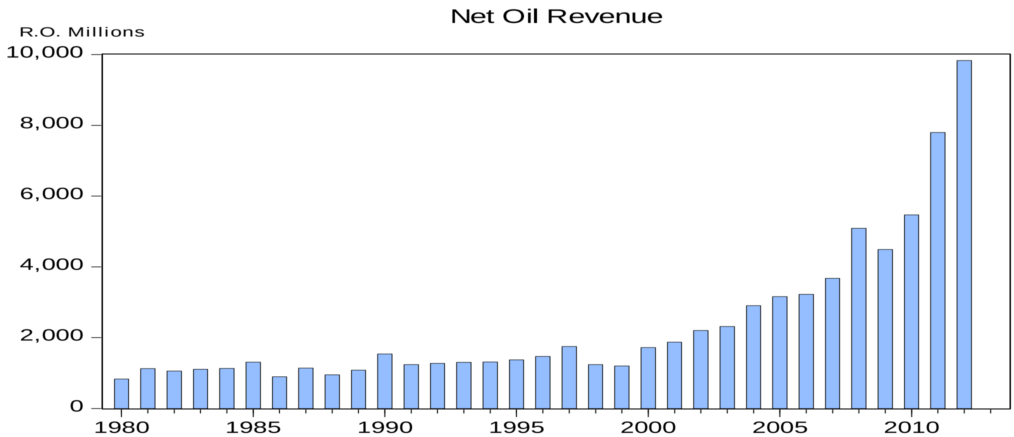

Figure 2

It can be noted from the data presented in Figure 2 that oil revenues have seen a significant increase in size during last decade (2003-2013), rising from R.O. 2.3 billion in 2003 up to R.O.10 billion in 2013, which is a quadruple change during the decade. This increase took place due to the rise in global prices of crude oil from $27/barrel in 2003 to above $140 per barrel in 2008, which is the highest level reached. Also accompanied the rise in oil prices is the increase in the quantity produced and continued high global demand for Oil. All these developments created and nurtured huge fiscal policy expansion in Oman.

2.2 Government Expenditure

In 1970s and 1980s Oman has embarked on modernisation programme that moved the economy into a new phase. This was assisted by revenue derived from the export of oil and the successive rises in prices of oil. This phase necessitated a strong intervention of the state into economic activities, which resulted in high government spending during this period rising from R.O. 46 millions in 1975 to more than R.O. 1.9 billion in 1985. These big government expenditures especially huge public investments raised domestic economic growth rates and created a good number of jobs for Omani youth. Such good economic growth rates push state to continue this approach supported and financed by the oil revenues, which represented the most important source of funding.

The crisis of oil prices in 1986 had a big impact on Omani economy which showed the weakness of Omani economic system, especially regarding access to the financial resources and also revealed the fragility of the country's tax system. Since the beginning of 1990s the government began considering economic reforms in order to change the pattern of economic structure and mitigate the dependency of fiscal policy on oil revenues. However, this situation did not lead to low rates of government spending, but on contrary the volume of public expenditure doubled from R.O. 2.2 billion in 1993 to R.O. 4.2 billion in 2005, owing primarily to significant expansion of services and social welfare provided by the government. During this time and specifically in 1999, rises in oil prices gave a kind of financial comfort to the government. Efforts to exploit alternative revenue sources led to further expansionary fiscal policy in terms of high volume of public spending to support their developments. This Trend clearly expresses the desire of the state to pursue Keynesian fiscal policy to activate the aggregate demand by stimulating major public investment projects. Fiscal policy has contributed significantly to the improvement of some economic indicators, most notably the rate of economic growth, which reached 7% in 2001.

The period from (2005-2013) has seen a clear increase in the size of government expenditure, as a result of the continued high oil prices and increased oil productivity, thus oil revenues jumped from R.O. 4.2 billion in 2005 to about R.O. 7.9 billion in 2010 as shown in Figure 3. Such government spending continues increasing because it is important in the volume of economic activity from the point view of the government officials. From 2010-2013, Government expenditure rose to R.O. 13.5 billion in 2013 as depicted by Figure 3. This increase is due to a rise in recurrent expenditure, especially in the area of wages, salaries and social benefits where government was forced by youth demonstrations during Arab Spring of 2011 to employ large numbers of job seekers in various government sectors. The Actual problem facing the government that most of these expenses are not flexible and cannot be reduced in case of declining oil revenues, which makes it difficult for the government to address.

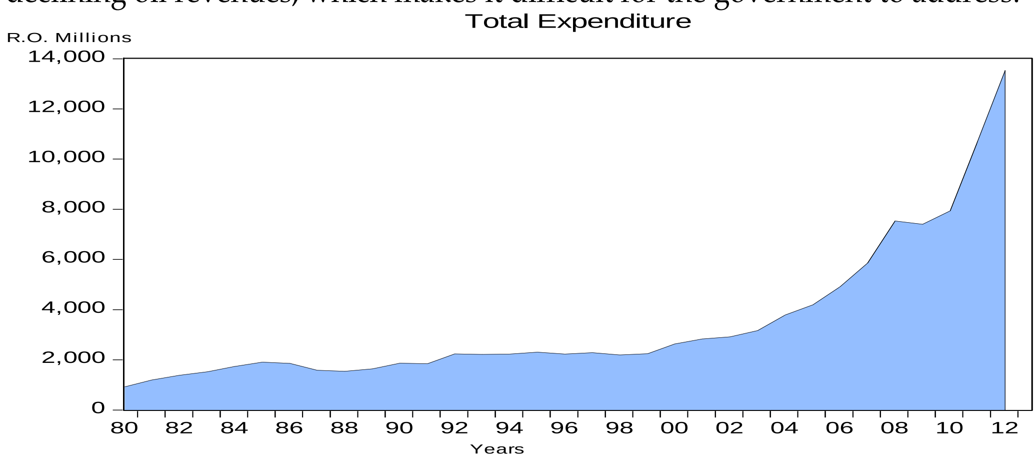

Figure 3

2.3 The Relationship between Real GDP, Government Expenditure and Oil Revenues

Figure 4 shows the relationship between GDP, the total government expenditure, and the oil revenues of Oman during the period 1980-2013. It is clear that government expenditure rises with rises in oil price, but does not fall when oil prices fall. This can be attributed to inflexibility of recurrent expenditure that does not decrease easily when oil revenues fall because of high social pressure on the government against salary reduction. The other characteristic of Oman public budget is that when oil revenues increase, total expenditures rises at accelerated rates exceeding total revenues. For example, between 1980 and 1985, oil revenues increased by 57%, but government expenditures rose by about 103%, causing budget deficit in 1984 (about 18% of total revenues). Such deficits in oil-exporting country such as Oman create pressure to expand oil production and exports to raise revenues so as to address the budget deficits.

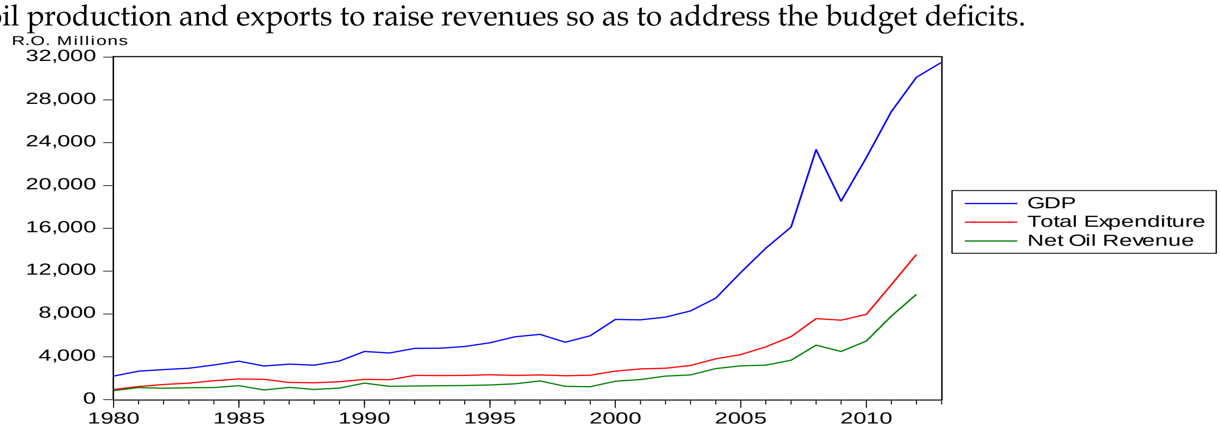

Figure 4

Since 1987, oil revenues increased gradually until 2006. Thereafter, oil revenue had raised sharply and by the result the government expenditure and GDP immediately follow oil revenue trend and increased in the same speed until all these three macroeconomic variables reached the peak in 2008. In 2009, all these variables witnessed the same sort of decrease due to the effects of the global financial crisis, which impacted the global demand for oil, causing a decrease in prices. From the 2010, oil revenues returned back to rising trend again dramatically and thus driving both government expenditure and GDP to rise at accelerating rates.

In general, we can deduce from Figure 4 that there have been increases in size of government expenditure over the research period driven by the rises in oil prices and increased in production of oil which is the main financier of the government's budget in Oman. These injections into the economy boost Oman GDP to $80.57 billion in 2013. Therefore, these three macroeconomic variables appear to have positive correlation. However, this relationship weakens between government spending and revenues when oil revenues declines because some key components of government expenditures are not flexible to decline such as employees' salaries and the result is an asymmetric adjustment.

3. Theoretical Background and Previous Empirical Works

(Frankel, 2012),there is a large body of literature that focuses on the relationship between resource-abundance and economic growth. Simple economic intuition would suggest that an increase in natural resources would have a potential beneficial role in fostering economic development by converted into capital to support future output levels (Rodriguez, 1999). Theoretically, resource abundance can give a "big push" to economy through more investments in health and education programs, construction of roads and modernization of telecommunication systems and so the whole economy benefits of such resource rents Iimi (2007).

However, experience over the last decades reveals that natural resources frustrate economic growth rather than promoting it. The major contribution was by Sachs and Warner (1995), conducting a large cross-country study, argue that there is a negative association between natural resource abundance and growth. Thereafter, literature focuses on such disappointing economic performance of natural-resource-rich countries and thus the phenomenon "resource curse" begin to enter the literature (ie. countries that are rich in natural resources tend to perform badly in terms of economic growth) (Iimi, 2007). Many papers considered the natural recourse curse from different perspectives. Some focus on the negative association between resource abundance and growth-inducing activities others concentrated on stability and quality of the political system and few on government behaviour and its use of these rents.

Emirical evidence seems consistent that an abundance of natural resources may reduce the quality of foreign, social, human and physical capital and so hider economic growth (Gylfason, 2001). Dalmazzo and de Blasio (2003) argue that natural resource income has same characteristics of foreign aid in that both are income-impeding crowding-out logic (Dalmazzo and de Blasio, 2003). The clear difference between them is that aid is often monitored by international agencies with conditions to be utilized for investment projects whereas natural resource rents are unconditional income and so the government misused such windfalls (Papyrakis and Gerlagh, 2006).

The literature suggests different channels through which natural resources could retard economic growth. These channels can be described as crowding out channels, that natural resources crowd out other types of capital which are important for development and therefore it retard economic growth (Gylfason, 2001). As argued by Sachs and Warner (2001) that natural resources are not harmful to income per se but tend to affect negatively several income-supporting activities such as physical capital, human capital, and institutional capital which affect growth. There is no general accepted theory in this literature of natural resource curse, but only possible explanations for the curse of natural resources based on Sachs and Warner (2001) crowding-out logic (Cerny and Filer, 2006). The structure of recent models just state that an abundance of natural resources affect some variables or mechanisms "X" which in turn hamper economic growth. The real challenge for empirical researchers and theorists in this field is to identify these variables and mechanisms that transmit the adverse effect to economic performance (Gylfason, 2001).

The first identified channel is the Dutch disease channel, where exporting of primary commodities leads to appreciation in exchange rate and this in turn leads to a contraction of the tradable sector (Krugman, 1987). Moreover, the natural resource-based industries in rich-abundance countries usually pay higher wages than other manufacturing industries and thus make it difficult for the latter to make profit leading to reallocation of factors of production from manufacturing towards the booming sector (Corden and Neary, 1982). Since it is the manufacturing sector that is important in increasing return to scale and positive externalities, this shifting away from competitive manufacturing sector would reduce the productivity and profitability of investment and therefore, affects economic growth negatively (Wijnbergen, 1984).

The second channel is the education and human capital. Natural resources reduce investment in skill-labor and high-quality education {Papyrakis, 2006 #25}. Since manufacturing sector contracts as result of resource booms, returns to education and high-skilled labour force which is the main production factor of manufacturing sector decline because of a decrease in demand for such capital. Gylfason (2001) run unrelated regression (SUR) estimates of a system of two equations for 85 countries over the period 1965-1998 and he found that natural resources crowd out human capital, therefore slowing the economic performance of natural-abundant countries. Using a stepwise regressions approach incorporating a wide range of plausible explanatory variables, Kronenberg (2004) examine the impact of natural resource on economic performance of the group of transition countries between 1989 and 1999. He found that basic education was neglected in the rich-resources countries and tertiary enrolment rates declined while they increased in the poor resource countries. These results support the human capital explanation for natural resource curse.

The third channel, investment and physical capital, natural resource abundance reduce the incentives to save and invest and so impede economic growth (Gylfason, 2001). There are various mechanisms that can explain the crowding-out of investment. For example, Natural resources provide a continues stream of future wealth that is less dependent on public saving for future period, so this would decrease the need for savings and investment (Gylfason and Zoega, 2001). Additionally, heavy dependence on natural resources exposes the country to volatility which creates uncertainty for investors in resource-abundance countries {Mikesell, 1997 #15}. Furthermore, governments in most developing countries that are resource-abundant spend their resource rents on public consumption rather than public investment which is more conducive for economic growth (Atkinson, 2003). Gylfason (2001) shows that an increase in natural resources by 25% points goes with a decrease in the investment ratio by 5% points which in turn decrease economic growth by 1% point.

Papyrakis (2004) argues that investment channel is the most important channel as it accounts for 41% of indirect negative effect of natural resources on economic growth. Atkinson, (2003) used cross-country regressions for 91 countries over the period 1980-1995 and found that rich-resources countries which have suffered from a resource curse are those where natural resources, public expenditure and macroeconomic policies have led to negative or low genuine savings (saving adjusted for resource depletion).

The fourth channel is the political economy effects. That is governance and public institutions quality. It is argued that natural resource booms in conjunction with ill-defined property rights, which tend to put large amount of resource in hands of state and thus promote rent-seeking competition rather than productive activities. That reduces institutional quality by inducing corruption and rent-seeking behavior. Martin and Subramanian (2003) stated that oil and minerals exert a negative impact on economic growth via their harmful impact on institutional quality. Also abundance of resources with lax legal structures may lead to the emergence of powerful interest groups that attempt to influence politicians to adopt policies that may not be beneficial to the general public (Mauro, 1998). Furthermore, natural resource rents may induce economic agents to bribe the administration to gain benefits of them (Ascher, 1999). In this corruption environment, natural resource can be seen as seeds of conflict among citizens, politicians, local developers and local tribes (Iimi, 2007). Robinson et al. (2006) claim that countries that are most possibly getting benefits of natural resources are those that have good institutions, but those that do not are more probably to be exposed to resource curse. Hence institutions are very important in mitigating the resource curse.

The fifth channel is the oil price volatility and its impact on public revenue. Indeed, oil price fluctuation is really one of the most challenges facing oil exporting countries. Such volatility puts the economy under the risk of exogenous fluctuations which hampers planning, increase inflation, boost deficits, raise debt and lead to exchange rate appreciation. These fluctuations reflect their impact on economic policies and therefore the high correlation with oil is added to instability and uncertainty in the global oil markets, making these economies vulnerable to shocks in oil prices. Van der Ploeg (2009) presents cross-country estimates on the effect of volatility in oil prices on economic growth and he shows that the resource curse is foremost a problem of volatility. He concludes that the key determinant of volatility of growth in income per capita of resource-abundant countries is fluctuations in commodity prices.

Ramey and Ramey (1995) found that countries with large volatility of economic growth tend to have lower economic growth in average. Blatman, Hwang and Willianson (2007) use a panel database for 35 countries to examine the impact of terms of trade volatility and secular change on country performance for the period 1870-1939 and they found that countries that specialized in commodities with high price volatility have more fluctuations in their terms of trade, less foreign investment and have lower economic growth than countries specialised in more stable prices and industrial leaders. However oil price impact is not the same among all countries. The impact depends on the country’s institutional structures, sectoral compositions and its economic development (Farzanegan, 2009).

The reading of the historical relationship between oil price fluctuations and macroeconomic variables highlight the impact of such shocks on the producing and consuming countries alike, but the size of such effect varies from one country to another and from one period to another. The most important studies in this regard, which include Darby, 1982; Hamilton, 1983; and Burbdge & Harrison, 1984) find statistically significant evidence of the relationship between oil prices and aggregate economic performance in developed countries.

Although there are plenty of studies that tested the relationship between oil price and macroeconomic aggregates, but most of these studies are for developed countries (Emami, 2012). Such studies of oil-importing countries have shown that oil price shock affect industrial production negatively. These studies include among others, Hamilton (1983), Burbridge and Harrison (1984), Gisser and Goodwin (1986), Hamilton (1988), Morry (1993), Lee et al. (1995), Hooker (1996), Rotmberg and Woodford (1996), Huang et al. (2005) and Schmidt and Zimmermann (2007). Nevertheless, most of these studies pointed to the fact that the strength of relationship of oil-economy nexus has not been stable for these economies over time. It is clear that oil price fluctuation effect on developed economies become weaker during the eighties (Farzanegan and Markwardt, 2009).

Recently, several empirical studies have been published on developing oil producing countries. An oil boom, according to Mehrara (2008), would release foreign exchange constraints and so stimulating economic performance for oil-exporting countries from both supply and demand sides. Furthermore, the government would follow expansionary fiscal policy and would use such money to finance its development and infrastructure which will induce investment, consumption and economic growth (Emami, 2012). However, such positive effect could be weakened by real exchange rate appreciation which leads to the contraction of tradable sectors and so the country will be under the risk of Dutch disease. In addition, when oil prices decrease, governments are not able to adjust its current spending immediately. This will lead to budget deficits which are one of critical issue for most developing countries (Farzanegan, 2011).

Eltony (2001) use a vector Autoregressive model (VAR) and (VECM) models to examine the impact of oil price volatility on seven macroeconomic variables for Kuwait. They found evidence that oil price shocks affect the key macroeconomic variables in Kuwait and the causality running from oil prices and oil revenue to government current and development expenditure; which are key drivers of Kuwait economy. Tijerina-Guajado and Pagan (2003) examine the intertemporal relationship between government spending, oil duties, taxes, and GDP for Mexico over the period 1981-1998 using VAR, they found a substitution effect between tax revenues and oil duties and tax revenues are not capable to absorb temporary decline in oil duties.

Ayadi (2005) examine the effects of oil price shocks on some macroeconomic variables in Nigeria for the period 1980-2004; using VAR model and he found that oil price affect industrial production indirectly, but such relationship is not statically significant and he concludes that oil prices does not necessarily lead to increase in industrial production. These finding were supported by another study by Lwayemi and Fowowe (2011). They employ Granger-causality tests, impulse response functions, and variance decomposition for the same country, Nigeria, and they found that positive oil price shocks have not caused government expenditure, inflation, real exchange rate and output. Their results suggest the existence of asymmetric effects of oil price shocks.

Jbir and Zouari-Ghorbel (2009) employ VAR, to study oil prices and macroeconomic relationship (used 5 macroeconomic variables: oil prices, government spending, inflation, real exchange rate and industrial production). They analysed the role of subsidy policy in Tunisia for the period 1993 Q1 to 2007 Q3. Their results show that oil price shocks have only indirect effect on economic activity and the most important channel by which the impact transmitted is government expenditure.

Some papers emphasis on differences in responses of macroeconomic activities to oil shock effects when they are either positive or negative. Symmetry responses of oil prices shocks means that the reaction of output to a positive oil price shock is exactly same as negative one, whereas asymmetry implies that the response of economy to a positive oil price shock is not equal to negative influence. Farzanegan (2009) study the asymmetric effects of oil price shocks on Iranian economy for quarterly data 1975-2006 and using VAR of 6 variables (oil prices, inflation, government expenditure, real effective exchange rate, industrial production, imports). He found strong positive relationship between increasing oil prices and industrial production and both positive and negative oil prices shocks significantly increase inflation. Mehrara (2008) explores non-linear relationship between oil revenues and industrial production for 13 oil exporting countries. He applied a dynamic panel model and two measures of oil shocks. He found that the relationship between output and oil revenues is non-linear and so the GDP responds to oil shocks in an asymmetric way. The results suggest that the magnitude of response of decreasing oil revenue is negative and more influential than positive oil shocks which have limited role in inducing economic growth. The Middle East and North Africa

Berument, Ceylan and Dogan (2010) study the effects of oil price shocks on output growth (proxied by industrial production) for a selected the Middle East and North Africa (MENA) countries, including Oman. They use several VAR models for the period 1960 to 2003. Their results show that the impact of oil price on GDP of Iraq, Algeria, Kuwait, Oman, Jordan, Syria, Qatar, UAE and Tunisia are significantly positive, but not significant for other countries in their dataset. I extend this analysis by using more data, using a higher dimension VAR models and considering other key macroeconomic variables such as government expenditure, government revenue.

Bouchaout and Al-Zeaud (2012) used a Vector Error Correction Model (VECM) and Variance Decomposition analysis (VD) to explore the effect of oil price volatility on Algerian economy during the period 1980-2011. Their results reveal that oil prices changes have a very limited impact on most macroeconomic variables in short run except a positive effect on inflation and negative influence on real exchange rate. However, in the long run oil prices changes have positively affected real GDP and inflation and have a negative effect on unemployment and real effective exchange rate. Ito (2008) investigated impact of oil prices and monetary shocks on the levels of inflation, interest rate and real gross domestic product (GDP) for Russia during the period 1995:Q3-2007:Q4, using the co-integrated VAR model. The results show that an oil price increase has a positive effect on real GDP and inflation and this shock effects are greater than monetary shock for Russia.

The channels by which oil prices may affect economic performance have not been systematically documented, but several studies have argued that variations in the fiscal behaviour, which in turn reflects changes in oil price driven fiscal revenue have exacerbated output cycles (Erbil 2011). Therefore, some recent researchers argue that fiscal policy (sixth Channel) and its procyclicality is one of the main channels of natural resource curse. Bleaney and Halland (2009) investigated fiscal policy volatility channel by entering primary product exports and volatility together in a growth regression and run the model for 75 countries over the period 1980-2004. They found that the volatility of government consumption is explained by natural resource exports and greater fiscal volatility acts as a transmission mechanism for the resource curse.

There are many studies in this area show that developing countries are the ones suffering most from fiscal policy pro-cyclicality which have detrimental implications for their economies.

Michael and Perotti (1997) were the first economists to discover the existence of fiscal policy pro-cyclicality in the countries of Latin America, as they proved that fiscal policy tends to be expansionary in good times while it is contractionary in bad times. Talvin and Vegh (2000) stated in their study that fiscal policy pro-cyclicality is the norm in most developing countries in their path for economic development, and found that the coefficient of positive correlation between the components of public spending and GDP for a sample of 36 developing countries is about 0.53 on average. For industrialized countries (G7 countries), it was found on average the correlation coefficient is not significant which means that the pro-cyclicality of fiscal policy in these countries does not exist.

Mpatswe, et al. (2011) examine fiscal cyclicality in six African countries during 1980-2008 using equations with the lagged values of explanatory variables as proxies for the long-run values and run the regression in their first differences. Their results show that total public expenditure is strongly pro-cyclical and although the cyclicality coefficients vary from one country to another the public investment is the most pro-cyclical component, which overreacts to economic growth with elasticity of more than a unity.

With regard to oil-exporting countries, mostly the policy of public spending linked to oil revenue which accounts for a substantial part of public budget. Therefore, the response of fiscal policy to rising oil prices is expansionary and when the prices fall the government cut the expenditure, and in this context, the role of fiscal policy provides a channel through which the fluctuations in the oil prices or oil revenue transmitted to the rest of the economy. Hence, as it is argued from the Keynesian theories that a reduction in public expenditure causes a fall in total demand, consumption, investment which will adversely affect economic growth. On the other hand, when oil prices increase, public spending, investment and economic growth will rise as a result of that spending effect multiplier.

Erbil (2011) examines the cyclicality of fiscal policy in 28 oil-exporting countries during the period 1990-2009, using pooled OLS regression, Diff-GMM and Sys-GMM methods and found that all fiscal variables are strongly pro-cyclical in the full sample, but results are not the same across income groups. The results show that government expenditure is pro-cyclical in low and middle-income countries, while it is countercyclical in the high-income countries. Husain et al. (2008) assess the impact of oil price shocks on non-oil economic cycle in 10 oil-rich countries, including Oman over the period 1990-2007. The obtained results from a panel VAR show that in countries where the oil sector is dominant, oil price changes affect the economic cycles through the fiscal policy channel.

In their examination of the behaviour of government expenditure during boom-bust in commodity price cycles of 32 oil-rich countries over the period 1992-2009, Arezki and Ismail (2013) found that current spending downwardly rigid, but increase in good times, whilst capital spending behaviour is just opposite to that. In the same line, Pieschancon (2009) used a vector autoregrsssive (VAR) model to assess the impact of oil prices on government revenue, government purchases, tradable and non-tradable output, transfers, private consumption and the real exchange rate for Norway and Mexico over the period 1980-2006. He found that fiscal policy is the most responsive policy to oil prices and argue that is the main transmission channel through which it determines the degree of exposure of the economy to oil price volatility.

The role of the government as well as reallocation process in the economy caused by the fiscal policy is taken into consideration by Cologni and Manera (2011). They address the effects of oil shocks and the expansionary fiscal policy on the business cycle of GCC countries (Oman, Kuwait, Bahrain, Saudi Arabia, UAE and Qatar) by using the real business cycle model. Results revealed that the negative impact of oil shocks on private output, capital and employment can be more than offset by the positive effects of oil shocks on government revenue and expenditure which cause a shift of productive factors from private sector to public sector and so government employment and output both expand causing a boost in the total output

The causality and long-run relationship between government revenue and government expenditure in oil-exporting countries are also documented in the literature. Petanlar and Sadeghi (2012) used panel VAR framework to assess such relationship for 15 oil-exporting countries for 2000-2009. The analysis shows that a 1% increase in oil revenue induces an increase of public expenditure of 1.16%. . Fasano and Wang (2002) examine the direction of causality between total revenue and total government spending for GCC countries including Oman, over the period1980-2000, using a cointegration and error-correction models. The results show that increase in revenue causes an increase in government expenditure in the first period for all GCC countries which means that government expenditure is pro-cyclical to changes in oil revenue.

This paper will focus on the sixth channel: the effect of oil revenues on economic growth and the mechanisms through which that effect can be transmitted to economic growth through government expenditure. I will use time-series analysis to examine how oil revenues affect economic growth both directly and indirectly through fiscal policy channel. Most literature in this area uses cross-country growth regressions, but as shown in the literature there is some case studies. In contrast with existing cross-country growth regression, using of time series cointegration technique and Granger causality models to examine the causal chain linking oil windfalls to economic performance through fiscal policy channel for specific case study (Oman) would add some contribution to this literature. This paper therefore is an attempt to empirically examine oil revenue changes and fiscal policy through government spending on the Omani economy.

4. The Data and Research Methodology

4.1 Details about the Variables

Three macroeconomic variables are used to analyse the dynamic relationship between oil revenues, government expenditure and GDP for Oman. The variables are REV = Real Oil Revenues, EXP = Real Total Government Expenditure and GDP = Real Gross Domestic Product (GDP).

The time period of the study is from 1980 to 2013. Oil revenues, total government expenditures, and GDP are the main variables in this study. Data are sourced from National Statistical Hand Book of Omani economy released by National Centre for Statistics and Information.

4.2 The Research Methodology

The objective of this paper is to investigate the dynamics of the relationship between oil revenue, government expenditure and economic growth in Oman using the annual data for the period 1980 to 2013. In this study, the variables are real oil revenue (OilR), real government expenditure (RGE) and real GDP (RGDP). All the variables are taken in their natural logarithms to avoid heteoscedasticity. There is a large number of macroeconomic variables which affects economic growth and may equally be considered, beside oil revenue and government expenditure. Including such variables into the specification increase the fit of the model, but would decrease the degree of freedom. For this reason the model is restricted to only these three interested variables.

To reach the purpose of this study some econometrics techniques are employed in this study such as cointegration and error correction technique. Moreover, some useful tools on these techniques such as impulse response functions and variance decomposition are used to examine the dynamic effects of oil revenue shocks on the Omani macroeconomy. The entire estimation consists of three steps: first, unit root test, second, cointegration test, third, the error correction models used.

4.2.1 Unite Root Test

As a first step we check the stationarity properties of the used variables. The order of integration for each variable is determined using Augmented Dickey- Fuller (1979) and Philips and Perron (1988) tests. Augmented Dickey-Fuller (ADF) unite root tests consists of running a regression of the first difference of series against the series of lagged once, lagged difference terms and optionally, a constant a time trend as following:

The investigation of non-stationarity properties of time series is the basic test in empirical investigation in order to avoid spurious results. There are a number of alternative tests of time series properties. In this paper Augmented Dickey-Fuller (ADF) test is used to check the order of integration of variables in our data set. The Augmented Dickey-Fuller (ADF) test is designed to distinguish between stationary either about mean or trend and non-stationary processes (LIoyd and Rayner; 1993). A series Xt is said to be integrated of order d denoted by Xt~I(d) if it becomes stationary after differencing d times and thus Xt contains d unit roots (LIoyd and Rayner; 1993). The general form of the Dickey and Fuller test can be written as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \beta_i \Delta Y_{1-j} + \varepsilon_t \qquad (1)$$

The null hypothesis here is that the investigated variable has a unit root. So if the null hypothesis of α_1 =0 is not rejected, it can be said that the series is non-stationary with a unit root. But if it is rejected which means then X_t is stationary and integrated of order *I (0).*

4.2.2 Cointegration Test

After establishing that interested variables include unit root and they are integrated of the same order one, I(1), the next step is to check whether there is any long-run relationship among them. Johansen's (1988) approach is applied to allow us to test for the presence of multiple cointegration relationships, r, in a single-step procedure. Here we want to determine if oil revenue, total government expenditure and GDP are co-integrated. Cointegration explains how a set of economic variables behaves in the long-run equilibrium. "If several variables integrated, then they may drift apart in the short-run. But in the long-run, economic forces will draw them back to their equilibrium relationship'' (Yuk 2005, pp. 11).

In general, a set of variables is said to be cointegrated if a linear combination of the individual variables is stationary. So if X_t and Y_t are both non-stationary and integrated of order 1 and if residuals (et) of cointegration regression are stationary [i.e., I(0)], then we can say that X_t and Y_t are cointegrated. Pesaran and Pesaran (1997) argued that Engle-Granger cointegration test is inefficient and can lead to contradictory results, but Inder (1993) mentions that it is good regression for modelling long-run equilibrium relationship. Holden and Thomson (1992) argue that this approach is efficient because it reduces the problem of multicollinearity. Indeed, most researchers that used bivariate system prefer to use Engle-Granger two steps approach.

The long run relationships between Oil revenue, government expenditures and Gross domestic product (GDP) are estimated by ordinary least square (OLS) (i.e., cointegrating regression) as following:

$$\ln GDPt = \alpha + \beta \ln OILRt + \beta 2 InGEt + \varepsilon_t \qquad (2)$$

Where GDPt is real GDP, OILRt is real oil revenue, and GEt is real total government expenditure. Equation (2) presents an estimation of the long-run relation between total government expenditure, Oil Revenue and gross domestic product (GDP) all are in natural log and real terms.

4.2.3 Error Correction Model (ECM)

After cointegration is confirmed between variables, then the third step is developing a class of models that embodies the notion of correction. This term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of short-run adjustments. The whole system is referred to as Error Correction Model (ECM) and it is used to allow for short-run adjustment dynamics and indicate the speed of such adjustment to the long-run equilibrium state. In general, an ECM derived from the Johansen test can be expressed as follows:

$$\Delta x_t = \mu_x + \alpha_x ECT_{t=1} + \sum_{k=1}^{p} \beta_{xx,k} \Delta x_{t-k} + \sum_{k=1}^{p} \beta_{xy,k} \Delta y_{t-k} + \sum_{k=1}^{p} \beta_{xz,k} \Delta z_t + \varepsilon_{xt}$$

$$\Delta z_t = \mu_{zx} + \alpha_{xz} ECT_{t=1} + \sum_{k=1}^{p} \beta_{zx,k} \Delta x_{t-k} + \sum_{k=1}^{p} \beta_{zy,k} \Delta y_{t-k} + \sum_{k=1}^{p} \beta_{zz,k} \Delta z_t + \varepsilon_{zt}$$

$$\Delta y_t = \mu_y + \alpha_x ECT_{t=1} + \sum_{k=1}^{p} \beta_{yx,k} \Delta x_{t-k} + \sum_{k=1}^{p} \beta_{yy,k} \Delta y_{t-k} + \sum_{k=1}^{p} \beta_{yz,k} \Delta z_t + \varepsilon_{yt}$$

where $ECT_{t=1}$ is the error correction term lagged one period, α is the short-run coefficient of the error correction term (-1< α<0), *X, Z, and Y are* the three endogenous variables in the system; and $\beta_{ij,k}$ describes the effect of the *k*th lagged value of variable *j* on the current value of variable *i*; *i*, *j*=*x*,*y*,*z*. The ε_{it} are mutually uncorrelated white noise residuals.

The error correction term represent the long-run relationship. A negative and significant one indicates the presence of long-run relationship. However, the coefficients of lagged explanatory variables indicate a short-run causality relationship between the examined variables.

4.2.4 Impulse Response Functions (IRF)

Because we are interested on checking the dynamic effects of oil revenue shocks on government expenditure and economic growth, IRF are the most appropriate tool to use for such purpose. Through IRF we can observe the effect and statistical significance of these variables responses to one standard deviation increase in oil revenue shock.

4.2.5 Variance decomposition analysis

The relative importance of oil revenues shocks in changes of other variables in the VAR system can be traced by using the variance decomposition analysis. It shows the percentage of change in a specific variable in connection with its own shock against the shocks to the remaining variables in the system. The whole system is studied by examining the variance decomposition of the system. The higher the share of explanation of error variance, the more important the variable compared to other variables in the system. The Choleski decomposition method is used to construct the variance decompositions.

5. Discussion of the Estimated Results

5.1 Unit Root Tests Results

It is essential to determine the level of the integration of the variables so as to determine whether it is appropriate to conduct the Johansen cointegration. The test requires all the variables should be non-stationary and should belong to the same level of order of integration. Augmented Dickey Fuller, ADF and the Philips-Perron, PP tests were used for that purpose. Table 1 reports the results for ADF and PP test for the level of integration of the variables. It is evident from the results that all the variables are non-stationary *I(1)* on levels and stationary *I(0)* on first difference. Therefore, it is appropriate to use the Johansen cointegration test in order to explore the long-run relationship between these macroeconomic variables.

Table 1
Unit Root Tests

ADF Test				
Variables	**LRGDP**	**LRGREV**	**LRGEXP**	**LROP**
Levels	6.302	-0.504	-1.858	-1.501
First Difference	-4.124**	-6.510**	-5.372**	-6.520**
Philips-Perron Test				
Levels	-2.416	-0.437	-1.845	-1.505
First Difference	-4.097**	-6.568**	-5.372**	-6.489**
** Signifies rejection at the 0.005 level.				

5.2 Johansen Cointegration Results

The Johansen cointegration tests, discussed in Section 4.2.2, are carried out on the macroeconomic variables in the model specified in equation 2. In addition, real oil prices, ROP, were used in place of the real oil revenue variable. The results for the two models are reported in Table 2. Both the Trace and the Max-Engen Statistics for the two estimated models show that the null of no cointegration among the variables is rejected in favour of the alternative.

Table 2 reports the results for the long-run equilibrium relationship between the variables. The estimated coefficients for the real oil revenues and the real government expenditure (LRGREV and LGEXP) are correctly signed and statistically significant at 5% level. Both variables depict positive relationship with GDP which are 0.672 and 0.872 respectively. This is consistent with Hamdi and Sabia (2013) findings for Bahrainan economy, which is an oil-exporter. Theoretically, for oil-importing countries, a negative sign is expected as recorded for New Zealand by Grounder and Barleet(2007) and Japan by Jin (2008).

Table 2
Johansen Cointegration Test Results

Model 1: RGDP, RGREV, RGEXP		
Hypothesised No. of CE(s)	Trace Statistic	Max-Engen
None**	34.585	26.497
At most 1	8.085	7.378
Model 2: RGDP**, RGREV, ROP**		
Hypothesised No. of CE(s)	Trace Statistic	Max-Engen
None**	44.729	26.480

At most 1	18.249	11.439
** Denotes rejection of the hypothesis at the 0.05 level.		

Thus, we can derive the cointegrating equation from the above results with the log of real GDP as dependent variable while log of real oil revenue and log of real government expenditure as regressors, as follows:

LRGDPt = 4.572 + 0.672 LRGREV + 0.872 LRGEXP

Looking critically at the numerical values of the coefficients and the their effects, The above equation is saying that a 10% permanent increase in oil revenue will cause the real GDP to increase by 6.7%, while the same 10% increase in government expenditure will increase real GDP by 8.7%. This shows that Oman's GDP increase more by fiscal policy channel and this is consistent with Bleaney and Halland (2009) Who argue that fiscal policy acts as a transmission mechanism for natural resource effects.

Table 3
Results of the Long-run Equilibrium Relationship
The Dependent Variable is LRGDP

Regressors	**Coefficients**	**t-Values**
LRGREV	0.672**	2.198
LRGEXP	0.871**	2.557
C	4.572**	
** Denotes significance at 5% level.		

The results of the estimated ECM are represented by Table 4. The results show the short-run dynamics of the variables in the model. It is evident from the table that real oil revenues recorded a significant negative response to the real GDP. The negative effect of oil revenue on economic growth in the short run could be attributed to oil price volatility where most oil-abundant countries vulnerable to boom-bust cycles leading to economic instability (Mehrara, 2008). Budina and Wijnbergen (2008) stated that managing oil revenue volatility is the main challenge facing oil-rich countries. Oman should use oil funds and fiscal rules to de-link public expenditure from volatile oil revenue by accumulating large oil funds assets to lower vulnerability to financial crises and debt overhang problems.

Table 4
The ECM Results

Regressors	**Coeeficients**	**t-Values**
ΔLRGREV(1)	-0.238	-3.696
ΔLRGREV(2)	-0.323	-4.966
ΔLRGEXP(1)	0.120	0.032
ΔLRGEXP(2)	-0.079	-0.701
ECM	-0.299	-4.051
Diagnostics Tests		
White Test	Chi-Sq.	Prob.
	82.237	0.534
LM Test (Serial Correlation)	LM-Stat.	Prob.
	7.836	0.551
Normality Test	Jarque-Bera	Prob.

	2.397	0.880

The ECM has the expected sign (negative) and highly significant. The coefficient of the ECM indicates that the system converges back to equilibrium in about three years whenever it deviates from the equilibrium. The lower part of Table 4 reports the diagnostic tests of the model. It is clear from the reported results that the model's residuals are free from serial correlation, hetroskesdascity and are normal, which means the estimated model is adequate.

5.3 Causality Test Results:

Table 5 reports results from Granger Causality Test based on the estimated VEC model discussed above. The results for model with the real GDP as a dependent variable indicate that the null of real government revenue does not Granger cause real GDP is rejected in favour of the alternative. Similarly the null of real government expenditure does not Granger cause real GDP is also rejected in favour of the alternative. The combine effects of both the real revenue as well as the real government expenditure show that they have significant impact on the real GDP as the null is rejected. However, both models where the dependent variables are real government expenditure and real government revenue, the null could not be rejected as none of the variables are significant at any conventional level. This is the case with the individual variables and their combined effects.

The conclusion, therefore, is that the direction of the causation between these series is uni-directional from real government expenditure and real government revenue to real GDP. That is the real government expenditure and the real government revenue Granger causes the real GDP, but not the other way round. This result is consistent with with Eltony and Al-Awadi (2001) about Kwait, and Hamdi and Sbia (2013) about Bahrain economy.

Table 5
VEC Multivariate Granger Causality Tests

Dependent	Independent	Chi-Square	Prob
GDP	GREV	36.31**	(0.00)
	GEXP	18.45**	(0.00)
	All	8.45**	(0.00)
GREV	GDP	10.20	(0.12)
	GEXP	8.71	(0.19)
	All	14.60	(0.24)
GEXP	GDP	6.87	(0.33)
	GREV	2.69	(0.65)
	All	9.58	(0.65)

** signifies rejection at 5% level of significance.

5.4 Impulse Response Functions

Figure 1 (Appendix A) reports the impulse response functions, IRFs, of the estimated stationary VAR explained in Section 4.2.5 above. The IRFs show the magnitude and the directions of how a variable respond to a shocks within the model. The reported result shows that real government expenditure responded positively to a positive real oil revenue and real GDP shocks immediately after the shock and lasted for about half of a year for the former and for about one year for the latter. Importantly, the real GDP has responded positively to a positive real expenditure for up to about three years. This and the positive long-run coefficients reported in Table 3 indicate that the Omani economy appears to have escaped from the resource curse as suggested by Abidin (2001).

5.5 Variance Decomposition

Variance decomposition shows the contribution of each variable to the variations of a variable within the estimated VAR model. Table 1 (Appendix A) reports the variance decomposition of the estimated tri-variate VAR mode as explained in Section 5.2.6.

- GDP:

The table shows that the variation of GDP is due to itself in the short-run, but the oil revenue accounted for about 50% of volatility in GDP by the eighth year and continued to rise up to about 52% by the tenth year.

- Oil Revenue:

The real GDP contributed by about 28% of the oil revenue variations by the second year and its contribution to the changes in the oil revenue declined a little to about 22% by the tenth year. Government expenditure affected oil revenue at long lags, the results shows that in the first year, government expenditure did not contribute to shocks in oil revenue, but then increasing effects continue until it reaches 17% in the eighth year. This might be attributed to public investment in oil production which does not produce outcome in the short-term.

- Government Expenditure:

Variations in government expenditure are generally due to the real GDP and the oil revenue. An interesting aspect of the result is that oil revenue shocks effects on government expenditure jump from 2.5% in the first year to 21% in the second year and 39.5% in the fifth, then it level off around 45%. This confirm the need of introduction of fiscal rules and fiscal stabilization policy to avoid oil revenue variability. This result contradicts with Farzanegan and Markwardt (2008) study who show that oil shocks have insignificant effect on government expenditure variation.

6. Conclusion and Policy Implication

This paper investigates the short-run and long-run relationship between three macroeconomic variables in Oman using the Johansen cointegration techniques as well as the stationary VAR. The results indicate that there is a long-run relationship between the three macroeconomic variables; the real GDP, the real government expenditure and the real oil revenues. The long-run coefficients indicate that there are positive long-run relationship between the real GDP, real government expenditure and the real oil revenues. These indicate that the Omani economy has escaped the resource curse as suggested by by Abidin (2001).

As suggested by Mashaekhi (1998) government is an important institution in the development process and good fiscal policy could play an important role in switching the natural resource curse to be blessing. In general, oil revenue is beneficial to economic growth in Oman, but could be more effective if associated with fiscal policy de-linking fiscal expenditures from oil revenue to insulate the economy from oil revenue volatility (Mehrara, 2008)

The impulse response functions and the variance decomposition from the stationary VAR show that these variables are very important to the short-run and long-run dynamics of the Omani economy. Importantly, the real expenditure appears to have positive impact on the real GDP and variations in government expenditure are generally derived by the changes in the oil revenue. Thus, we can argue that the transmission channel that oil revenue affect GDP is through government expenditure, hence, Oman should control its expenditure mange oil revenue instability and be more inductive for economic growth.

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Appendix A:

Figure 1
The Impulse Response Functions

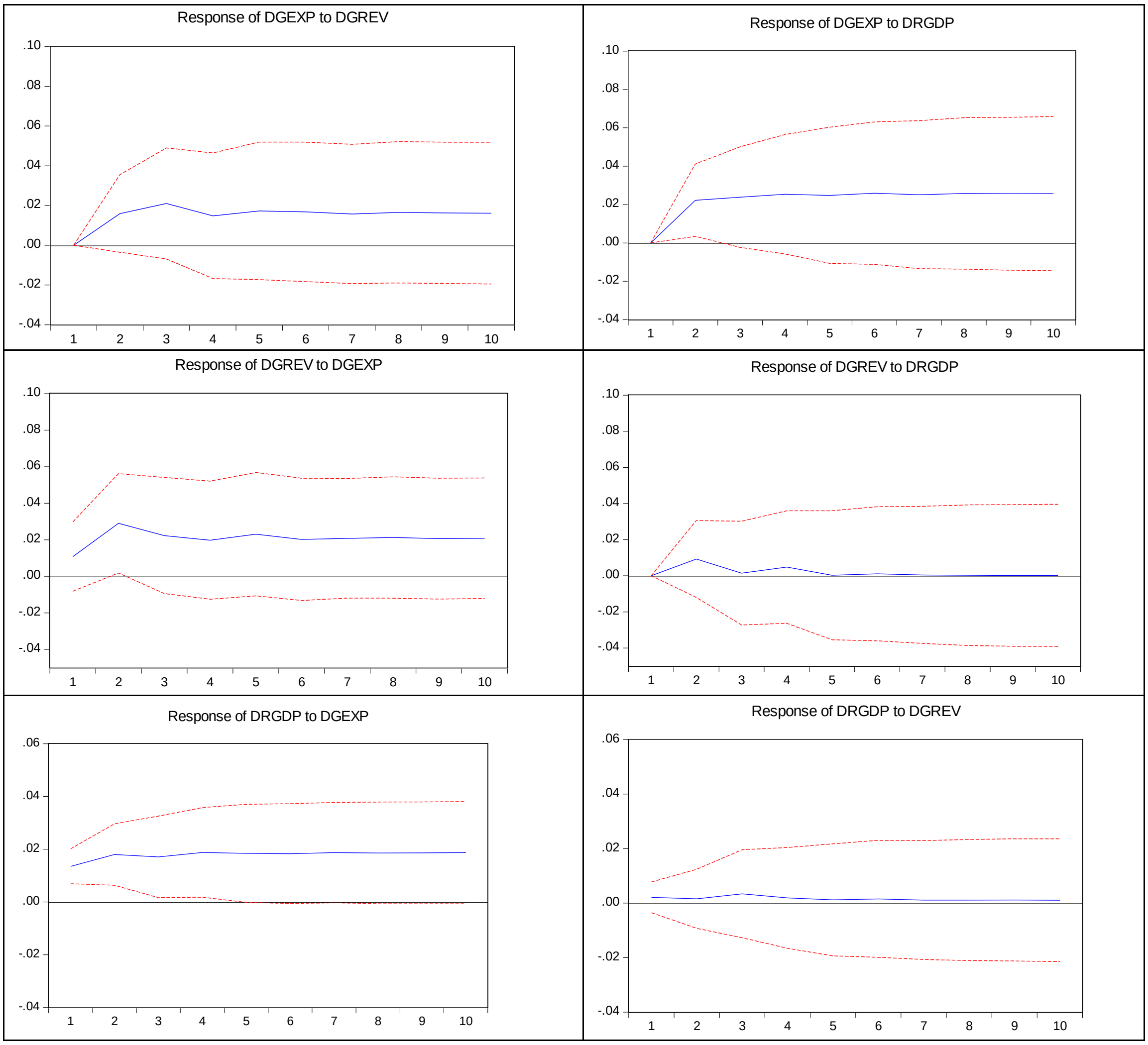

Table 1

Variance Decomposition of LRGDP:

Period	S.E.	LRGDP	LRGREV	LRGEXP
1	0.019236	100.0000	0.000000	0.000000
2	0.025780	96.00899	3.754790	0.236217
3	0.027746	93.51303	4.680203	1.806768
4	0.029393	93.28294	4.861236	1.855829
5	0.032227	80.50164	17.94302	1.555337
6	0.036232	65.88419	32.41498	1.700836
7	0.040550	55.16743	43.40800	1.424575
8	0.044203	48.68998	50.11113	1.198887
9	0.046374	46.30299	52.47709	1.219918
10	0.047235	47.11831	51.70587	1.175822

Variance Decomposition of LRGREV:

Period	S.E.	LRGDP	LRGREV	LRGEXP

1	0.057371	7.354833	92.64517	0.000000
2	0.077145	27.83866	69.66278	2.498566
3	0.087401	22.13717	72.09963	5.763205
4	0.093227	21.34961	70.07387	8.576517
5	0.097830	23.85404	67.59860	8.547356
6	0.099280	24.02743	66.34343	9.629139
7	0.101690	22.98328	63.27484	13.74189
8	0.104283	21.85471	61.09466	17.05063
9	0.105141	22.27976	60.21450	17.50574
10	0.105296	22.30394	60.21295	17.48311

Variance Decomposition of LRGEXP:

Period	S.E.	LRGDP	LRGREV	LRGEXP
1	0.047059	46.83415	2.573061	50.59279
2	0.066897	53.34415	21.06897	25.58687
3	0.078759	46.50137	32.80002	20.69860
4	0.083580	45.89488	34.17667	19.92844
5	0.087847	42.35642	39.51189	18.13169
6	0.091434	39.09842	44.10727	16.79431
7	0.092242	38.99979	44.49896	16.50125
8	0.095503	36.43489	46.91820	16.64690
9	0.096875	35.73676	48.08446	16.17879
10	0.097428	36.26905	47.71461	16.01634