Tasmanian School of Business and Economics
University of Tasmania

Discussion Paper Series N 2021-04

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ISBN 978-1-922352-70-5

Oil Prices and Fiscal Policy in an Oil-exporter country: Empirical Evidence from Oman

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Abstract

This paper studies the impact of oil price shocks on fiscal policy and real GDP in Oman using new unexplored data. We find that an oil price shock explains around 22% and 46% of the variation in the government revenue and GDP, respectively. Decomposing the government revenue and GDP further into petroleum and non-petroleum related components, we find that an oil price shock explains around 26% of the variation in petroleum revenue and 90% of the petroleum-GDP. Though petroleum and non-petroleum GDP respond positively to oil price shocks, government expenditure is not affected by oil prices but is affected by government revenue. The results suggest that the Omani government uses its reserve fund and local and international debt to smooth and reduce the impact of oil price fluctuations.

Keywords: oil price shocks, fiscal policy, GDP, SVAR

JEL Classification: C32, E17, E62, N15

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1 Introduction

The objective of this study is to investigate the impacts of oil price shocks on an oil-exporter small open economy such as Oman. To realize and quantify the impact of oil price shocks on the economy, it is critical for a resource reach economy like Oman to understand the optimal fiscal responses to oil shocks. For example, between June 2014 and January 2016 oil prices declined from around $110 to $40 a barrel. The International Monetary Fund (IMF) has documented that, due to the plunge in oil prices, the current account balance in oil-exporting Middle East and North Africa countries on average shifted from 8.8% as a percentage of gross domestic products (GDP) surplus in 2014 to 3.6% deficit in 2016.

For the Omani economy, 2014-2016 declined in oil prices, resulted in the value of exports declining by 23% in 2016 while the nominal GDP contracted by 16% and 5.2% in 2015 and 2016 respectively.[2] Consequently, rating agencies downgraded the credit rating of the Omani debt in 2015, 2016, and 2017.[3] These events show the sizable impact that oil has on Omani government revenue, exports, and output. The government responded to these events in several ways. It removed the subsidy on fuel products in 2016, restructured corporate taxes in 2017, and imposed 5% value-added taxes in April 2021. The government established two new units in the ministry of finance (fiscal policy and debt management office.

Kilian (2009), Baumeister and Gert Peersman (2013), Baumeister and Kilian (2013), Aastveit et al (2015), Baumeister and Kilian (2016), Vespignani and Ratti (2016) and Raghavan (2020) show empirically that oil prices are shaped by global supply, demand and global business cycle fluctuations, implying that oil is one of the most traded commodities in the world. Baumeister and Kilian (2016), and Hamilton (2011) described the main geopolitical and economic events which created large fluctuation in oil prices since the 1970s.[4] Arezki and Blanchard (2014) documented that the impacts of these oil price shocks have varied across oil-exporting countries, depending on the percentage of the oil sector's contributions to export, government income, and GDP, and the ability of the government to boost the economy with countercyclical policy through monetary and fiscal policies. Further, Arezki and Ismail, (2013) argue that because of the government expenditure stickiness and the high percentage of oil revenue in the total government revenue, oil-exporting countries face considerable challenges in adapting to oil price swings.

We present novel results from the unexplored data from the National Centre for Statistics and Information of Oman (NCSI) by developing a six variable vector autoregressive (VAR) model with

[2] From different issues of the statistical yearbook, NCSI, Oman.
[3] https://tradingeconomics.com/oman/rating visited in 27/10/2017.
[4] These events are October 1973-early 1974 the war and oil embargo, October 1978-February 1979 Iranian revolution, September 1980 Iran-Iraq war, August 1990 invasion of Kuwait, March 1999 OPEC meeting, 2003-2008 global economic expansion, 1998 Asian Financial Crisis, 2008 Global Financial Crisis and recent improvement in the shale resource production in North America.

quarterly data from 1989 to 2016 which allow us to quantify the impact of oil shocks on GDP and government revenues. Our results show oil price shocks explain 18.65% of the government revenue in the 1st quarter following the shock, and 55.22% of the GDP. Consistently with Mehrara and Oskoui (2007) findings, these results indicate that oil price, government revenue, and government expenditure have an impact on the economic growth in an oil-exporter small open economy such as Oman.

The impact is even higher on petroleum government revenue and petroleum GDP. However, government expenditure stabilises within six quarters. When examining the subcomponents of government spending, current government expenditure does not respond to oil price shocks, while government investment responds negatively. Considering the impact of government revenue and government expenditure, GDP responds positively and significantly to both variables' shocks. The results indicate that oil price, government revenue, and government expenditure have an important impact on the economic growth in Oman. The results also show a classic symptom of the "Dutch disease" literature, where oil price shocks appreciate the exchange rate.

The Dutch disease is a process of a boom in a natural resource sector that results in shrinking the non-resource tradable, leading to specialization in the resource sectors leaving the economy more vulnerable to resource-specific shocks. Torvik (2001) argue that the Dutch disease phenomenon is specific for each economy depending on the characteristics of country-specific characteristics such as the mix of tradable and non-tradable sectors.[5]

This fills the gap in the literature which study several aspects of oil shocks for an oil-exporter small open economy. The first aspect is the global determination of oil prices which is required the assumption that an oil-exporter small open economy takes oil prices as a given. The second aspect is the impact and responses of fiscal policy of oil shocks from an oil-exporter small open economy, finally, this study is also linked to the so-called "Dutch disease" as the exchange rate may hurt other sectors of the economy when oil prices are high.

The paper is structured as follows: Section 2 includes an overview of the Omani economy; Section 3 describes the data and introduces the methodology; Section 4 discusses the empirical results for the impulse response function, the forecast error variance decomposition and the historical decomposition of the key shocks; Section 5, includes the conclusion and the policy implications.

[5] Using cross-country data, Sachs and Warner (2001) find that natural resource abundance harms growth. Ismail (2010) find that natural resource exports negatively affect manufacturing exports in a cross-country analysis.

2 Oman economy and oil prices

Over the last forty years, the petroleum sector has been the main economic activity, government income, and export commodity for Oman. According to the NCSI in 2017, oil has contributed up to 80% of the government's revenue, 60% of export value, and 40% of the GDP, respectively. Al-Saqri (2010) argue that oil has been the main generator of economic growth since it was discovered in 1964 and exported three years later. Figure 1 shows the co-movements between the annual change in oil prices and Oman's fiscal balance as a percentage of GDP.[6] This figure shows that except for the period 1998 to 2000, oil prices and fiscal balance in Oman are highly correlated. The brief diversion is attributed to the large fiscal reform undertaken by the Omani government which include but not limited to tax incentives, modest procurement preferences, subsidies mostly to industrial and agricultural ventures and tax cuts to encourage foreign direct investment.

Consistently with Arezki and Bruckner (2010) results, Figure 1 illustrates the fiscal problem of commodity-exporter countries in which government debt accumulation arise because public spending is not adjusted sufficiently to accommodate falls in commodity prices. This puts more pressure on the government to achieve fiscal consolidation, sustainability, and to move forward for diversification and pursuing deficit reduction.

Although oil booms play a vital role in improving the Omani economy, they have negative effects on the two main traditional economic sectors: agriculture and fisheries. Currently, both sectors contribute less than 3% of the non-petroleum GDP sector. An increase in government spending on social capital infrastructure and increases in living standards is likely to lead to an increase in the demand for imported commodities and services. Mehrara and Oskoui (2007) argue that fiscal measures in Oman attempt to re-structure the economy towards the non-tradable sector. Currently, the service sector dominates the non-petroleum activities at 43.3%, 44.8%, and 44.3% in 2016, 2017, and 2018 respectively (NCSI, 2019), and contributes to creating a non-competitive industrial sector. Asia is the main market for Omani crude oil. In 2018, Omani oil was exported mostly to China, India, and Japan for 83.1%, 7.6%, and 5.8% respectively (NCSI, 2019). Omani crude oil future contracts are used as flagship contracts by Dubai Mercantile Exchange Limited (DME) which was established for Middle Eastern crude oil exports to Asia.[7]

In Oman, oil price fluctuations and oil depletion are the two main challenges that face policymakers in sustaining economic growth. Oman's share in the total global proved reserve is only 0.3% and the reserves to production ratio, which gives the length of time remaining if the production

[6] Fiscal balance is a representation of the government's fiscal position because governments' express annual targets as a flow term such as, balance, deficit or surplus.

[7] http://dubaimerc.com/about-dme.

rate continues at the same rate, is 14.6 years.[8] A recent survey by the Central Bank of Oman showed that oil price decreases are considered the greatest threat to financial stability in Oman.

Figure 2 shows that a high percentage of the total export value is sourced from petroleum which depended on the trend of the oil price. For instance, the value of petroleum exports declined from 66% in 2014 to 58% in 2015 as oil prices dropped by 45% between2014 to 2015, even though the annual volume production of crude oil increased by 4% in the same period. In Figure 2, the right vertical axis shows the fiscal oil breakeven price (the oil price at which the current account balance is zero). For example, when the oil prices were 103, 57, and 40 US$/BBL in 2014, 2015, and 2016, the breakeven external oil prices were 88, 90, and 75 US$/BBL respectively. As a result, the current account balance fell. Another important point to note from Figure 2, despite oil price fluctuations, the breakeven fiscal oil price increased gradually from less than 50 US$/BBL in 2005 to more than 100 US$/BBL in 2015. This creates a challenge for the government to adjust to oil price changes creating a gap between government revenue and government expenditure as Figure 3 illustrates. Therefore, as shown in Figure 3, the government debt (as a percentage of GDP) increased dramatically to 4.9%, 15.4%, and 33.3% of the GDP in 2014, 2015, and 2016 respectively.

3 Data and methodology

In this paper, our baseline VAR model uses the following variables: oil price, exchange rate, government revenue, government expenditure, inflation, and gross domestic product (GDP). All variables are used in log-first difference form to warrant stationarity. The model includes two blocks, oil price as the exogenous block and the other variables as the domestic block. It studies the petroleum and non-petroleum segment of the economy, breaks down the revenue into petroleum and non-petroleum, the government expenditure into current and investment.

3.1 Data

Oil prices represent the global exogenous factor, and the exchange rate is included to represent the open economy nature of Oman. Government revenue and government expenditure are two fiscal policy variables, and inflation and GDP are two variables representing macroeconomic conditions. Generally, these variables are used to study the business cycle movements and are commonly used in the literature (see for example Eltony and Al-Awadi, 2001; Farzanegan and Markwardt, 2009; Emami and Adibpour, 2012; Hamdi and Sbia, 2013; Dizaji, 2014).[9] A detailed description of the variables can be found in Appendix A2.

[8] Please see: BP statistical review of world energy, June 2017.

[9] Appendix A1 provide a summary of empirical studies on the impact of oil price shock on the macroeconomic variables in oil-exporter economies.

The data source is from the monthly statistical bulletin published by the NCSI, the formal data provider for government data in the Sultanate of Oman.[10] The gross domestic product and consumer price index are provided quarterly, while government revenue (net revenue after transfer to the reserve fund), government expenditure, oil price, and the effective exchange rate index are monthly. For government revenue and government expenditure, three months of data are accumulated to get the quarterly data, while the average of three months of data is used for the oil price and effective exchange rate. The GDP deflator is not available for the whole period. Consequently, the consumer price index is used to convert the data from nominal to constant prices.

Figure 4 shows the log of real GDP, government revenue, and government expenditure on the left vertical axis, while the log of real oil price is on the right vertical axis. There is a co-movement between the four variables with an upward trend. This figure shows the fall in oil price, GDP, and government revenue in 1998, 2008, and since late 2014. It is worth noting as the oil price spikes, the government revenue in Oman does not move in tandem. This observation is expected as the published government revenue is the net revenue after transfer to the reserve fund if the oil price in that period is higher than the anticipated price for a specific five-development plan. In terms of the relationship between government revenue and government expenditure, they are both trending closely upwards. However, in periods where revenue falls, the spending does not respond which reflects the smoothing policy undertaken by the Omani government plus a large chunk of government expenditure is current spending, dominated by salaries. Hence, this provides the government with less space to adjust the expenditure.

We first test the data for stationarity using three different tests: Augmented Dickey-Fuller (ADF), Philips –Perron (PP), and Kwiatkowski-Philips-Schmid-Shin (KPSS). As appendix A3 reports, the results are not consistent across the three tests if the variables are expressed in level and mostly are integrated of order I(1), while it is more consistent for the variables to be stationary I(0) in first difference. Following the literature, all data are expressed in the logarithmic first difference in the vector autoregressive framework.

3.2 The SVAR model

To study the impact of oil price shock on the Omani economy, the six variables described in the previous section are ordered as follows: oil price (OP), the exchange rate (EX), government revenue (GR), government expenditure (GE), inflation (IN), and GDP.

$$y_t = [OP, EX, GR, GE, IN, GDP]' \qquad (1)$$

[10] The first monthly report published in November 1989 and included data for the earlier three months only.

The macroeconomic relationship among these variables is modelled using a structural vector autoregression model (SVAR):

$$\mathbf{B}_0 y_t = \mathbf{B}_1 y_{t-1} + \cdots + \mathbf{B}_p y_{t-p} + \varepsilon_t \qquad (2)$$

Where y_t is $(N \times 1)$ vector of the endogenous variables at time t. The dimension of $\mathbf{B}_0$ is a $(N \times N)$ matrix that illustrates the contemporaneous relationship between the variables. The $\mathbf{B}_i$ where $i = 1, \dots, p,$ show how each variable is affected by its lag as well as by lags of the other variables and ε_t is a $(N \times 1)$ vector of structural disturbances mutually uncorrelated with white noise properties. In this research, one lag is used based on lag order selection criteria results reported in Appendix A4.

Since ε_t and $\mathbf{B}_0, \dots, \mathbf{B}_p$ cannot be estimated in equation (2), we estimate through the reduced form of (VAR) model which can be expressed as

$$y_t = \mathbf{A}_1 y_{t-1} + \cdots + \mathbf{A}_p y_{t-p} + e_t \qquad (3)$$

Here we have $\mathbf{A}_1 = \mathbf{B}_0^{-1}\mathbf{B}_1$ and $\mathbf{A}_p = \mathbf{B}_0^{-1}\mathbf{B}_p$ and $e_t = \mathbf{B}_0^{-1}\varepsilon_t$

This matrix allows us to express the typically mutually correlated reduced form innovation (e_t) as weighted averages of the mutually uncorrelated structural innovations (ε_t) and the elements of B_0^{-1} serving as the weights.

We can express the reduced form equation (3) in terms of the lag operator:

$$y_t - \sum_{i=1}^{p} \mathbf{A}_i y_{t-i} = e_t$$

$$(I - \mathbf{A}_1 L - \mathbf{A}_2 L^2 - \cdots - \mathbf{A}_p L^P) y_t = e_t$$

$$\mathbf{A}(L) y_t = e_t \qquad (4)$$

So, $L^P y_t = y_{t-P}$ defines the lag operator and $\mathbf{A}(L) = I_N - \mathbf{A}_1 L - \cdots - \mathbf{A}_p L^p$

and the inverse of (4) gives the vector moving average to identify the dynamic properties of the VAR

$$y_t = \mathbf{A}(L)^{-1} e_t = \mathbf{\Theta}(L) e_t = \mathbf{\Theta}(L) B_0^{-1} \varepsilon_t \qquad (5)$$

Where $\mathbf{\Theta}(\mathrm{L}) = \mathbf{\Theta}_0 + \mathbf{\Theta}_1 L + \cdots + \mathbf{\Theta}_q L^q$ therefore, the impact of a shock in ε_t on the dependent variables in the future $y_t, y_{t+1}, y_{t+2}, \dots$ are respectively the $(N \times N)$ parameter matrices $\mathbf{\Theta}_0, \mathbf{\Theta}_1, \mathbf{\Theta}_2, \dots$.

Through the moving average, we can get the impulse response function (IRF) and forecast error variance decomposition (FEVD). Impulse responses trace the impact of an unexpected shock in current and future errors of one variable on the other variables while holding other shocks constant. The forecast error variance decomposition (FEVD) is the percentage of the variance in the error of a variable associated with a specific shock in the model and depends critically on the orthogonality of underlying shocks (Stock and Watson, 2001).

As the Omani economy is a small open economy, the structure of the vector autoregressive (SVAR) model consists of two blocks. One block represents the exogenous external variable (oil price), and the second block represents the domestic fiscal policy (government revenue, government expenditure) and macroeconomic variables (exchange rate, inflation, and GDP).

The oil price will affect the domestic variables contemporaneously and in lag, while the oil price is not affected by domestic variables contemporaneously nor in lag as Table 1 shows. Oil price is the most exogenous variable, as it reflects the relationship between supply and demand in the international market. Oman is a price taker and has no impact on the international oil price. In addition, Oman is not a member of OPEC, which may assume to have some influence on the oil price. While the oil price has an impact on the domestic block contemporaneously and in lag but not vice versa. In contrast, the domestic variables affect each other in lag and contemporaneously by using Cholesky decomposition order to get the orthogonalized residuals. So, the order of domestic variables started with the exchange rate, government revenue, government expenditure, inflation, and GDP.

To identify the structural shock, the model should be exactly or over-identified. B_0 has K^2 parameters so we need at least $\frac{K(K-1)}{2}$ restriction to impose on B_0.

$$\begin{bmatrix} e_{OP,t} \\ e_{EX,t} \\ e_{GR,t} \\ e_{GE,t} \\ e_{IN,t} \\ e_{GDP,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{2,1}^{(0)} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{3,1}^{(0)} & \alpha_{3,2}^{(0)} & 1 & 0 & 0 & 0 \\ \alpha_{4,1}^{(0)} & \alpha_{4,2}^{(0)} & \alpha_{4,3}^{(0)} & 1 & 0 & 0 \\ \alpha_{5,1}^{(0)} & \alpha_{5,2}^{(0)} & \alpha_{5,3}^{(0)} & \alpha_{5,4}^{(0)} & 1 & 0 \\ \alpha_{6,1}^{(0)} & \alpha_{6,2}^{(0)} & \alpha_{6,3}^{(0)} & \alpha_{6,4}^{(0)} & \alpha_{6,5}^{(0)} & 1 \end{bmatrix} \times \begin{bmatrix} \varepsilon_{OP,t} \\ \varepsilon_{EX,t} \\ \varepsilon_{GR,t} \\ \varepsilon_{GE,t} \\ \varepsilon_{IN,t} \\ \varepsilon_{GDP,t} \end{bmatrix} \tag{6}$$

The model is exactly identified. For the domestic block, we expect the exchange rate (EX) to be affected contemporaneously only by OP. EX is weighted by the imports of major trade partners of the Sultanate. Oman has used a pegged exchange rate regime to the US dollar since 1973 (CBO, 2018a), and the US currency is the main pricing and settlement currency in oil transactions. The US dollar is affected by the US monetary policy, therefore, the fluctuations of the dollar play an important role in world oil prices (Hou et al., 2016). In addition, countries with abundant natural resources are expected to experience currency appreciation following an oil price hike. So, there is a direct relationship between oil and the exchange rate. The third variable is government revenue (GR), where about 80% is petroleum revenue and 20% is from customs duties, corporate income tax, and other resources. Therefore, GR is assumed to be affected contemporaneously by the oil price and exchange rate. The fourth variable is government expenditure (GE). The government expenditure is divided into current expenditure (dominated by salaries) and investment expenditure (development and capital). We assume that GE is affected contemporaneously by the oil price, exchange rate, and government revenue. The fifth macroeconomic variable is inflation (IN). There are three reasons which explain the inflationary pressure in Oman; government spending, international prices, and the value of the US dollar (CBO, 2017). So, inflation is affected contemporaneously by all variables except GDP. Blanchard and Perotti (2002) indicate that "fiscal variables move for many reasons, of which output stabilization is rarely predominant, in other words, they are exogenous (concerning output) fiscal shocks". In the case of Oman, the fiscal variables move mainly for oil prices and social reasons. The last variable is gross domestic products (GDP) as a proxy for economic growth. GDP is affected by all five variables in the model.[11]

4 Empirical results

This section presents the results from impulse responses, variance decomposition, and historical decomposition of the baseline model. In addition, it reports the results from different specifications of the baseline model which include the subcomponents of government revenue, government expenditure, and GDP.

4.1 Impulse response function (baseline model)

First we present the results of the impact of oil price shocks and fiscal policy shocks in the baseline model which includes the variables: $[OP, EX, GR, GE, IN, GDP]'$. Starting with the responses to oil price shocks, the exchange rate (*EX*) responds positively and statistically significant to the oil price shock as shown in the first graph in Figure 5. This appreciation is expected for countries with abundant natural resources and the result is consistent with Farzanegan and Markwardt (2009) finding for the Iranian economy.[12]

Total government revenue (*GR*) responds strongly and positively to the oil price shock as the second graph in Figure 5 shows. The response is statistically significant; this is expected since petroleum revenue contributes up to 80% of the total revenue. However, the effect on government expenditure (*GE*) is relatively short-lived, stabilizing within six quarters. This result is consistent with

[11] Please refer to Appendix A1 for further justification on the choice and order of the variables.

[12] In contrast, one study found that the exchange rate in Gulf countries does not appreciated as the oil price increased, because these countries pegged their currencies to the US dollar (Setser, 2007).

Devlin and Titman (2004) and Fasano and Wang (2002) who included Oman within the oil-exporting countries for their studies. The result is also consistent with Farzanegan and Markwardt (2009), who found similar outcomes for the Iranian economy. The figure also show that GDP responds positively to the oil price shock. This is anticipated, as petroleum activities contribute a high portion of GDP, i.e., around 40% of the total GDP. In contrast, the oil price shock has no impact on inflation, and it may reflect the impact of the subsidies system in Oman.

Figure 6 illustrates the responses to government expenditure shock. Government revenue responds positively and marginally to government expenditure shocks. The GDP response is positive and statistically significant while inflation responses are negative and significant. The result appear to be conflicting to expectations since the government expenditure was reported as one of the three reasons which explain the inflationary pressure in Oman; along with international prices and the US dollar value (CBO, 2017). This contradicting result may be explained by three possible reasons: (i) inflation in Oman is predominantly imported inflation, as it is a small open economy with pegged currency. Therefore it trends with global inflation (CBO, 2018b). (ii) The export plus import as a percentage of GDP, which is used as a measure for the openness of the economy (Huntington, 2015), is high in Oman. The trade openness as a percentage of GDP is 93.6% and 77.4% in 2015 and 2016, respectively. Moreover, import merchandise as a percentage of GDP is high; it is around 42.5% and 35.9% in 2015 and 2016 respectively (CBO, 2017). (iii) The subsidies system in Oman includes subsidies for food commodities, the electricity sector, fuel products, and housing loans (NCSI, 2017). The model does not capture the source of inflation and as reported in Table 2, the variance decomposition results highlight that the variation in inflation is mostly due to its own shock.

4.2 Different model specifications

This subsection presents different specifications of the baseline model; it includes the subcomponents of government revenue, government expenditure, and GDP. As we noticed earlier in the baseline model, inflation does not respond to the other variables in the model except to government expenditure. Therefore, inflation has been excluded from the extended model specifications. This exclusion is perceived to be fine as inflation in Oman is largely imported inflation, and as a small open economy with pegged currency, Oman's inflation trends with the global inflation (CBO, 2018b).

4.2.1 Petroleum government revenue versus non-petroleum government revenue

In this new model set-up, we study the impact of petroleum government revenue and non-petroleum government revenue. We replace the government revenue from our baseline model with petroleum-government revenue (*GR_P*). As mentioned earlier, petroleum revenue contributes 80% of the total government revenue (Equation (1) is replaced with Equation (7) below).

$$y_t = [OP, EX, GR\_P, GE, GDP]' \qquad (7)$$

Figure 7 shows that petroleum government revenue response is higher than the total government revenue to oil price shock and the response of government revenue stabilizes at around 0.75, while the response of petroleum government revenue stabilizes at around 0.83. The government expenditure response is minor and slightly statistically significant to a petroleum government revenue shock. The impact is slightly lower compared to the response to the total government revenue. This result implies that the government expenditure does not react much to the petroleum government revenue and oil price changes. Oman adopted a formal saving policy as stated previously, and if the oil price is higher than the anticipated price for a specific five-development plan, the excess revenue goes to the reserve fund. We notice that both GDP and exchange rate respond positively and significantly to the petroleum government revenue.

To examine the impact of non-petroleum revenue, we replace the government revenue from Equation 1, with non-petroleum government revenue (*GR_NP*) as described in Equation (8) below:

$$y_t = [OP, EX, GR\_NP, GE, GDP]' \tag{8}$$

Consistent with expectations, there is no response from the non-petroleum government revenue to the oil price shock as Figure 8 demonstrates. The government expenditure responds positively and statistically significant to the non-petroleum revenue even though it only contributes 20% of the total revenue. The non-petroleum revenue responds positively and significantly to the exchange rate. This may be associated with the contribution of custom duties in non-petroleum government revenue. The exchange rate used in this case is the trade-weighted exchange rate, which is weighted by imports of major trade partners of the Sultanate. A rise in the index of the exchange rate, in this case, indicates that the purchasing power of the Omani rial is increasing. Therefore, as the exchange rate appreciates, we expect imports to increase, and thus the government increase revenue from the customs duties.

4.2.2 Petroleum GDP versus non-petroleum GDP

Gross domestic product in Oman is divided into petroleum GDP (*GDP_P*) and non-petroleum GDP (*GDP_NP*).

$$y_t = [OP, EX, GR, GE, GDP\_P]'$$

Or

$$y_t = [OP, EX, GR, GE, GDP\_NP]'$$

This specification aims to examine the responses of GDP subcomponents to the oil price, government revenue, and government expenditure as Figure 9 shows. As expected, petroleum GDP responds strongly to the oil price shock. Similarly, non-petroleum GDP responds positively and statistically significant to oil price shock; it may be due to the impact of the petrochemical industry and government investment in non-petroleum GDP. Turning to examine the impact of two fiscal policy shocks: government revenue and government expenditure. Petroleum GDP does not respond to government revenue or government expenditure. It is mainly influenced by the global oil price movements which are driven by the global demand and supply conditions, rather than by any domestic driven factors. Compared to that, non-petroleum GDP responds positively and statistically significant to both government revenue and government expenditure. The fiscal policy variables appear to have an impact on non-petroleum GDP while it has no impact on petroleum GDP.

4.2.3 Current and investment government expenditure

In this subsection, we examine the responses of subcomponents of government spending, current government expenditure (GE_C), and investment government expenditure (GE_I), to an oil price shock. The current expenditure in Oman is dominated by salaries, which is less flexible compared to investment government expenditure. For this model we replace Equation (1) with Equation (9) below:

$$y_t = [OP, EX, GR, GE\_C, GE\_I, GDP]' \qquad (10)$$

The variables order are in line with Dizaji (2014) and the discussion of Farzanegan (2011) for the Iranian economy. In comparison, Eltony and Al-Awadi (2001) started with investment government expenditure for the Kuwaiti economy. Figure 10 shows the impact of oil price shocks on the negative current government expenditure which are only statistically significant for the first period and stabilised after six periods. These results are consistent with Eltony and Al-Awadi (2001), who find that oil price shocks do not have much impact on the current government expenditure on the Kuwaiti economy.

Investment government expenditure responses are very large, negative and statistically significant to oil price shocks, indicating that the Omani government adopts a countercyclical policy. This appears to be consistent with Frankel et al. (2013) who analysed the fiscal policy in 94 developed and developing countries including Oman. Their results show that the fiscal policy in Oman was procyclical between 1960 and 1999 while it turned to be countercyclical between 2000 and 2009. Dizaji (2014), on the other hand, found there is a positive and significant impact of government revenue on both current and investment expenditure for the Iranian economy compared to the non-significant impact of oil revenue.

4.3. Forecast error variance decomposition

This section presents the result of forecast error variance decompositions (FEVD) for the baseline model and different model specifications. It shows the percentage that each shock in the model contributes to the predicted error variance for a specific variable within a specific time horizon.

The forecast error variance decomposition for the baseline is presented in Table 2. The results reveal that oil price shocks play a key role in explaining the variance in government revenue and GDP.

It explains 18.65% of variance decomposition for the government revenue and 55.22% for GDP in the 1st quarter. This percentage increases to 22.02% for government revenue while it decreases to 45.62% for the GDP in the 5th quarter and persists until the 15th quarter. Compared to that, besides its own shock, two variables contribute to the variance of government expenditure: oil price and government revenue. Oil price shock contributes by 5.51% in the 1st quarter then increases to 14.03% in the 10th, and government revenue contributes by 3.54% in the 1st quarter increases to 7.41% in the 10th quarter. A government revenue shock explains 4.45% of the GDP's variance in the 1st quarter and increases to 10.63% in the 5th quarter. In contrast, the contribution of government expenditure is lower to the GDP's variances, only 1.57% in the 1st quarter and increased to 1.72% in 5th, 10th, and 15th.

Tables 3 and 4 show the results for forecast error variance decomposition for the model with petroleum government revenue and non-petroleum revenue respectively. The contribution of oil price shock on the variance of petroleum government revenue is higher compared to the total government revenue. Oil price shocks explain 22.14% in the 1st quarter increasing to 25.63% in the 10th quarter of the petroleum government revenue variance. Oil price shock contributes only 1% of the variance of non-petroleum government revenue. On the other hand, non-petroleum government revenue explains a high percentage of the government expenditure variance compared to petroleum government revenue. About 11.67% of the variance decomposition for government expenditure is attributed to non-petroleum government revenue compared to only 4.27% for the petroleum government revenue in the 5th quarter. Petroleum government revenue explains between 4.34% in the 1st quarter and 6.63% in the 5th quarter of GDP's variances. Compared to that, non-petroleum revenue explains close to 0% in the 1st quarter and only increases to 1.46% in the 5th quarter.

Table 5 shows oil price shocks explain a higher proportion of the variance of the government investment expenditure (GE_I) compared to government revenue shocks. In the 5th quarter, 17.11% of the investment expenditure is explained by oil price shock compared to only 3.72% by government revenue. This stems from the fact that the investment expenditure is planned based on the long-term development plans centred on the anticipated future oil prices. In contrast, both oil price and government revenue contributed almost equally to the variance of current government expenditure (GE_C), i.e. 10.98% for the former, and 9.25% for the latter in the 5th quarter. For the impact of the two expenditure components on the GDP, in the 5th quarter, current expenditure contributes only 1.57% only, while investment expenditure contributes by 2.97% to the GDP's variance.

4.4. Historical decomposition

This section presents historical decomposition for the three main variables in the model, namely GDP, government revenue, and government expenditure. The historical decomposition quantifies the importance of different shocks on a variable. Figure 11 shows the historical decomposition of Oman

GDP. This figure shows that oil shocks have had a very large positive impact on GDP during 1999-2000 and between 2002 and 2008. This is consistent with the high oil prices during the 2000's decade attributed to the increase in energy consumption from developing countries, in particular, China (see for example Kilian and Hicks (2013). The main negative contribution of oil prices to GDP is observed during the 2014 plunge of oil prices (see: Baumeister and Kilian (2016)).

Figure 12 shows the historical decomposition of Oman's government revenue. This figure shows that the government revenue is closely linked to oil fluctuations as 80% of the revenue is driven by oil prices. Similar to government GDP, the main positive contributions of oil prices are observed from 1999 to 2000, and from 2002 to 2008. The main negative contribution of oil prices to government revenue is also observed during the large declined in oil prices in 2014.

Figure 13 illustrates government expenditure decomposition attributes. We observe the impacts of the oil price fall in three different periods: Asian Financial crisis, Global Financial Crisis, and the recent fall in oil prices 2014-2016. It is clear that the impact of the 1998 Asian Crisis and recent fall is higher compared to the impact of the 2008 Global Crisis as Asia is the main export destination for Omani crude oil. In addition, the impact of the recent fall on the GDP and government revenue is high compared to the previous two events because of an increase in the supply of shale oil, and increased production from Russia, and Saudi Arabia.

5 Conclusion and policy implication

The study provides a comprehensive analysis of the effect of oil price shocks to an oil-dependent small open economy, which can be used as a guide for policy for other similar economies, particularly in the Middle East such as Saudi Arabia, United Arab Emirates, Iran, Iraq, Kuwait, and Qatar.

Our results show that oil price shocks have a positive impact on the exchange rate, government revenue, and GDP. Though the impact of oil price shock on government expenditure is weak and insignificant, it responds positively to a government revenue shock. The high portion of salaries in government spending, establishment of the saving fund, and using it along with local and international debt to smooth the government spending are possible reasons to explain this weak response.

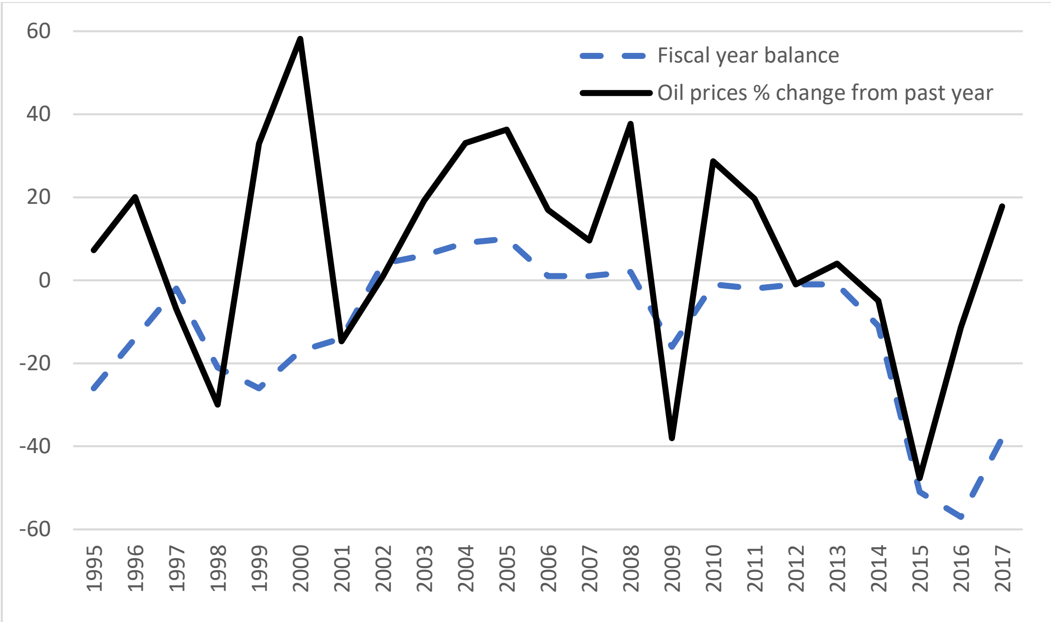
Turning to the model specifications, the petroleum components of GDP and government revenue respond more to oil price shocks compared with the non-petroleum related components. In addition, the oil price has an impact on the non-petroleum GDP, possibly through the petrochemicals industry and government spending. Surprisingly, the investment component of government expenditure responds negatively to the oil price and government revenue shocks. This may be caused by changes in the fiscal policy in Oman from procyclical to countercyclical between 2000 and 2009. It may also be an indicator that the amount allocated for government investment expenditure is not sufficient to create long-term sustainable gain can be associated with crowding-out effects. This needs more investigations which is beyond the scope of this paper.

The results of forecast error variance decompositions support the results from impulse responses. Oil price shocks explain more of the variation in the petroleum-related components compared to non-petroleum. The highest is in the case of petroleum GDP; oil price shock explains 91.51% of the variance in petroleum GDP in the 1st quarter and 90.08% in the 5th, 10th, and 15th quarters.

The historical decomposition for GDP, government revenue, and government expenditure also show that oil price has more impact on GDP and government revenue compared to government expenditure. The oil price shock has no impact on government expenditure which indicates the ability to smooth the spending using saving funds and domestic and international debt. Moreover, since a high percentage of government spending is on current expenditure, this causes difficulties for the government to decrease the spending in response to negative oil price shocks. Although, the government included reduction of fiscal spending as one of the three goals (along with enhancing non-petroleum revenue and pursuing economic diversification) of the 2017 general budget, the current government expenditure could increase due to social and political reasons.

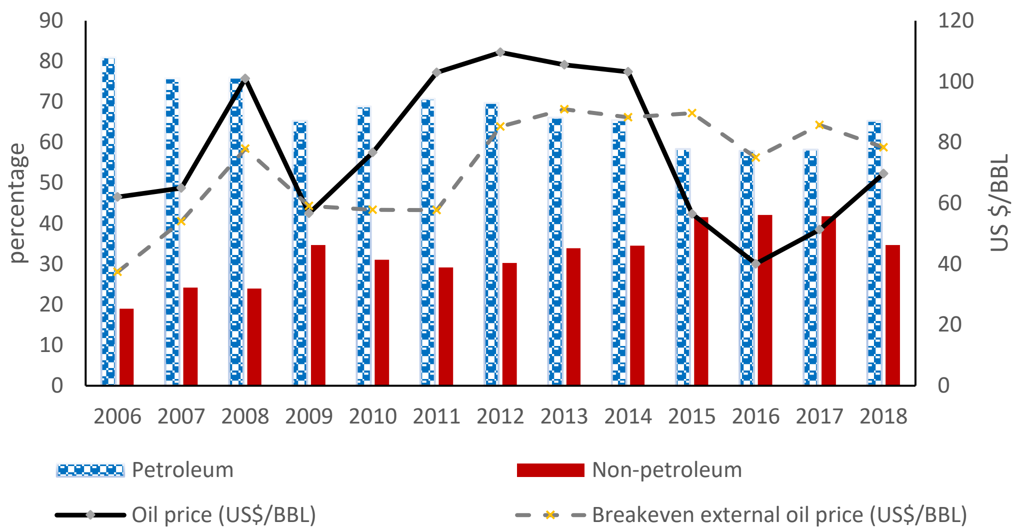
The fiscal policy in oil-exporting countries such as Oman uses public sector employment, higher wage, and social welfare as a tool to share the oil wealth (Chemingui and Roe, 2008). Although, these are good intentions to distribute the oil rent, managing large size government in oil-exporting countries can be a challenge, particularly when oil price declines. Falls in oil prices can be associated with gradual increases in the fiscal breakeven price, which leads to the budget deficit, high debt, and depletion of reserve funds. These outcomes harm the economic legacy for future generations unless the government control its spending and prudently manages the public debt. Currently, the investment is only less than one-third of the total government spending, which is not adequate in the long run to create sustainable growth.

Figure 1. Oman fiscal balance as percentage of GDP and oil prices annual change (1995-2017)



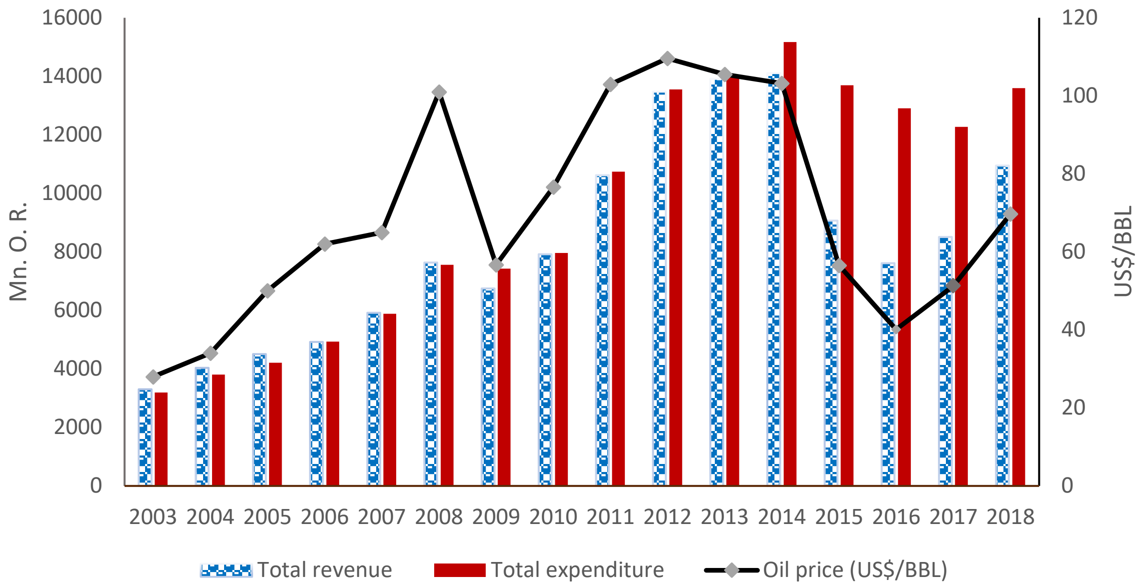
Source: Different issues of the statistical yearbook, NCSI, and IMF.

Figure 2. Percentage of petroleum and non-petroleum from the export value, oil price and breakeven external oil price (2006-2018)



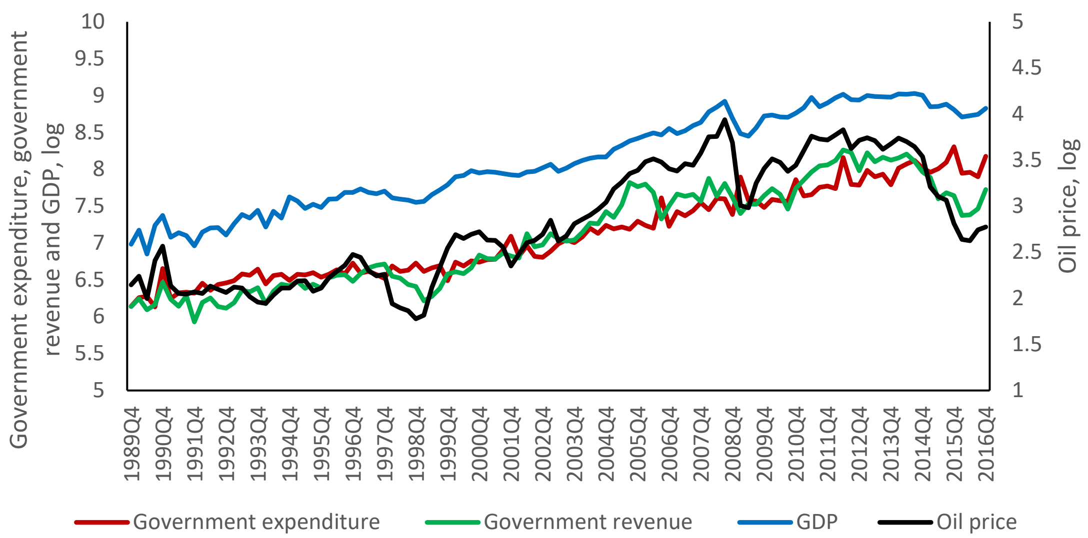
Source: Different issues of the statistical yearbook, NCSI, and IMF.

Figure 3. Oil price, government revenue and expenditure (2003-2018)



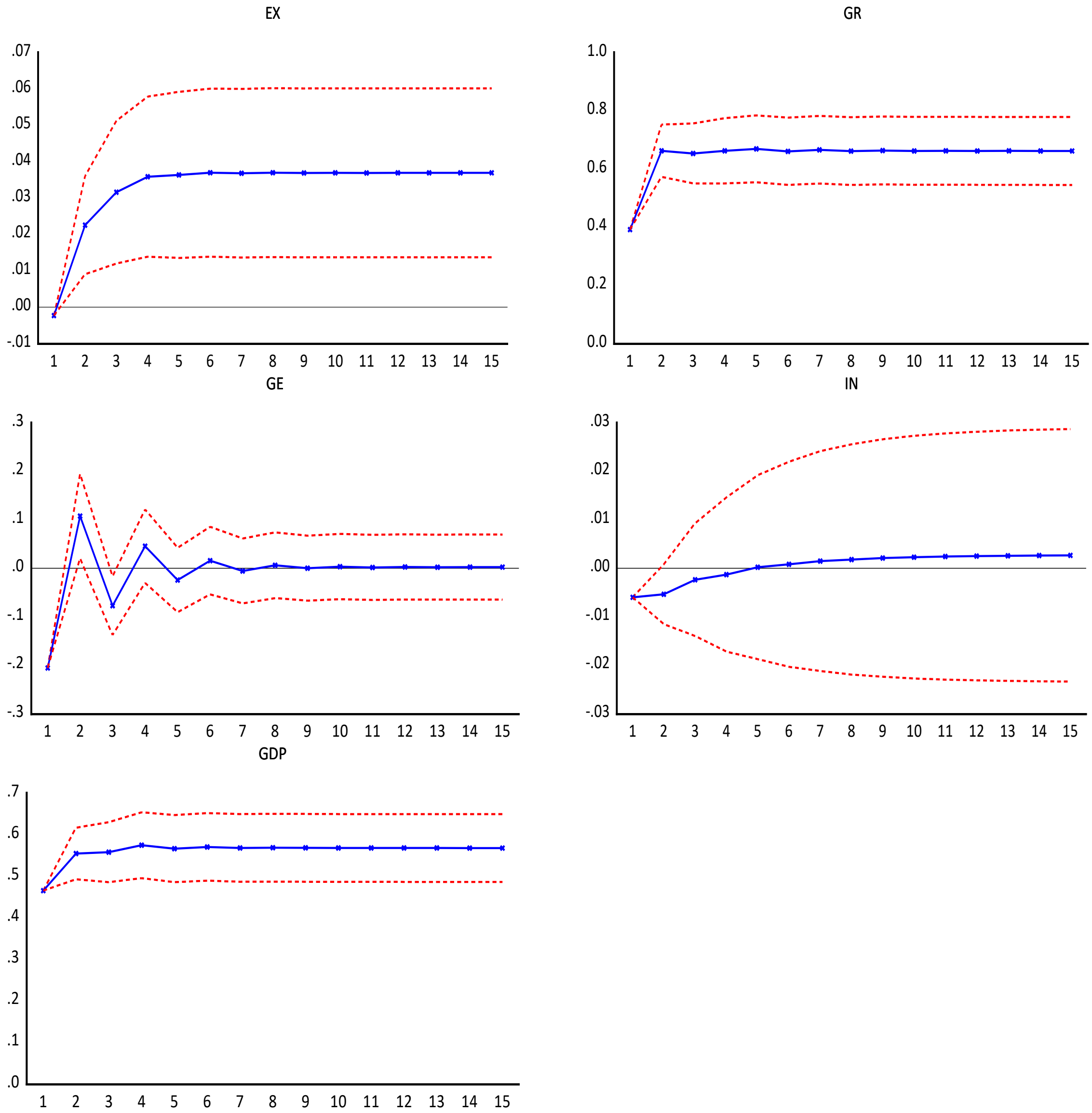
Sources: Different issues of the statistical yearbook, NCSI, the value are in million Omani Rial (Mn.O.R), O.R.1 = US$ 2.6.

Figure 4. The GDP, government revenue, government expenditure, and oil price



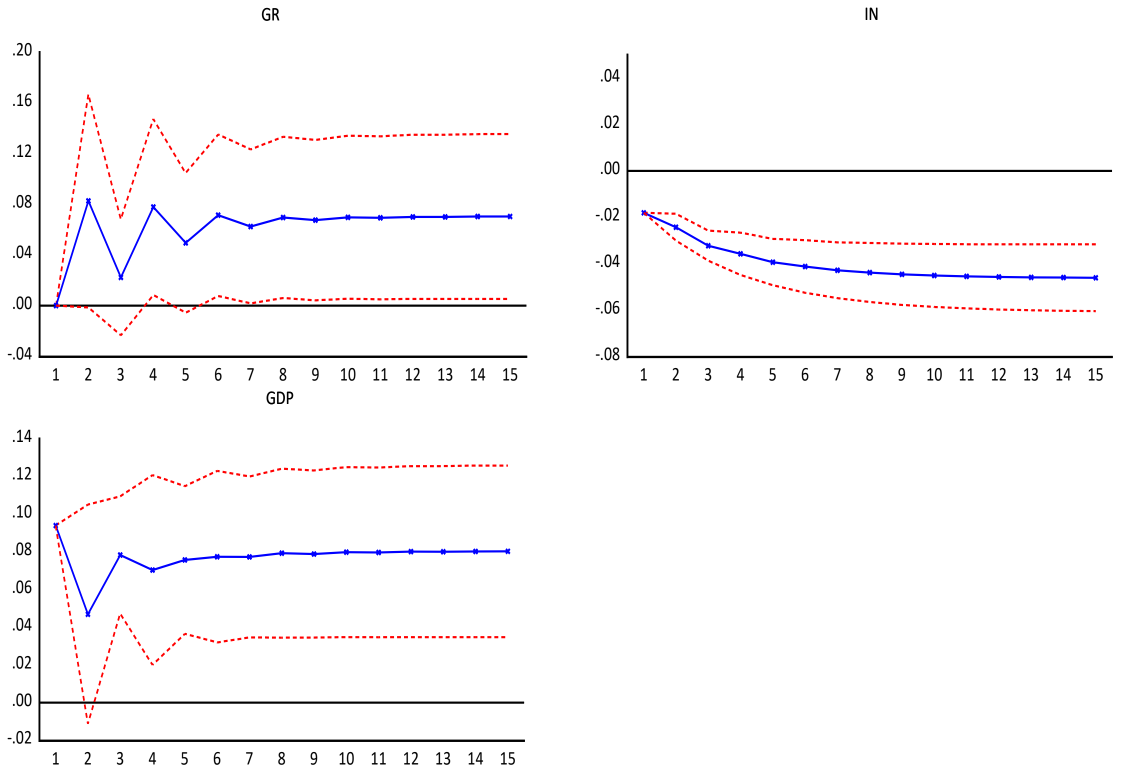
Source: Different issues of the monthly statistical bulletin, NCSI.

Figure 5. Accumulative responses of *EX*, *GR*, *GE*, *IN* and *GDP* to an oil price shock



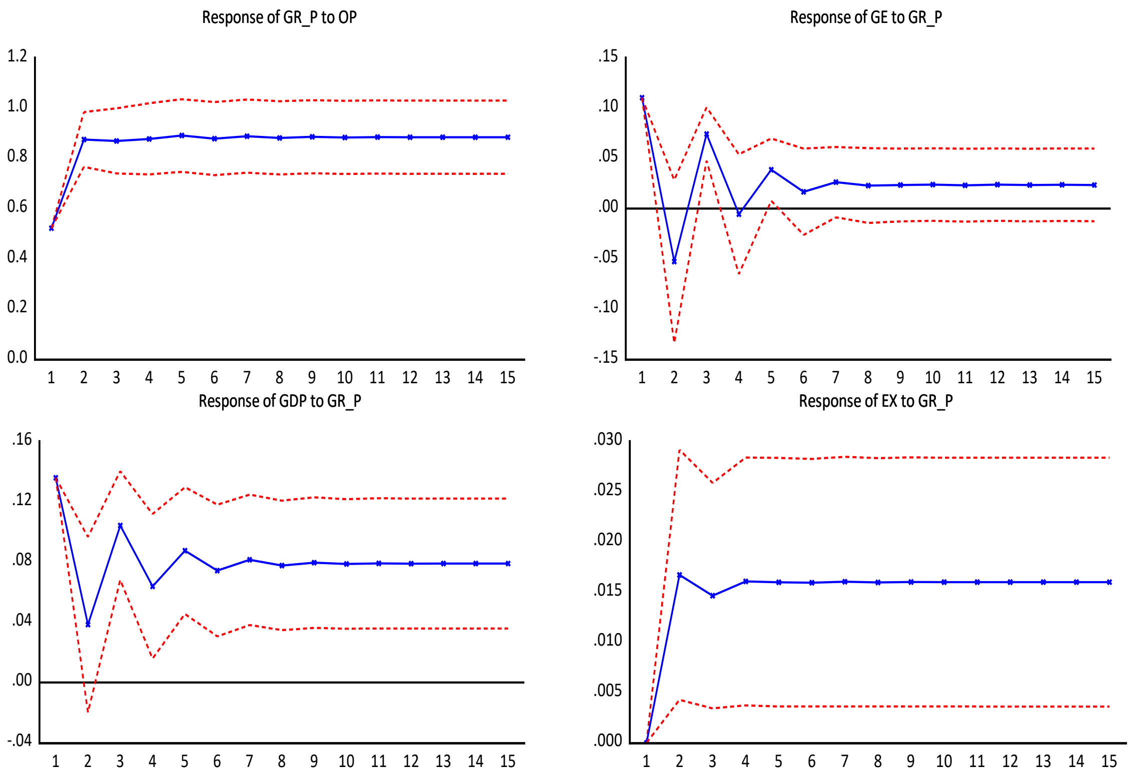
Note: The responses are in the y-axis and time index (quarters) in the x-axis in all figures. The dashed lines represent a two standard error confidence band around the estimates of the coefficients of the impulse response functions.

Figure 6. Accumulative responses of *GR*, *IN* and *GDP* to a government expenditure shock



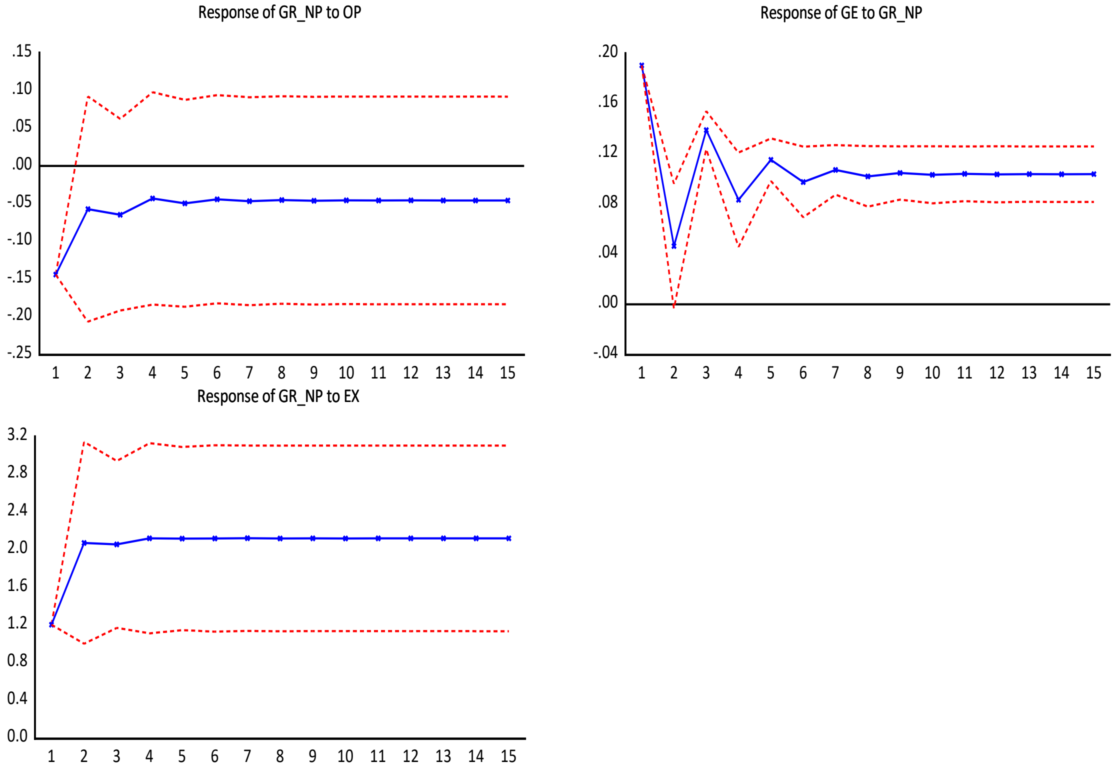
Note: Refer to Figure 5.

Figure 7. Accumulated responses of *GR_P* to an oil price shock and accumulated responses of *GE*, *GDP* and *EX* to a petroleum government revenue shock



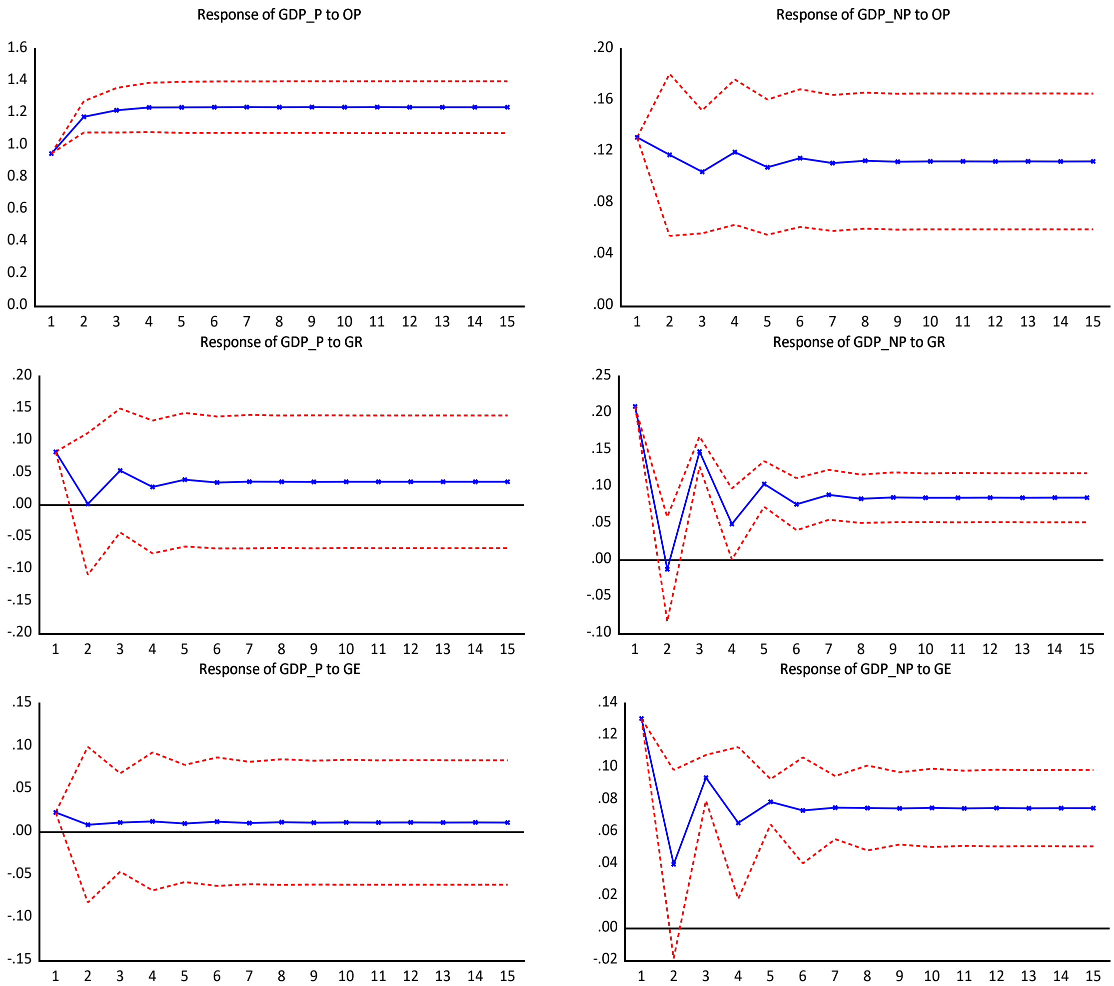
Note: Refer to Figure 5.

Figure 8. Accumulated responses of *GR_NP* to an oil price shock and exchange rate shock and accumulated responses of *GE* to a non-petroleum government revenue shock



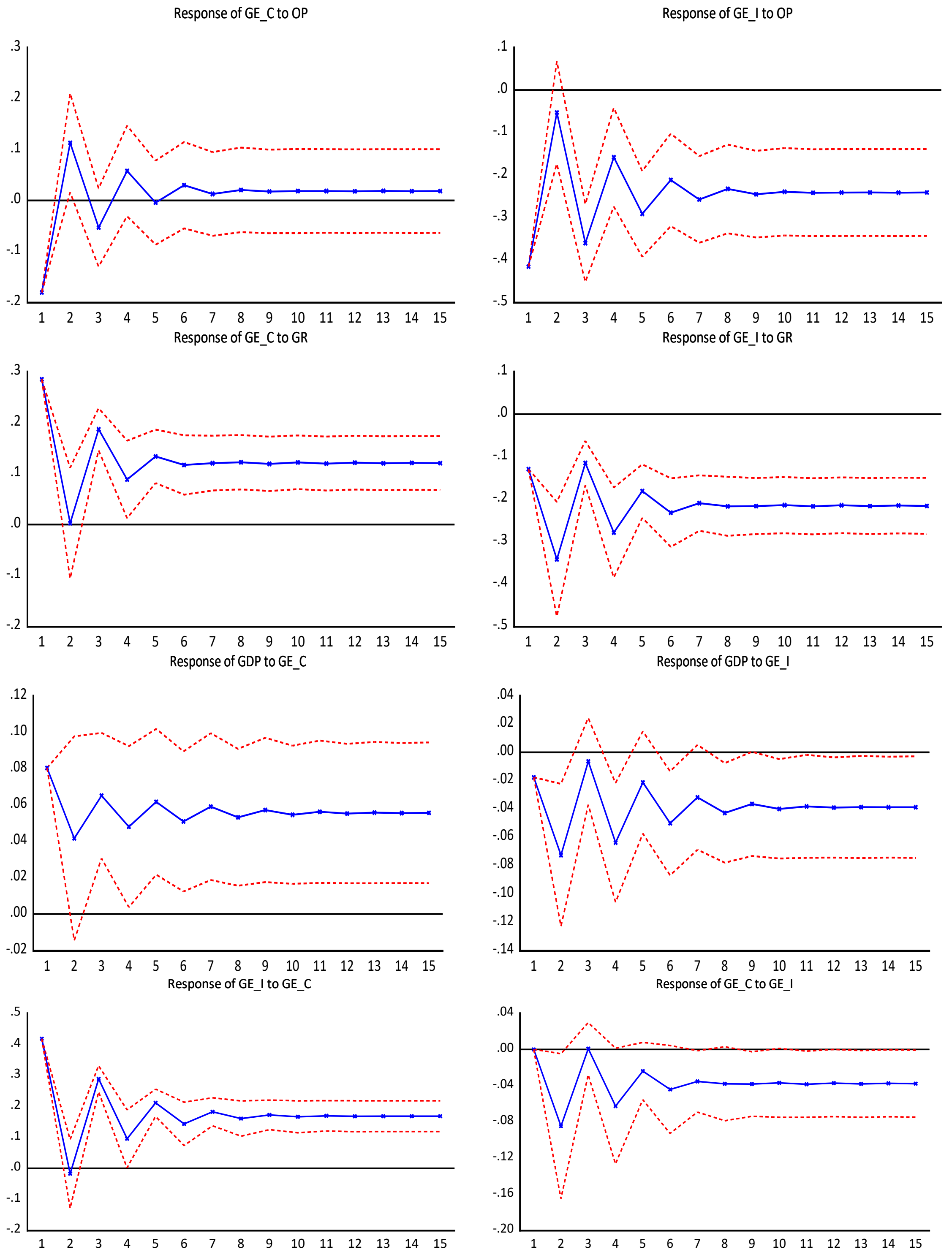
Note: Refer to Figure 5.

Figure 9. Accumulated responses of *GDP_P* and *GDP_NP* to oil price, government revenue and government expenditure shocks



Note: Refer to Figure 5.

Figure 10. Accumulated responses of *GE_C* and *GE_I* to oil price and government revenue shocks and accumulated responses of GDP to current government expenditure and investment government expenditure shocks



Note: Refer to Figure 5.

Figure 11. Historical decomposition for GDP

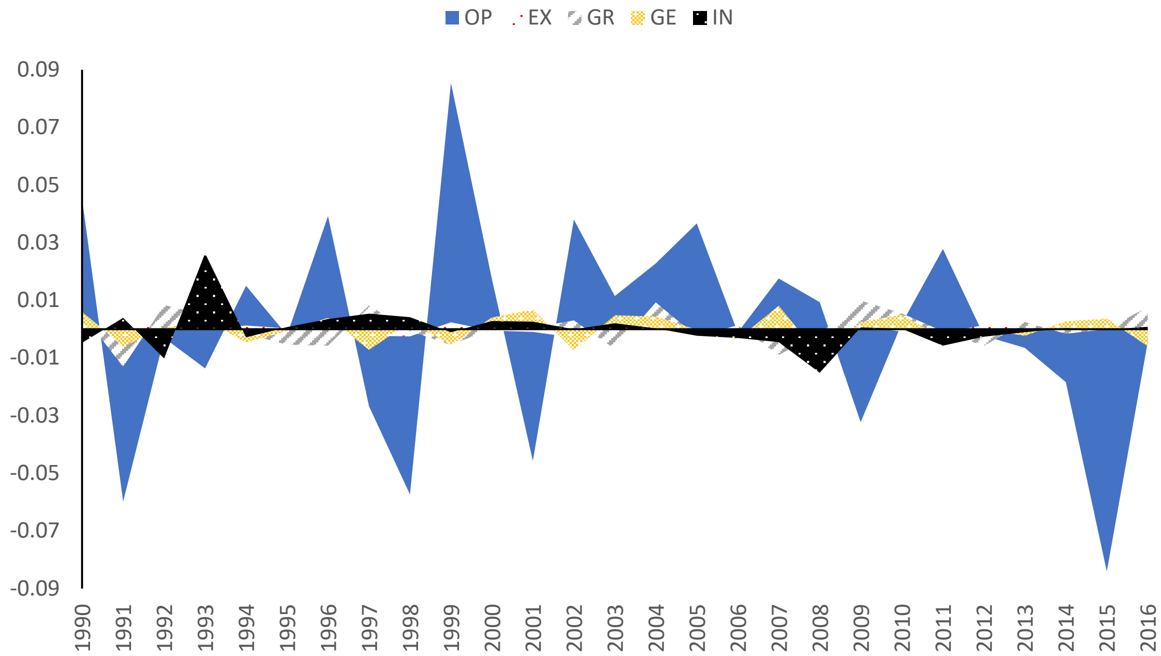


Figure 12. Historical decomposition for government revenue

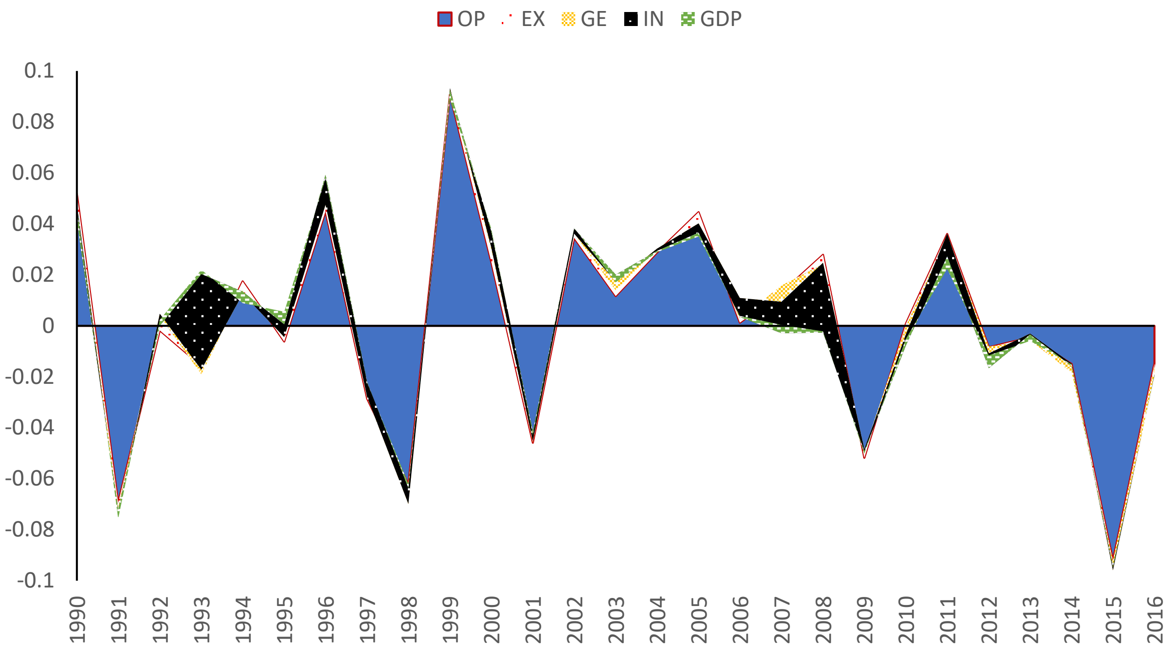


Figure 13. Historical decomposition for government expenditure

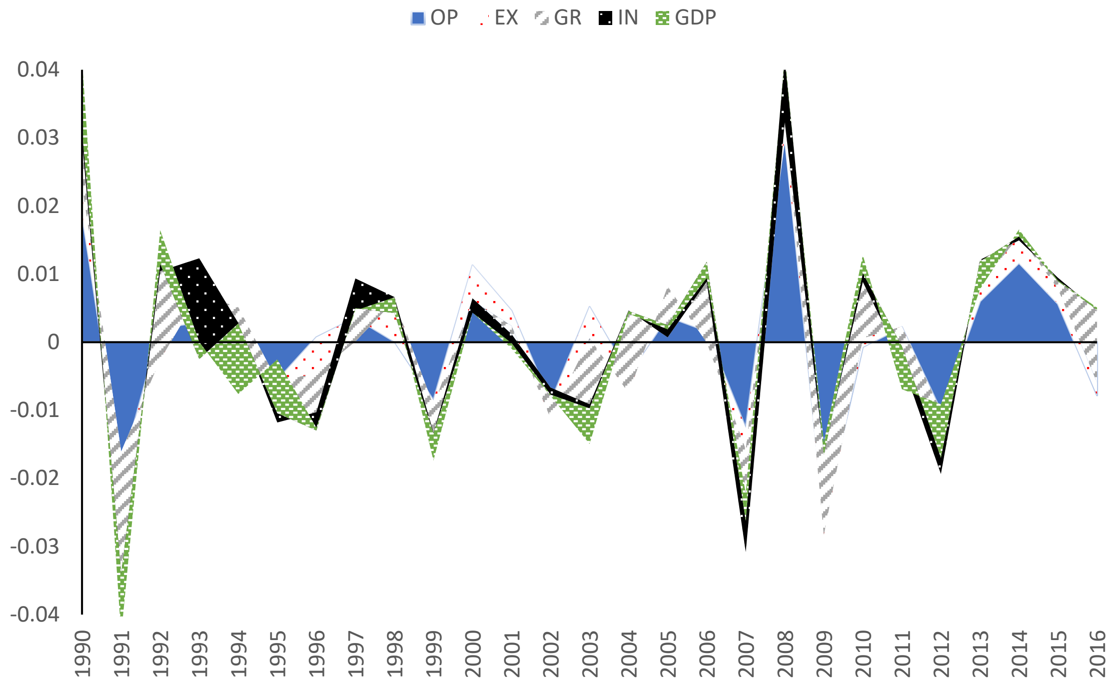


Table 1. The relationship between oil price and domestic variables

Dependent	Independent variable					
Variable	OP	EX	GR	GE	IN	GDP
OP	*					
EX	*	*	*	*	*	*
GR	*	*	*	*	*	*
GE	*	*	*	*	*	*
IN	*	*	*	*	*	*
GDP	*	*	*	*	*	*

Table 2. Forecast error variance decomposition for the baseline model

Variable	Horizon (quarters)	Source of Disturbance					
		OP	EX	GR	GE	IN	GDP
EX	1	0.03	99.97	0.00	0.00	0.00	0.00
	5	3.54	95.69	0.19	0.20	0.03	0.35
	10	3.54	95.68	0.19	0.20	0.03	0.35
	15	3.54	95.68	0.19	0.20	0.03	0.35
GR	1	18.65	0.34	81.01	0.00	0.00	0.00
	5	22.02	0.34	75.14	0.97	0.71	0.81
	10	22.01	0.34	75.08	1.01	0.74	0.81
	15	22.01	0.34	75.08	1.01	0.74	0.81
GE	1	5.51	0.47	3.54	90.48	0.00	0.00
	5	13.98	0.39	7.45	75.13	0.18	2.87
	10	14.03	0.39	7.41	74.77	0.20	3.20
	15	14.03	0.39	7.41	74.77	0.20	3.20
IN	1	0.93	0.30	0.14	5.83	92.79	0.00
	5	0.67	0.74	0.16	4.34	94.04	0.05
	10	0.67	0.76	0.16	4.30	94.06	0.05
	15	0.67	0.76	0.16	4.29	94.06	0.05
GDP	1	55.22	0.02	4.45	1.57	0.47	38.26
	5	45.62	0.24	10.63	1.72	1.80	39.99
	10	45.58	0.24	10.68	1.72	1.83	39.95
	15	45.58	0.24	10.68	1.72	1.83	39.95

Table 3. Forecast error variance decomposition for model specification with petroleum government revenue.

Variable	Horizon (quarters)	Source of Disturbance				
		OP	EX	GR_P	GE	GDP
GR_P	1	22.14	1.21	76.66	0.00	0.00
	5	25.64	0.98	71.12	1.55	0.72
	10	25.63	0.98	71.04	1.63	0.72
	15	25.63	0.98	71.04	1.63	0.72
GE	1	5.51	0.65	1.47	92.37	0.00
	5	14.74	0.56	4.27	77.95	2.48
	10	14.83	0.56	4.28	77.49	2.84
	15	14.83	0.56	4.28	77.49	2.84
GDP	1	53.17	0.03	4.34	2.05	40.41
	5	44.93	0.16	6.63	3.04	45.24
	10	44.89	0.16	6.67	3.05	45.23
	15	44.89	0.16	6.67	3.05	45.23

Table 4. Forecast error variance decomposition for model specification with non-petroleum government revenue.

Variable	Horizon (quarters)	Source of Disturbance				
		OP	EX	GR_NP	GE	GDP
GR_NP	1	0.89	1.14	97.96	0.00	0.00
	5	1.01	1.42	97.41	0.01	0.14
	10	1.02	1.42	97.40	0.01	0.14
	15	1.02	1.42	97.40	0.01	0.14
GE	1	4.48	0.32	10.53	84.67	0.00
	5	11.89	0.26	11.67	74.68	1.50
	10	11.96	0.27	11.64	74.44	1.69
	15	11.96	0.27	11.64	74.44	1.69
GDP	1	53.89	0.11	0.00	3.08	42.91
	5	45.73	0.39	1.46	3.76	48.65
	10	45.67	0.39	1.51	3.77	48.65
	15	45.67	0.39	1.51	3.77	48.65

Table 5. Forecast error variance decomposition for model specifications with current and investment government expenditure

Variable	Horizon (quarters)	Source of disturbance					
		OP	EX	GR	GE_C	GE_I	GDP
GE_C	1	3.43	1.14	5.67	89.76	0.00	0.00
	5	10.98	0.86	9.25	75.04	1.53	2.34
	10	11.03	0.86	9.22	74.75	1.56	2.57
	15	11.03	0.86	9.23	74.75	1.56	2.57
GE_I	1	11.81	0.01	0.76	10.21	77.20	0.00
	5	17.11	0.56	3.72	16.26	60.27	2.07
	10	17.23	0.57	3.75	16.26	59.70	2.49
	15	17.23	0.57	3.75	16.26	59.70	2.49
GDP	1	52.67	0.13	4.83	1.47	0.09	40.81
	5	43.42	0.32	10.93	1.57	2.97	40.79
	10	43.28	0.32	11.03	1.60	3.26	40.50
	15	43.28	0.32	11.03	1.60	3.26	40.50

Table 6. Forecast error variance decomposition for model specifications with petroleum GDP and non-petroleum GDP

Variable	Horizon (quarters)	Source of disturbance					
		OP	EX	GR	GE	GDP_P	GDP_NP
GDP_P	1	91.51	0.02	0.48	0.04	7.95	-
	5	90.08	0.44	1.10	0.05	8.33	-
	10	90.08	0.44	1.10	0.05	8.33	-
	15	90.08	0.44	1.10	0.05	8.33	-
GDP_NP	1	4.20	0.00	7.21	2.89	-	85.70
	5	3.00	0.02	14.80	3.38	-	78.80
	10	3.01	0.02	14.89	3.38	-	78.70
	15	3.01	0.02	14.89	3.38	-	78.70

Table 7. Forecast error variance decomposition for the baseline model

Variable	Horizon (quarters)	Source of Disturbance					
		OPV	EX	GR	GE	IN	GDP
EX	1	6.50	93.50	0.00	0.00	0.00	0.00
	5	6.26	89.12	1.67	0.56	0.21	2.18
	10	6.26	89.10	1.67	0.56	0.23	2.18
	15	6.26	89.10	1.67	0.56	0.23	2.18
GR	1	2.28	0.01	97.71	0.00	0.00	0.00
	5	2.05	0.74	87.92	0.27	0.17	8.84
	10	2.06	0.74	87.85	0.32	0.18	8.84
	15	2.06	0.74	87.85	0.32	0.18	8.84
GE	1	5.28	1.90	0.54	92.28	0.00	0.00
	5	5.82	1.24	0.44	86.51	0.23	5.77
	10	5.82	1.24	0.44	86.44	0.24	5.83
	15	5.82	1.24	0.44	86.44	0.24	5.83
IN	1	0.08	0.34	0.24	4.17	95.18	0.00
	5	0.57	0.30	0.15	3.28	95.21	0.49
	10	0.60	0.30	0.15	3.25	95.20	0.50
	15	0.61	0.30	0.15	3.25	95.20	0.50
GDP	1	0.76	0.05	30.30	0.02	0.01	68.85
	5	1.12	1.66	31.19	3.22	0.10	62.70
	10	1.13	1.66	31.17	3.23	0.11	62.70
	15	1.13	1.66	31.17	3.23	0.11	62.70

Table 8. Forecast error variance decomposition for model specifications with petroleum government revenue or non-petroleum government revenue

Variable	Horizon (quarters)	Source of disturbance					
		OPV	EX	GR_P	GR_NP	GE	GDP
GR_P	1	1.37	0.45	98.18	-	0.00	0.00
	5	1.56	1.30	86.65	-	0.40	10.08
	10	1.57	1.30	86.56	-	0.49	10.08
	15	1.57	1.30	86.56	-	0.49	10.08
GR_NP	1	1.36	1.94	-	96.70	0.00	0.00
	5	1.18	2.38	-	96.37	0.00	0.07
	10	1.18	2.38	-	96.37	0.00	0.07
	15	1.18	2.38	-	96.37	0.00	0.07

Table 1. Forecast error variance decomposition for model specification with current government expenditure and investment government expenditure

Variable	Horizon (quarters)	Source of disturbance					
		OPV	EX	GR	GE_C	GE_I	GDP
GE_C	1	6.54	3.32	1.64	88.50	0.00	0.00
	5	7.90	2.49	1.41	82.91	1.04	4.24
	10	7.90	2.49	1.41	82.88	1.06	4.26
	15	7.90	2.49	1.41	82.88	1.06	4.26
GE_I	1	0.01	0.00	3.51	14.97	81.51	0.00
	5	0.66	0.05	2.24	25.27	67.63	4.15
	10	0.67	0.05	2.24	25.28	67.50	4.25
	15	0.67	0.05	2.24	25.28	67.50	4.25

Table 10. Forecast error variance decomposition for model specification with petroleum GDP and non-petroleum GDP

Variable	Horizon (quarters)	Source of Disturbance					
		OPV	EX	GR	GE	GDP_P	GDP_NP
GDP_P	1	0.23	0.00	23.12	3.26	73.38	-
	5	1.11	3.15	21.44	5.58	68.73	-
	10	1.11	3.15	21.44	5.58	68.73	-
	15	1.11	3.15	21.44	5.58	68.73	-
GDP_NP	1	1.87	0.16	10.76	1.55	-	85.65
	5	1.63	1.04	16.29	3.22	-	77.82
	10	1.63	1.04	16.30	3.31	-	77.72
	15	1.63	1.04	16.30	3.31	-	77.72

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Appendix

Appendix A1: Summary of empirical studies on the impact of oil price shock on the macroeconomic variables in oil-exporter economies

The study	Aim and Methodology	Country
Eltony and Al-Awadi (2001)	- Study the impact of oil price shock on the macroeconomic variables. - Applied VAR and VECM models. - The variables used: oil price, oil revenue, government development expenditure, government current expenditure, inflation, money demand, and value of imported goods and services.	Kuwait
Olomola and Adejumo (2006)	- Study the impact effect of oil price shock on the macroeconomic variables. - Applied VAR model. - The variables used: Industrial production index, consumer price index, exchange rate, domestic wholesale price index, and oil price.	Nigeria
Mehrara and Oskoui (2007)	- Study the source of macroeconomic fluctuations in oil exporting countries. - Applied SVAR model. - The variables used: oil price, industrial output, exchange rate, consumer price index.	Iran, Indonesia, Kuwait, Saudi
Farzanegan and Markwardt (2009)	- Study the dynamic relationship between oil price shock and macroeconomic variables. - Applied VAR model. - The variables used: oil price, government expenditure, industry GDP per capita, inflation, exchange rate, import.	Iran
Al-Saqri (2010)	- Study the long-run relationship between GDP, government revenue, exchange rate and oil price. - Applied VECM model. - The variables used: GDP, government revenue, exchange rate and oil price.	Oman
Berument et al. (2010)	- Study the effect of oil price shocks on exchange rate, inflation and output. - Applied SVAR model. - The variables used: oil price, exchange rate, inflation and GDP.	16 MENA countries
Farzanegan (2011)	- Study the dynamic impact of oil revenue on the government expenditure categories. - Applied VAR model. - The variables used: oil export revenue per capita, government health expenditure, government military expenditure, government security expenditure, government education expenditure, government culture expenditure.	Iran
Bouchaour and Al-Zeaud (2012)	- Study the impact of oil price fluctuations on the macroeconomy. - Applied VECM model. - The variables used: GDP, unemployment rates, inflation, exchange rate and money supply.	Algeria
Emami and Adibpour (2012)	- Study the impact of oil revenue shocks on the output. - Applied SVAR model. - The variables used: GDP, government expenditure, liquidity, exchange rate, positive oil revenue and negative oil revenue.	Iran

Esfahani et al. (2013)	- Study the long run impact of the oil export on the economy. - Applied vector error-correcting model (VECX*) model. - The variables used: real output, real money balance, inflation, exchange rate, oil export, and foreign real output.		Iran
Hamdi and Sbia (2013)	- Study empirically the dynamic relationships between oil revenue, government spending and economic growth. - Applied VECM model. - The variables used: oil revenue, government spending and GDP.		Bahrain
Dizaji (2014)	- Study the relationship between the government revenue and government expenditure. - Applied SVAR model. - The variables used: oil prices, ratio of oil revenues to GDP, and ratio of government total expenditures to GDP.		Iran
Pazouki and Pazouki (2014)	- Study the impact of oil price shocks on the government spending. - Applied VAR model. - The variables used: oil price and four different government expenditure (social security, education, health, culture).		Iran
Masan (2016)	- Study the dynamics relationship between GDP, oil revenue and government expenditure. - Applied VECM model. - The variables used: GDP, oil revenue, and government expenditure.		Oman
Alawadhi et al. (2018)	- To study the impact of global shock on the Kuwait economy. - Applied GVAR model. - The variables used: GDP, inflation rate, short-term interest rate, long-term interest rate, exchange rate and equity prices.		Kuwait

Appendix A2: The data source is the monthly statistical bulletin, retrieved from NCSI website: (https://www.ncsi.gov.om/Elibrary/Pages/LibraryContentView.aspx)

The variables	Abbreviation	Source	Frequency	Measure
Gross Domestic Products	GDP	Table (2): Gross Domestic Products	Quarterly	Constant, seasonally adjusted, log
Petroleum Gross Domestic Products	GDP_P	Table (2): Gross Domestic Products	Quarterly	Constant, seasonally adjusted, log
Non-Petroleum Gross Domestic Products	GDP_NP	Table (2): Gross Domestic Products	Quarterly	Constant, seasonally adjusted, log
Government Revenue	GR	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Petroleum Government Revenue	GR_P	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Non-Petroleum Government Revenue	GR_NP	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Government Expenditure	GE	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Current Government Expenditure	GE_C	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Investment Government Expenditure	GE_I	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Oil Price	OP	Table (7): Crude oil and gas sector	Monthly	Constant, seasonally adjusted, log
Effective Exchange Rate Index	EX	Table (9): Money and banking	Monthly	Seasonally adjusted, log
Consumer Price Index	IN	Consumer Price Index	Quarterly	Seasonally adjusted, log

Appendix A3: Unit root results for the variables in logarithmic difference

Variable	level						1st diff					
	ADF		PP		KPSS		ADF		PP		KPSS	
GDP	-3.47	I(0)	-3.28	I(1)	0.13	I(0)	-13.41	I(0)	-16.72	I(0)	0.17	I(0)
GDP_P	-2.43	I(1)	-2.08	I(1)	0.14	I(0)	-9.37	I(0)	-9.52	I(0)	0.11	I(0)
GDP_NP	-3.87	I(1)*	-7.52	I(0)	0.09	I(0)	-18.63	I(0)	-74.59	I(0)	0.11	I(0)
GR	-2.83	I(1)	-2.83	I(1)	0.12	I(0)	-12.62	I(0)	-12.87	I(0)	0.09	I(0)
GR_P	-2.77	I(1)	-2.64	I(1)	0.11	I(0)	-12.50	I(0)	-12.77	I(0)	0.09	I(0)
GR_NP	-3.45	I(0)	-9.12	I(0)	0.20	I(1)	-12.12	I(0)	-36.18	I(0)	0.09	I(0)
GE	-2.76	I(1)	-8.45	I(0)	0.24	I(1)	-9.26	I(0)	-49.18	I(0)	0.10	I(0)
GE_C	-3.19	I(1)	-8.91	I(0)	0.23	I(1)	-9.50	I(0)	-53.05	I(0)	0.15	I(0)*
GE_I	-2.28	I(1)	-4.68	I(0)	0.15	I(1)	-17.79	I(0)	-21.29	I(0)	0.11	I(0)
EX	-1.04	I(1)	-0.93	I(1)	0.92	I(1)	-8.21	I(0)	-8.16	I(0)	0.24	I(0)
IN	-1.04	I(1)	-0.26	I(1)	0.70	I(1)	-4.62	I(0)	-4.76	I(0)	0.23	I(0)
OP	-1.60	I(1)	-1.50	I(1)	0.96	I(1)	-8.08	I(0)	-8.05	I(0)	0.14	I(0)

*significant at 1%, while the other results are significant at 5%

Appendix A4: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	887.4653	NA	2.06E-15	-16.78981	-16.63816	-16.72836
1	999.3829	208.9129	4.85e-16*	-18.23586*	-17.17428*	-17.80569*
2	1032.469	57.97864*	5.16E-16	-18.18035	-16.20884	-17.38146
3	1060.304	45.59705	6.13E-16	-18.02484	-15.14339	-16.85722