Iranian Journal of Economic Studies, 8(1) 2019, 7-25

Iranian Journal of Economic Studies

Journal homepage: ijes.shirazu.ac.ir

The Effects of Oil Price Shocks on Discretionary Fiscal Policy in Selected OPEC Countries: Panel Structural Vector Autoregressive

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Article History

Received date: 28 July 2018
Revised date: 13 October 2018
Accepted date: 21 November 2018
Available online: 28 November 2018

JEL Classification:
H69
O56
E62

Keywords:
Panel SVAR
OPEC Countries
Discretionary Fiscal Policy
Oil Price Shocks

Abstract

The present study was aimed to investigate the effects of oil price shocks on discretionary fiscal policies in selected OPEC countries during 1980-2015. In this regard, the heterogeneous dynamic reaction to structural shock was examined using Panel Structural Vector Autoregressive (PSVAR) technique. Based on the findings, the effect of oil price shocks on discretionary fiscal policy was positive in short-run but ineffective in long-run.

In addition, the oil price shocks caused an increase in inflation and government expenditure and a decrease in the economic growth in selected OPEC countries according to the Resource Curse phenomenon. Moreover, as variance decomposition showed, the government expenditure and economic growth have the most effect on discretionary policy changes. The effect of discretionary fiscal policy on economic growth in selected OPEC countries was negative, contrary to the Keynesian theory and the results of some other studies. Because discretionary fiscal policies play a major role in decisions of the countries mentioned above, the results also showed that a limitation in the government authority in OPEC countries would come into conflict with the decrease in economic growth and production fluctuation.

1. Introduction

Fiscal policy plays an important role in transferring the oil price shocks in the economy of oil-exporting countries (Samadi et al., 2009; El-Anshasy et al., 2011). Fiscal policy in these countries has three significant features. First, government financing depends greatly on oil. As a result, fluctuation in the oil revenue flow affects the budget via income. Second, since oil is a non-renewable resource and it would end, the income would decrease ultimately. In this situation, governments in these countries must allocate the income from oil to the most appropriate place to maximize the long-run economic growth. Third, some oil price shocks may continue for a long time and can be very large. In

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DOI: 10.22099/ijes.2018.30257.1470

addition, no compatible pattern exists for oil price cycles, and it is so unpredictable and unexpected to change the regime (El-Anshasy et al., 2011).

Based on the present theories, fiscal policy is divided into three categories: (a) automatic stabilizers, (b) discretionary fiscal policy (DFP) that reacts to the state of the economy, and (c) DFP that is implemented for reasons other than current macroeconomic conditions (Fatas and Mihov, 2003). DFP can be defined as cutting tax rates or increasing government expenditure due to a political decision to stabilize the business cycles by raising Aggregate Demand (AD). The output is determined by the level of AD, so a DFP can be used to increase AD and thus increase the output. This measure would help to close the deflationary gap. From a theoretical point of view, these measures can have quite opposed effects (Bank, 2011).

According to the Neoclassical viewpoint, the DFP has no effect on the business cycles, since, according to this theory, labor supply determines the real income. Therefore, the tax cut and increase in government expenditure have no effect on production. From a Keynesian perspective, DFP causes stability in the business cycles. An increase in government expenditure or a tax cut causes an increase in private consumption and stimulates higher production (Boiciuc, 2015).

It is mentioned that exogenous shocks such as oil price change does not affect DFP (Gali and Perotti, 2003; Chalk, 2002; Beetsma, 2008).

The fluctuation in oil price is the main source of economic fluctuation in oil-rich countries, and consequently affects the budget and economic decisions. Now, the question is that in the case of eliminating cyclical fluctuations in the fiscal policy (DFP), would the effects of oil price shocks still exist in government fiscal decision-making? Would fiscal structures in selected OPEC countries be affected by oil price changes? How much oil price shocks would affect the DFP in selected OPEC countries? To answer the above questions, the effectiveness of oil price shocks on DFP and other economic variables like economic growth and inflation were studied using Panel Structural Vector Autoregressive (PSVAR) approach.

To date, no study has been done on the DFP and the effect of oil price shocks on it in selected OPEC countries. Moreover, the PSVAR approach provided us with a clearer view of the economic status of selected OPEC countries so that we could study the effects of oil price shocks on macroeconomic variables.

The rest of the paper is organized as follow. In section 2, the literature review is presented. Section 3 provides the theoretical framework. The empirical model is presented in section 4, where we specify and introduce the variables and present the PSVAR technique. The fifth section presents the results. Finally, the sixth section is devoted to conclusion.

2. Literature Review

Empirical studies regarding the present study fall in one of these two categories: Those that study oil price shocks effects on macroeconomic variables, and those that study DFP effects on variables including economic growth, consumption, and investment.

Fatas and Mihov (2003) analyzed the effects of DFP on economic growth for 91 countries. Accordingly, the fiscal policies of the governments led to the instability of the economy, increasing the output, and declining economic growth. Based on Fatas and Mihov (2003), constraining discretion leads to a reduction in economic instability; hence decreasing the output volatility and enhancing economic growth.

Samadi et al. (2009) analyzed the effects of oil price shocks on macroeconomic variables in Iran using VAR technique for annual data from 1965 to 2005. The results suggested that a positive shock at oil price positively affected Iran's industrial productions in the short-run, but the positive effects would become less in the medium- and long-run. It also caused a gradual decrease in the real exchange rate in the short-run, but its effect in long-run was negative. Marking a positive shock in oil price negatively affected the price index in the short- run, but it brought about a continuous increase in the price index in Iran in long-run. Bringing a positive shock at oil price in the short-run affected the import aggressively and caused an increase in import, but in long-run, although the positive effect still existed, it decreased the import gradually.

Beetsma et al. (2010) reviewed the theoretical and empirical literature about the outcomes of DFP changes. They presented some evidence from European Unions about the consequences of DFP. They reviewed changes and the consequences of a DFP increase in government expenditure through PSVAR. The results showed that the potential positive effects on output and the public budget were spoiled.

El-Anshasy et al. (2011) studied oil price and fiscal policies in oil-exporting countries during the period 1972-2007 using dynamic panel data. Fiscal policies in oil-producing countries moved along with the cycle. However, the amount of government consumption expenditure was not compatible with oil revenue. It means that the government expenditure would decrease because of the positive shocks. In addition, the more oil- producing countries relied on this part, the more it led to high government expenditure by an increase in current oil price. Ultimately, positive changes in oil price and the positive effects on government size are in short-run, and when the government predicts positive shocks in the future, the outcome is the faster growth of government expenditure.

Bank (2011) studied the impact of DFP through a SVAR technique. No convincing evidence was found on the effectiveness of the DFP. The findings indicated that cutting tax rates did not cause stability in the business cycles. In addition, increasing government expenditure could bring an unclear impact. Higher government expenditure did not bring stability for business cycles. The question is whether policymakers have to adopt active fiscal policies. Particularly, the government must pay attention to DFPs that are adopted since they cause a larger public debt in the medium- and long-run. Therefore, limiting government performance would be needed in the future.

Eltejai and ArbabAfzali (2012) studied the asymmetric effects of oil revenue in Iran on economic growth, inflation, government investment growth, and current government expenditure growth, using the SVAR approach on quarterly data during the period 1990:05 to 2008:06. The findings suggested that the effects of negative shocks as a decrease in economic growth were much more than the effect of the positive shocks as an increase in economic growth. In addition, the reaction of inflation and the current government expenditure growth to oil price shocks were asymmetrically increased. Regarding the government investment expenditure growth, it was implied that positive shocks had more effect on the behavior of this variable compared with negative shocks.

Mohammadi and Baratzadeh (2013) studied the effects of oil revenue shocks decrease on government investment expenditure, current government expenditure, and liquidity in Iran using the VAR technique from 1980 to 2010. The results suggested that the oil revenue shock would affect government investment expenditure, current government expenditure, and liquidity.

Attinasi and Klemm (2016) analyzed the impact of DFP on economic growth for a sample of 18 European Union countries over the period 1998-2011. They found out evidence that fiscal consolidation generally has a negative short-run impact on growth, although some specific budget categories are not found to be statistically significant. Accordingly, it was understood that a reduction in investment and consumption would lead to a reduction in growth, and the indirect tax would lead to a stronger negative impact.

Based on the studies, to date, no study has been done on the DFP and the effect of oil price shocks on it in selected OPEC countries. Moreover, the PSVAR approach provided us with a clearer view of the economic status of selected OPEC countries so that we could study the effects of oil price shocks on macroeconomic variables.

3. Theoretical Framework

To study the impact of oil price shocks on macroeconomic variables, a macroeconomic model is needed to design that oil revenue affects the gross domestic product and other macroeconomic variables. So in the present study, an attempt was made to evaluate how oil price had an influence on macroeconomic variables and on DFP based on Chalk (2002), and Gali and Protti (2003).

3.1 Household

The overlapping generations (OLG) model introduced by Samuelson (1958) has been used extensively for the analysis of alternative fiscal policies.

Consider a growing two-period OLG exchange economy with a government sector (Marrewijk and Verbeek,1991).

Initially, household consumption is determined in two periods. So two-period lived consumers maximize utility over consumption and leisure when young subject to a budget constraint. So we have:

$$\begin{aligned} &max \quad u(c_t^t) + \beta u(c_{t+1}^t) + v(l_t) \\ &s.t.: \\ &p_t c_t^t + z_t = (w_t - l_t + \pi_t)(1 - t_t) \\ &p_{t+1} c_t^t = R_{t+1} z_t \end{aligned} \tag{1}$$

where c_t^t is the consumption by generation t when they are young and c_{t+1}^t is consumption by generation t when they get old. l_t is leisure, z_t is the savings of the young. p_t is the price of the consumption good, R_t is the return on savings, π_t is the profit received by the young from their ownership of the firm. Consumers will earn total labor income up to $W_t - l_t$ at their young age. Both labor income and profits are subject to a uniform income tax at a rate of t_t. So:

$$p_t c_t^t = \emptyset(w_t + \pi_t)(1 - t_t) \tag{2}$$

The total consumption in the time t would be as follows, considering that the population growth is zero in order to make it easy:

$$p_t c_t^t = \emptyset(w_t + \pi_t)(1 - t_t) + R_t \beta \emptyset(w_{t-1} + \pi_{t-1})(1 - t_{t-1}) \tag{3}$$

3.2 Government

The government's budget constraint is:

$$B_{t+1} = R_t B_t + [G_t - TR_t] \tag{4}$$

where B_t is the government debt, and G_t and TR_t are government expenditure and government revenues without the interest, respectively. The phrase inside bracket in the right-hand side of Equation (4) is called the primary deficit. Considering the primary deficit instead total deficit is often a better way to understand how the fiscal policy affects the government budget in a particular time.

It is assumed that the government distributes bonds to the amount of $G_t - TR_t$. Therefore, the government debt to the household is $G_t - TR_t$. This current budget constraint can, of course, be solved and the no-Ponzi game condition is held for the budget constraint. The total tax revenue is expressed as follow:

$$T_t = t_t(w_t + \pi_t) \tag{5}$$

As in the models proposed by Motevasseli et al. (2010) and Seyyedi et al. (2015), it is assumed that the government is the only agent in the economy. This assumption is not so unreasonable due to the low level of central bank independence in many countries that possess natural resources. Thus, the government earns revenue through not only selling and exporting oil and obtaining taxes but also through money creation. In addition, it is considered that the country, except for oil exports, has no other interactive relationship with foreign countries. Therefore, we have:

$$TR_t = (1 - \emptyset_f) Y_t^{oil} + T_t + (m_t - m_{t-1}) \tag{6}$$

where $\emptyset_f$ is the total share that is spent on national development fund or the oil company that is determined in the annual budget of each country. Therefore, the government share from oil revenue is attained after subtracting the shares mentioned from the total oil revenue. T_t is the government's total tax revenue, and $m_t - m_{t-1}$ is seigniorage.

The government expenditures are current government expenditures G_t^C and government investment expenditures I_t^G.

$$G_t = G_t^C + I_t^G \tag{7}$$

Government's behavior is such that a decrease in the oil revenue causes a decrease in investment expenditures. Assume that the contribution of each unit of oil revenue shock ($\varepsilon_t^{Y^{oil}}$) to investment expenditures is α_{GI}. We have considered the government investment I_t^G as AR(1). Therefore, we have:

$$I_t^G = \rho_{I^G} I_{t-1}^G + (1 - \rho_{GI})\overline{I^G} + \varepsilon_t^{I^G} + \alpha_{I^G} \varepsilon_t^{Y^{oil}} \tag{8}$$

According to the special feature that the oil-rich countries are highly dependent on oil revenue, allowing the oil section to the model seems necessary to assume oil price shocks. We assumed that oil revenue shock is exogenous variable and it is an AR(1) process. So:

$$Y_t^{oil} = \rho_{Y^{oil}} Y_{t-1}^{oil} + (1 - \rho_{oil})\overline{Y^{oil}} + \varepsilon_t^{Y^{oil}} \varepsilon_t^{Y^{oil}} \sim N(0.\delta_{Y^{oil}}^2) \tag{9}$$

where $\overline{Y^{oil}}$ is the fixed level of the oil revenue stream. Thus, with replacing the defined equation in the government budget, we will have the Equation (10):

$$\begin{aligned} B_{t-1} = \quad & R_t B_t + G_t^C + \rho_{I^G} I_{t-1}^G + (1 - \rho_{GI})\overline{I^G} + \varepsilon_t^{I^G} + \alpha_{I^G} \varepsilon_t^{Y^{oil}} - \Big\{\big(1 - \emptyset_f\big) \\ & \Big[\rho_{Y^{oil}} Y_{t-1}^{oil} + (1 - \rho_{oil})\overline{Y^{oil}} + \varepsilon_t^{Y^{oil}}\Big] + T_t + (m_t - m_{t-1})\Big\} \end{aligned} \tag{10}$$

Therefore, considering Equation (10), oil price shocks can also affect the government budget balance through both government revenue and expenditure.

3.3 Firms

There are N firms producing a single good under imperfect competition and facing a unit elastic demand function and a cost function composed of both fixed costs (f_i) and marginal costs (m). Since firms play an oligopoly game, the price higher than the marginal cost would be $0 \leq \mu \leq 1$. Therefore, we have:

$$\mu = (p - m)/p \tag{11}$$

As a result, the total firm profit ($\pi_{\ i,t}$) for each firm is as follows:

$$\pi_{i,t} = p_t q_{i,t} - m q_{i,t} - f_i. \tag{12}$$

where $q_{i,t}$ is the production by firm i. Aggregating across firms and recognizing that $p_t \sum_{i=l}^{N} q_{i,t} = Y_t$, yields the following expression for the total profit:

$$\pi_t = \mu Y_t - F \tag{13}$$

In this equation, $F = \sum_{i=1}^{N} f_i$ is the total fixed costs incurred by all firms. It is considered that households are owners of the capital (K_t^P) that is supplied to firms in t times. To express the equation of capital accumulation more exactly, this equation should be based on long-run production in an oil-exporting country in which part of the oil revenue will be invested. The oil revenue plays an effective role in capital accumulation. The capital accumulation equation of capital market can be defined as the following:

$$K_{t+1}^{P} = (1-\delta^{P})K_{t}^{P} + I_{t}^{pa} \tag{14}$$

I_{t}^{pa} is an increased investment, part of which is from the firm in the private sector and the other part is from the oil revenue devoted to the private sector for increasing the required investment accumulation. $\delta^{P} \in [0\ 1]$ is also the depreciation rate. The total investment in the economy (I_t) is the sum of investment of public sector I_{t}^{G} and private sector I_{t}^{pa}.

$$I_t = I_{t}^{G} + I_{t}^{pa} \tag{15}$$

The total national income is as follows:

$$Y_t = C_t + G_t + I_t \tag{16}$$

The total income is obtained by combing the equations of the total consumption, government expenditure, and investment with Equation (16) as follows:

$$\begin{aligned} Y_t = \ & \emptyset(w_t - \mu Y_t - F)(1-t_t) + R_t\beta\emptyset(w_{t-1} - \mu Y_{t-1} - F)(1-t_{t-1}) \\ & + I_{t}^{G} + I_{t}^{pa} + G_{t}^{C} + \rho_{I^G} I_{t-1}^{G} + (1-\rho_{GI})\overline{I^{G}} + \varepsilon_{t}^{I^G} + \alpha_{I^G}\varepsilon_{t}^{Y^{oil}} \end{aligned} \tag{17}$$

After simplifying the Equation (17), to evaluate the effect of variables on demands, we have the following:

$$\begin{aligned} dY_t = \ & \frac{1}{1-\emptyset\mu(1-t_t)} dG_{t}^{C} - \frac{\emptyset}{1-\emptyset\mu(1-t_t)} dT_t + \frac{1}{1-\emptyset\mu(1-t_t)} dI_t + \frac{1}{1-\emptyset\mu(1-t_t)} d\varepsilon_{t}^{I^G} \\ & + \frac{\alpha_{I^G}}{1-\emptyset\mu(1-t_t)} d\varepsilon_{t}^{Y^{oil}} \end{aligned} \tag{18}$$

The Equation (18) involves the assumption of imperfect competition that is a Keynesian property and allows fiscal policy to affect overall demand with an increasing factor. In addition, the oil price shocks impact is also obvious on demand.

3. 4 Discretionary Fiscal Policy

To measure DFP, it is necessary to compute cyclical and structural budget balance. In other words, it is necessary to distinguish the differences in fiscal policy that are resulted from the politicians' discretionary acts from those that are the result of the automatic reaction of fiscal variables to business cyclical fluctuations. It is assumed that government expenditure and tax rates are as follow:

$$\begin{aligned} G_t &= G(Y_{t}^{*}) - \gamma(Y_t - Y_{t}^{*}) \\ T_t &= T(Y_{t}^{*}) + \tau(Y_t - Y_{t}^{*}) \end{aligned} \tag{19}$$

The primary government expenditure and tax revenue are composed of a structural part (a level in which if the economy is in full employment Y_{t}^{*}, production happens) and a cyclical part (reflecting the current economic status toward the full employment). In Equation (19), the structural part of government expenditure and tax revenue are shown by $T(Y_{t}^{*})$ and $G(Y_{t}^{*})$. In addition, the cyclical part is a function of the differences among the production of potential production (output gap).

The structural part of the difference in the fiscal policy is as follows:

$$dG(Y_t^*) - dT(Y_t^*) = (\gamma - \tau)dY + dG - dT \tag{20}$$

As it is obvious in Equation (20), the structural budget balance is a function of production, government expenditure, and tax revenue in balance. According to various researches like Larch and Salto (2005), the differences in the structural budget balance show the DFP. To show the indifference of exogenous shocks to DFP, note that the structural part of primary government expenditure and tax revenue is composed of two sections. One is determined through policy and the other results from a change in the exogenous factors including oil price or an exchange rate that is not related to the output gap. So:

$$\begin{aligned} G_t &= \sigma_t + G^P(Y_t^*) - \gamma(Y_t - Y_t^*) \\ T_t &= \theta_t + T^P(Y_t^*) + \tau(Y_t - Y_t^*) \end{aligned} \tag{21}$$

In Equation (21), σ_t and θ_t are exogenous shocks, and $G^{\mathrm{P}}(Y_t^*)$ and $T^{\mathrm{P}}(Y_t^*)$ are government expenditure and tax revenue in full employment. The change in the structural budget balance can be shown as Equation (22):

$$\begin{aligned} dG^P(Y_t^*) - dT^P(Y_t^*) = &\left[\frac{1+\gamma-\tau-\phi\mu(1-t)}{1-\phi\mu(1-t)}dG - d\sigma\right] \\ &- \left[\frac{1+\phi(\gamma-\tau)-\phi\mu(1-t)}{1-\phi\mu(1-t)}dT - d\theta\right] \end{aligned} \tag{22}$$

It is clear that based on the definition, the DFP is not dependent on exogenous shocks (meaning $d\theta$ and $d\theta \approx 0$). It can be concluded that the effects of the exogenous shocks on DFPs are ineffectual. Thus, the impacts of exogenous shocks are converged in the long-run.

4. Empirical model

The most important studies in the field of SVAR technique belong to Sims (1986), Bernanke (1986), Blanchard and Watson (1986), and Blanchard and Quah (1989). SVAR aims to extract unobserved shocks and, as a result, some dynamic relationship between economic variables. According to Pedroni (2013), one of the problems with this methodology is when we are dealing with large-scale data. Thus, Pedroni (2013) proposed a panel approach to SVAR analysis, noting that cross-sectional variation is present in the panel. Thus, SVAR is based on a structural decomposition of shocks into common type shocks versus idiosyncratic shocks.

The technique can be applied to a big range of data types like multi-country and multi-regional data. Pedroni (2013) pointed out the usefulness of this technique for any panel including a time-series dimension with sufficient length to at least minimally estimate member-specific VAR coefficients.

To deal with these complexities, we employ the heterogeneous panel SVAR model proposed by Pedroni (2013) and Goes (2016). Consider an unbalanced panel in which $y_{i,t}$ is a vector of n endogenous variables over country-specific time period $t = [1, \dots T_i]'$ for each member $i = [1, \dots M]'$. The Equation (23) is estimated to deal with country fixed effects:

$$y_{i,t}^* = y_{i,t} - \overline{y}_i \tag{23}$$

where $\bar{y_i} = T_i^{-1} \sum_{t=1}^{T_i} y_{i,t} \, \forall i$. Thus, we have the Equation (24):

$$B_i \Delta y_{i,t}^* = A_i(L) {y^*}_{i,t-1} + e_{i,t} \tag{24}$$

where $A_i(L)$ is a polynomial of lagged coefficients ($A_i(L) = \sum_{j=0}^{J_i} A_j^i L^j$) with country-specific lag-length J_i, A_j^i is an $n \times n$ matrix of coefficients, $e_{i,t}$ is a vector of residuals, and B_i is an $n \times n$ matrix of contemporaneous coefficients. J_i is selected based on the Schwartz Information Criterion to assure that residuals approximate white noise.

Panel data technique may result in inconsistent estimation and interference between the relationships. The method gives an assumption of homogeneous dynamics by identifying a reduced-form VAR for countries:

$$\begin{aligned} B_1 \Delta y_{i,t}^* &= A_1(L) {y^*}_{1,t-1} + e_{1,t} \\ &\vdots \\ B_M \Delta y_{M,t}^* &= A_M(L) {y^*}_{M,t-1} + e_{M,t} \end{aligned} \tag{25}$$

from which idiosyncratic dynamics can be obtained. Therefore, correlated deleted variables influence all the countries heterogeneously. One more advantage of the heterogeneous approach is that comparability of countries is less as each member in the panel is treated independently. Thus, an additional VAR is estimated using cross-section averages for each period, serving to capture the common dynamics.

$$\bar{B} \Delta \bar{y}_t^* = \bar{A}(\mathrm{L}) \bar{y}_{t-1}^* + \bar{e}_t \text{ where } \bar{y}_t^* = M^{-1} \sum_{i=1}^{M} y_{i,t}^* \tag{26}$$

Recovering SVAR, it is reduced form residuals in Equation (24) and (25) that these are mapped into $u_{i,t} = B_i^{-1} e_{i,t}$ and $\overline{u_t} = \bar{B}^{-1} \bar{e}_t$, respectively. Thus, we calculate nM correlation coefficients to construct M diagonal matrices:

$$\Lambda_i = \begin{bmatrix} \rho({u_{i,t}}^1, u_t^{-1}) & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \rho({u_{i,t}}^n, u_t^{-n}) \end{bmatrix} \tag{27}$$

where $\rho({u_{i,t}}^1, u_t^{-1})$ denote the correlation coefficients between structural residuals of the n^{th} endogenous variable for each country i. Now, the Composite shocks $u_{i,t}$ can be decomposed as:

$$u_{i,t} = \Lambda_i \bar{u}_{i,t} + \tilde{u}_{i,t} \tag{28}$$

where $\bar{u}_{i,t}$ are the common shocks, $\tilde{u}_{i,t}$ are the idiosyncratic shocks, and Λ_i are $n \times n$ diagonal matrices containing country-specific loadings which account for the relative importance of common shocks. Then, the matrices of composite responses to structural shocks $R_i(L)$ for each country can be recovered. Further, the loading matrices in Equation (27) can be used to disentangle the composite responses into responses to common shocks and responses to idiosyncratic shocks:

$$R_i(L) = \Lambda_i R_i(L) + (I - \Lambda_i \acute{\Lambda_i}) R_i(L) \tag{29}$$

It should be noted that $R_i(L) = \overline{R_i}(L) + \tilde{R}_i(L)$, where $\bar{R}_i(L) \equiv \Lambda_i R_i(L)$ and $\widetilde{R}_i(L) = (I - \Lambda_i \acute{\Lambda_i}) R_i(L)$. Thus, we can rely on the cross-section distribution of $R_i(L), \overline{R_i}(L)$, and $\tilde{R}_i(L)$; we can also rely on selected descriptive statistics of the impulse response functions (IRF), such as their medians, averages, and interquartile ranges. In the end, standard errors of medians can be calculated by medians through sampling simulation with 500 repetitions.

SVAR requires an identification strategy. The focus is on the Cholesky decomposition and not on imposing economic relationships. The order of the variables is based on the following argument.

A number of 10 restrictions $\left(\frac{1}{2}(M^2 - M)\right)$ is added to the matrix of variables. According to a study based on the open economy in OPEC countries, oil revenue is considered as exogenous; thus, it is gained just through its one lag values. On the contrary, each one of the variables $Y_{i,t}$ comes from lag values and oil revenue. Also, oil revenue is an exogenous variable. ε_{it} is structural error term, in which ε^{DFP} is DFP, ε^{GEXP} government expenditure shock, ε^{GDP} Gross Domestic Production shock, ε^{INF} inflation shock, and ε^{POIL} oil price shocks. It is assumed that based on the open economy, endogenous shocks will have a long-run effect on exogenous variables (oil price). Therefore, except this component b_{11}, the others are zero in the first row. Now, there must be some restriction on the long-run effects of structural shocks on endogenous variables. Samimi (1997) stated that due to the relations between government and central bank regarding spending the revenue from selling, the changes made in the amount of country's liquidity were one of the serious factors in the emergence of fluctuation in the inflation. Therefore, oil price, inflation and the government expenditure influence on inflation.

Regarding economic growth, it can be claimed that all of the present variables in the model affect this variable. Mardokhi (1999), Komijani and Alavi (1999), and Fallahi et al. (2012) evaluated the impact of the variable inflation on the negative economic growth. Nilly and Amid (1999) evaluated the impact of investment expenditure on growth. In addition, paying attention to the Keynesian theory, the increase in DFP would lead to an increase in the private consumption which, in turn, could lead to an increase in demand and ultimately an increase in the economic growth. Because of the high dependence of government on oil revenue and a large share of oil in the total revenue in Iran, a large share of government expenditure is directly influenced by oil revenue. Moreover, because of the large share of the government in the economy in these countries, it is thought that the relationship between government expenditure and economic growth is mutual. Therefore, the variables of government expenditure, economic growth, and oil price would influence government expenditure.

However, according to the theory mentioned previously regarding DFP, exogenous shocks, like oil price and inflation, do not affect these variables. Regarding the effectiveness of government expenditure on DFPs and considering Equation (22), the increase in government expenditure leads to an increase in DFPs. Note that the economic cycle (stagnation and boom) is effective regarding fiscal policy. Thus, economic growth would also affect the

DFP. Therefore, the variables government expenditure, DFP, and economic growth would affect it. Consequently, the layout of the PSVAR model could be presented as the following:

$$\begin{bmatrix} \varepsilon^{POIL} \\ \varepsilon^{INF} \\ \varepsilon^{GDP} \\ \varepsilon^{GEXP} \\ \varepsilon^{DFP} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & b_{23} & 0 \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{41} & 0 & b_{43} & b_{44} & 0 \\ 0 & 0 & b_{53} & b_{54} & b_{55} \end{bmatrix} \begin{bmatrix} u^{POIL} \\ u^{INF} \\ u^{GDP} \\ u^{GEXP} \\ u^{DFP} \end{bmatrix} \tag{30}$$

It is noteworthy that to study the effect of shocks, i.e., the impulse response functions and variance decomposition, the authors of this study used both the insights offered by Pedroni (2013) and the Software RATS.

5. Results

5.1 Data

The present study was aimed to investigate the effects of oil price shocks on DFP fiscal policy in selected OPEC countries over the period 1980-2015. Due to the limited access to the data and the homogeneity of countries, nine countries were selected from among 15 OPEC countries based on their continuous budget deficits and similar economic growth rate during the period under study. The chosen list includes the countries Algeria, Ecuador, Iran, Kuwait, Nigeria, Qatar, Saudi Arabia, Emirates, and Venezuela.

In line with our objectives, the effects of an oil shock on DFP and other variables, like government expenditure, annual GDP, and inflation, were studied using the PSVAR approach. To calculate DFP, we have used the variables of the government expenditure and revenue in dollars at constant 2010 prices. Oil price index was also computed by changes in real oil price logarithm in dollars at constant 2010 prices. The inflation was measured using the consumer price index at fixed 2010 prices. The annual GDP also was calculated in dollars at constant 2010 prices.

GDP, population, government expenditure, consumer price index, tax revenue, and exchange rate were extracted from the World Bank database. The data on government revenue and oil price were taken from the Trading Economic, Global Economy, and Statista. To calculate the DFP, first, a separation is needed between cyclical and structural government budget. The approach used by Reis et al. (2007) was applied in the present study. Accordingly, the actual government budget balance (BB) is composed of two sections of cyclical and structural budget balance in the form of a percentage in GDP:

$$BB_{actual} = BB_{structural} + BB_{cyclical} \tag{31}$$

At first, the cyclical part is computed; then, the cyclically adjusted balance or structural budget balance is obtained by subtracting the cyclical part from the actual budget balance. The cyclical part ($BB_{cyclical}$) of the budget balance (BB_{actual}) is usually recognized through the impact of GDP variances from the potential production or the trend. The cyclical part is calculated through the Equation (32):

$$BB_{cyclical} = \varepsilon gdp \tag{32}$$

Therefore, considering the Equation (32), the cyclical part ($BB_{cyclical}$) can be expressed as a multiplication of revenue elasticity and the government expenditure elasticity divided by production (GDP), and then multiplied by the output gap. The elasticity mentioned can be analyzed as the impact of the output gap on government expenditure and income.

$$BB_{cyclical} = \varepsilon.\left(\frac{y_t - y_t^P}{y_t^P}\right) = (\varepsilon_G - \varepsilon_R).gdp_t = \left(\eta_G \frac{G_t}{Y_t} - \eta_R \frac{R_t}{Y_t}\right).gdp_t \tag{33}$$

where, y shows the production, and superscript p represents potentiality. In the Equation (33), $\eta_R = \left({}^{\Delta R}/_{\Delta Y}\right)\left({}^{Y}/_{R}\right)$ and $\eta_G = \left({}^{\Delta G}/_{\Delta Y}\right)\left({}^{Y}/_{G}\right)$ are the government expenditure and revenue elasticity divided by production. Therefore, the structural budget balance or cyclically adjusted balance can be measured as below:

$$BB_{structural} = BB_{actual} - BB_{cyclical} = BB_{actual} - \left(\eta_G \frac{G_t}{Y_t} - \eta_R \frac{R_t}{Y_t}\right).gdp_t \tag{34}$$

In the end, changes in the structural budget balance indicate DFP. Regarding the explanations given above and equations presented, government expenditure and revenue elasticity in each country are calculated using the Eviews software, and the filtering of Hodrick-Prescott (HP filter) is also used to compute the potential production (see for more details Rajaee and Jalayi (2017) and Hoghaberkiani and Moradi (2012)). Then, the output gap in selected OPEC countries is calculated using the Eviews software.

Table 1 shows an average of variables in selected OPEC countries during the period 1980-2015.

Table 1. An average of variables in selected OPEC countries during the period 1980-2015

Country	DFP	Growth of government spending at constant prices 2010 (percent)	Inflation (%)	GDP per capita (constant 2010 Billion US$)	Real oil price (U.S. dollars constant 2010 per barrel)
Algeria	-0.15302	0.92	9.34	3860.06	1.417015
Ecuador	-0.09075	0.02	25.88	4097.19	77.82289*
Iran	-0.26848	-0.40	19.90	4654.70	10.39523
Kuwait	-0.55309	10.63	3.41	35295.22	0.558435
Nigeria	-2.39466	-0.08	19.44	1655.78	13.89578
Qatar	-0.538	8.10	3.70	50516.91	0.605388
Saudi Arabia	-0.63621	8.96	1.58	19939.52	0.473286
Emirates	-0.32663	5.37	4.23	61396.78	0.660299
Venezuela	-3.83014	0.03	33.42	12778.54	128.7807*

*** *Highest Real Oil Price is due to the method used to compute the index and CPI in this country.*

***Source**: Central Bank, Trading Economic, Global Economy and Statista*

5.2 Some Statistical Test

Before estimating the models, we must examine stationarity of all variables because non-stationarity of variables would cause a spurious regression. For this purpose, three stationarity tests are used in panel data including one. Levin, Lin & Chu (LLC), 2. Im, Pesaran, and Shin (IPS), and 3. Fisher ADF. According to the special features of each unit root test, the stationarity of variables were studied through at least one of these tests. The result is shown in Table 2.

Table 2. Panel Unit Root Test

Variables	ADF - Fisher		IPS		LLC	
	Statistic	Probability	Statistic	Probability	Statistic	Probability
DFP	159.657	0.0000	-12.3779	0.0000	-13.1928	0.0000
GEXP	21.8545	0.2385	1.62715	0.9481	-4.28810	0.0000
INF	59.6311	0.0000	-4.80430	0.0000	-4.10905	0.0000
GDP	40.9215	0.0016	-2.16964	0.0150	-2.74908	0.0030
POIL	74.8893	0.0150	-6.27959	0.0150	-7.86002	0.0000

***Source**: The researcher's findings.*

The null hypothesis is "The existence of unit root in the series". The results of the tests reject (at least one of these stationary tests) the null hypothesis and all of the series for the sample period are stationary.

One of the most important issues in the SVAR model is to determine the optimum lag length. Several tests like Lagrange coefficient test (LR), Akaike's Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ) exist in this field. The lag length is one as optimum lag in the SC and HQ. Although the optimum lag length is three in AIC and Lagrange coefficient metrics, since the larger lag selection leads to more loss in the degree of freedom, the lag length was chosen one as the optimum lag in the model (Table 3).

Table 3. PSVAR Lag Order Selection Criteria

Lag	LR	AIC	SC	HQ
0	NA	24.22447	24.28806	24.24995
1	2861.933	14.24938	14.63094*	14.40229*
2	74.02700	14.15575	14.85527	14.43608
3	57.54403*	14.11780*	15.13529	14.52555
4	37.64774	14.15041	15.48586	14.68558

***Source**: The researcher's findings*

In addition, checking the pattern stability test showed that eigenvalues were located within the unit circle. As a result, it was concluded that sustainability existed.

5.3 Impulse Response Functions and Variance Decomposition

IRFs indicate the dynamic behavior of variables in equations over time when a one-standard-deviation shock occurs. In addition, variance decomposition shows the relative share of each variable in the change of other variables. Figure 1 shows the effect of oil price shocks on DFP. Due to the uncertainty in the variation of sampling, the Bootstrap was used to produce standard deviation, giving confidence interval in the levels 25% and 75% for Variance Decomposition and IRF. Therefore, the median of these two levels is selected as the standard in the present analysis. As can be seen, the oil price shocks to the amount of a standard deviation made 10% positive reaction to DFP in the first year. Although fluctuating behavior is seen on DFP in the second year, these fluctuations converge after the sixth year. Thus, the exogenous shock of oil price had no impact on DFP in the long-run. Based on the theory mentioned before, exogenous shocks like oil price and exchange rate have no effect on DFP.

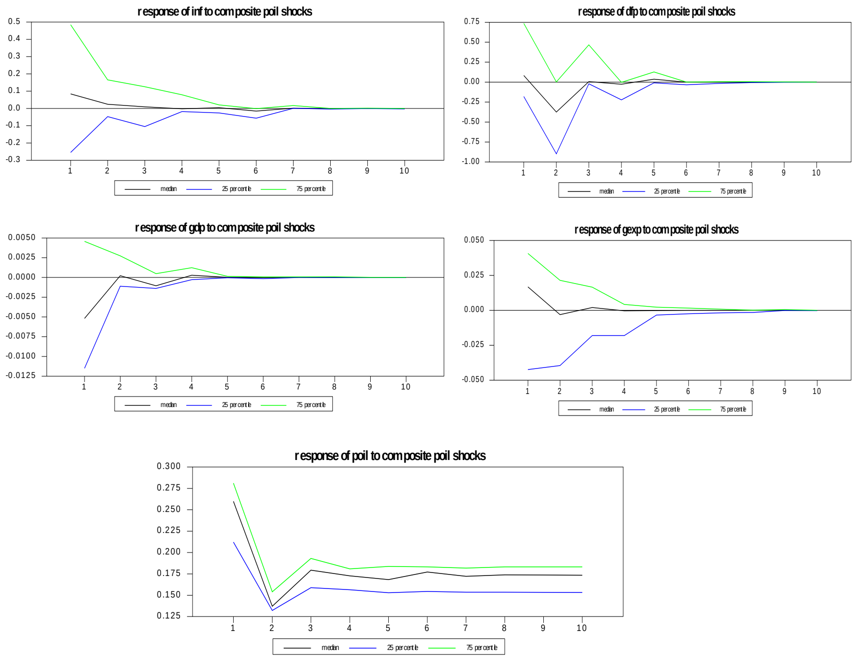

Figure 1. Investigating Composite Shocks of oil price on macro-economic variables in OPEC countries.

Therefore, the reaction of DFP to exogenous shocks of oil price was against the theory in the short-run. It seems that as the oil price increases, government expenditure goes up and tax rates cut, leading to an increase in the DFPs. Therefore, oil price changes in selected OPEC countries influence their government decisions in the crisis and affect their economic structure. It is implied that the economy depends on oil price in these countries.

Oil price shocks, to the amount of a standard deviation, cause 10% positive reaction to inflation. Then, the effects converge in the long-run. The inflation reaction is according to the theory. In other words, the increase in oil price leads to an increase in government revenue, government expenditure, and liquidity, and consequently leads to an increase in inflation.

A one-standard-deviation shock to oil price creates a positive reaction (2%) in government expenditure that is in agreement with the theory. In other words, the oil price increase leads to an increase in government revenue, thus an increase in government expenditure. The reaction of GDP per capita to oil price shocks in OPEC countries was negative, and it was about 0.5 %. The effects converge after about five years. The negative economic growth caused by the increase in oil revenue in the period under study in OPEC countries was a contradiction that is known as Paradox of Plenty or Resource Curse. In other words, the increase in oil revenue restricted economic performance and growth through importing commodities, reducing investment in the country, and increasing rent-seeking activities.

Moreover, in variance decomposition of effective variables on DFP, the shares of government expenditure (30%) and GDP per capita (10%) were more than other variables in DFP changes. a one-standard-deviation shock to government expenditure caused a positive 70% reaction to DFP, and then they converge gradually. In addition, the reaction of DFP to economic growth shock was negative 70%, and it converges gradually.

Moreover one-standard-deviation shock to DFP causes a negative reaction (0.1%) in economic growth. Based on the Keynesian theory, cutting tax rates and increasing the government expenditure (DFP) could lead to an increase in private consumption in the short-run. Afterward, and due to the sticky prices and imperfect competition on the market, the demand would increase. The increase in total demand leads to an increase in production. However, contrary to the Keynesian theory, the supporters of the neoclassic perspective claim that production is not influenced by DFP. Therefore, according to the studies by Fatas and Mihov (2003) and Attinasi and Klemm (2016), the effect of DFP on economic growth was negative in OPEC countries.

Figure 2 shows the variance decomposition of oil price on macroeconomic variables studied. It can be said that the most effect of oil price shocks is on GDP per capita after oil price shocks itself.

The share of oil price shocks in DFP changes was 1% in the first period that increases up to 3% in the second period, and it decreases gradually. The relative share of oil price shocks in inflation changes was 0.7% in the first year that decreases gradually. In addition, the relative share of oil price shocks would be 2% in GDP per capita that decreases gradually. The relative share of oil price shocks in government expenditure changes was 0.2% that decreases over time.

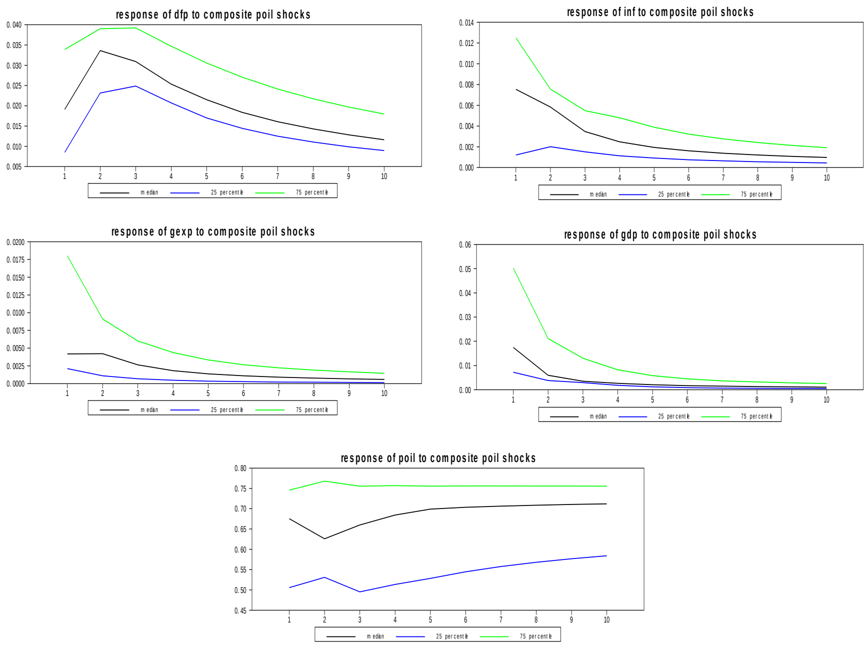

Figure 2. Variance decomposition of Composite oil price shocks on Macro-Economic Variables in OPEC countries

6. Concluding Remarks

In OPEC countries, the indirect effect of exogenous shocks on fiscal policy is very important, because supplying the sources of government finance are highly related to international trade. Since the economy in oil-rich countries depends on the variation in oil prices, it is important to investigate that after removing the cyclical fluctuations from fiscal policy (DFP), whether its effects still persist in government fiscal decisions. Therefore, the present study was aimed to study the impacts of oil price shocks on DFP in OPEC countries during 1980-2015. After the theoretical description and showing the effects of an oil price shocks on the macroeconomic variables and DFP in the form of a theory, the DFP was calculated. Then, using the PSVAR technique introduced by Pedroni (2013), the effects of oil price shocks on DFP and other macroeconomic variables were studied. Moreover, the effects of DFP on economic growth in OPEC countries were investigated. The result of the investigation suggested that a one-standard-deviation shock to oil price led to a 10% positive reaction of DFP in the first year. Thus, the reaction of DFP to the exogenous shock of oil price was against the theory in the short-run. However, the effects disappear in the long-run (after six years). It seems that the increase in the oil price caused an increase in government expenditure and a decrease in tax rates, indicating that oil price changes affect the government decision in oil-dependent countries.

Furthermore, the relative share of oil price shocks in DFP changes was 1% over the first period. That effect was supposed to increase in the second period up to 3%, but it decreased gradually.

Moreover, studying the effectiveness of macroeconomic variables regarding OPEC countries from oil price shocks suggested that a one-standard-deviation shock to oil price, caused a 10% positive reaction in inflation, according to the theory. The reaction of government expenditure to a one-standard-deviation shock to oil price was positive up to 2% that was compatible with the theory. In addition, the reaction of GDP per capita to oil price shocks in OPEC countries was negative and about 0.5%, against the theory. The results mentioned reminds us of the Resource Curse phenomena in OPEC countries. In the variance decomposition, it can be said that the most effective factor in oil price in macroeconomic variable changes was related to the oil price shocks itself, having 70% of shares in the changes. Next, the GDP per capita variable was affected by the oil price shocks more than other variables.

In addition, it was seen that a one-standard-deviation shock to DFP caused a negative 1% reaction on economic growth. In the variance decomposition of the effective variables on DFP, government expenditure had a share of 30%, and GDP per capita had a share of 10% that these amounts were more than those of the other variables.

As a whole, the results of this study indicated the impact of oil price shocks on discreationary fiscal decisions of OPEC countries in the short-run.

In other words, the evidence in the present study supports restricting the government authorities as a way for them to decrease production fluctuations and increase the economic growth rate.

Thus, the most important political suggestion in the present study is that policymakers should establish institutions like investment and saving fund, using the successful experience of other oil-producing countries and the experience gained from the exchange saving account. In this way, they can prevent shocks and exogenous fluctuations having a direct impact on the internal economy and can decrease the negative effects caused by oil price instability on gross domestic production and government revenue.

The key issue is to design and develop a saving fund that is defined in the political-economic structure of the country in a suitable position. The governing management of such a system should be designed to be strong, and there should be enough transparency for monitoring it. Also, there should be strategies for keeping fund assets and controlling the cost of it optimally and efficiently. Ultimately, and most importantly, the relationship between the government and the fund needs to be properly designed, and the fund should have sufficient independence.

Moreover, some other supplementary measures can be devised regarding monetary and fiscal policy authority aiming to manage the government expenditure and the demand. Reforming the tax budgeting system is proposed as a means for efficient utilization of oil revenues for long-run development.

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