



# Oil Price and Economic Growth Nexus in Saudi Arabia: Asymmetry Analysis

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## ABSTRACT

Oil Price (OP) and revenue play a significant contribution to the income of oil producers. Saudi income is majorly sourced from the oil sector. Therefore, it is very important to see the influence of OP on income. Particularly, testing asymmetry is necessary to see whether increasing OP has the same effect on income or not as of decreasing OP. This present research cares about this issue using nonlinear cointegration techniques. We found the symmetrical effect of OP on income in the long-run and asymmetrical effects in the short-run. Moreover, increasing and decreasing OP have equal pleasant and harmful effects on income. Moreover, increasing OP has a more pleasant effect than that of decreasing OP harmful effects on income in the short-run.

**Keywords:** Asymmetry, Oil Price, Economic Growth, Cointegration

**JEL Classifications:** Q41, O47, C12

## 1. INTRODUCTION

The oil sector is a strength of exporting countries as a contribution of the oil sector to the income. Oil Price (OP) would significantly determine the oil revenue. Because of inelastic oil demand, the increasing OPs are signal for higher income in the oil-exporting economies and decreasing OPs may harm the growth process of any oil-exporting economy. Therefore, OP is a pertinent concept for the oil-exporting economies as most of the income of these countries are depending on the oil production, price, and revenue to support income levels. Further, increasing OP is good news for the oil-exporting country. Therefore, increasing OP may boost investment and other economic activities in the country so may accelerate the economic growth resultantly.

OPs have been falling very sharply since July 2014 and touch the minimum level in February 2016 and start rising afterward. Now-a-day, the OPs are almost half than that was observed at the highest point in July 2014 (Government of Saudi Arabia, 2019).

The falling/lower OPs are single for the slump in Gulf Cooperation Council (GCC) countries and Saudi income is mostly sourced from oil production and its revenues. Therefore, it is very pertinent to check the effects of OP on the income level of Saudi Arabia to verify the statistically significant relationship because low OPs are signaling the slow economic growth but statistical evidence/significance is necessary before floating any contra-cyclical policy in the response of decreasing OPs.

Saudi Arabia is facing an economic downturn nowadays due to declines in the OP with minor increases as well. The income level of Saudi Arabia is highly oil sector dependent. The possible asymmetry of OP may exist on the effect of income but this has not been investigated before in the context of Saudi Arabia and asymmetry issue is still scant in the Saudi literature. Therefore, this research is considering this literature gap and trying to put very relevant research regarding this issue. The research is to probe an impact of OP on income levels of Saudi Arabia in possible asymmetrical settings. Testing the influence of OP on income is not very common in the literature as it is an interesting topic for majorly oil-exporting country.

The context of Saudi Arabia and the role economic instruments might affect the growth of the oil sector. While formulating policies for the energy sector in Saudi Arabia, it is crucial to understand the country has a huge energy demand and contribute to the energy sector to a wide extent. Therefore, there is enough space for research and development in the field, and this current study is focused on contributing to that pool of research, the sector needs. Saudi Arabia has a diverse and ever-growing energy profile, and it is crucial to understand how growth is affected by the oil sector. In the present literature, the influence of increasing and decreasing OP changes on income is scarce in the global literature and it is ignored in Saudi Arabia. So, we are going to bridge the literature-gap of Saudi Arabia.

The government is trying to establish the policy regarding economic diversification from oil-dependence. Because, any fluctuation in oil demand and price in the world market could disturb in terms of business activities, government revenue, and income level as well. This research is going to estimate the elasticity parameters of OP changes on the income per capita of Saudi Arabia in the asymmetrical settings. The estimated parameters would signify the contribution of oil prices' rises and falls in the economic growth which would be utilized for the growth policy while any OP change. Therefore, our estimated results would help in designing optimal economic growth policies in the boom or bust periods of OPs.

An impact of OP has been studied on the imports and stock market in Saudi Arabia (Khamis et al., 2018; Algaheed, 2018). The role of OP has been investigated in determining the foreign investment and local capital formation of Saudi Arabia (Mahmood and Alkhateeb, 2018; Alkhateeb and Mahmood, 2020). Hence, promoting investment could also determine the growth of this economy. Therefore, it is pertinent to explore the direction of OP on the growth of the Kingdom. Though, some studies have investigated this issue in the case of Saudi Arabia considering a linear relationship (Foudeh, 2017; Nyangarika et al., 2018). But, ignoring asymmetry in the presence of an asymmetrical relationship may cause biased estimations. Therefore, asymmetry should be assumed at first. So, this study aims at differentiating the effects of increasing (a positive movement) and decreasing (a negative movement) of OP to see whether increasing OP support income significantly. Moreover, decreasing OP has any significant influence to the falling income or not. Hence, testing the asymmetrical effects is our main objective and we explore the relationship of OP and growth considering the possibility of asymmetry using Shin et al. (2014) methodology.

## 2. LITERATURE REVIEW

There is very limited research available on testing the non-linear influence of OP on the income. For example, Chai et al. (2015) argued that oil importers may have negative economic growth effects of increasing OPs. Because increasing OP may raise costs and may generate supply shock in the economy. But, significant effect may only be observed in peak OP period as the minute changes could not affect the economic activities significantly. Alkhateeb et al. (2017) used a period of 1980-2015, a nonlinear

ARDL and found a positive effect of OP on employment. In the asymmetrical results, they found that increasing OP helped in generating employment than that of negative employment effect of decreasing OPs. Moreover, the income of the country helped in employment generation. Hence, OP had an indirect effect on the income through increasing employment in the Kingdom and increasing income again helped to increase employment. Hence, the dynamic relationship corroborated the links of OP, employment, and growth.

Using data from 1980-2016, Maalel and Mahmood (2018) instituted that increasing oil-export dependence and oil-income dependence have negative and positive effects on income respectively. Moreover, decreasing oil-export dependence and oil-income dependence have positive and negative impacts respectively. Hence, oil dependence in terms of exports and growth has a dynamic asymmetric relationship with economic growth through oil-exports dependence and income dependence as well. Farhani (2012) investigated the effect of OP on US income level and found that OP had a weaker impact on the US economy. This weak relationship was observed due to the structural breaks in the period of analysis. He further explained that OP shocks during the 1970s decreased the growth rates and increasing OP was responsible for recession in the world. Ghalayini (2011) investigated this issue and found the feed-effects for OP and income in G-7 countries.

Burakov (2017) investigated this issue in Russia using the period 1990-2015 and found a strong relationship between OP and growth. He claimed that OP variations directly affected the growth of oil-exporting economies. Further, this is affected the migration through the indirect channel. He established the causality between OP and growth and also between growth and migration. So, the OP has directly affected the growth and is indirectly affected migration through growth. Alkhateeb and Mahmood (2020) explored and found a positive asymmetrical impact of OP on the energy depletion in GCC countries. Fiti et al. (2016) investigated an influence of OP on growth for the period 2000-2010. They argued that OP was directly affected the economic activities in the oil producers' countries. Further, they found that financial recessions were significantly affected the OP-growth relationships.

Anoruo and Elike (2009) investigated this relationship for Africa and found that high OP is impeding the income in the selected countries. Therefore, they suggested that these oil-importing countries should develop a substitute to remove reliance on foreign oil to avoid any shock to income from the high global OP. Mahmood and Alkhateeb (2018) studied the impact of OP on foreign and local investments in Saudi Arabia using the period 1970-2015. They found that OP and financial markets helped in boosting foreign investment. However, domestic investment showed a negative influence on foreign investment hence these investments are found as substitutes for each another. The growth effect of the OP is channelized through domestic and foreign investment as investment is also a part of income.

Gershon et al. (2019) scrutinized an impact of OP on growth for oil-importing countries from Africa using a period of

1980-2015 and did causality analyses. They found that OP could cause the growth of a few sample countries and also affected the growth for other countries in the short-run. Other than oil-exporters, these studies highlighted the negative growth effects of OP in the oil-importing countries. Hence, OP is responsible for affecting the growth negatively and positively in the oil-importing and exporting countries respectively. Alkhateeb et al. (2017) investigated the multidimensional relationships of OP and other macroeconomics' proxies using a period of 1991-2016. They found that the oil sector and government expenditure significantly cause employment in the Kingdom. Hence, the oil sector is indirectly contributed to economic growth by causing employment in the Kingdom.

Siddiqui et al. (2019) explored the role of OP on the GCC market using weekly data. They found the asymmetry in the Saudi market. Before the slump period, they found some negative effects of OP on the stock markets of some sectors, and also positive effect of OP was found for the utility sector. During a slump, they found that OP has significant influence on most of the sectoral stock markets in Saudi Arabia. Khamis et al. (2018) investigated and found a less profound response of the Saudi stock market to the fall in price. Mahmood and Zamil (2019) investigated the OP and its slump on the personal consumption of the Kingdom and found the positive influence of OP. Consumption is a part of national income hence OP may affect income as well. On the other hand, the OP slump could not have effect on consumption. Algaheed (2018) studies and found a negative influence of OP and the positive influence of income on Saudi imports.

Other than the positive economic role of OP, it has also negative environmental consequences for oil-producers. For example, Mahmood et al. (2020) investigated OP and pollution emissions relationships in Saudi Arabia using the period 1980-2014. They found that OP accelerated the pollution in the Kingdom. Moreover, urbanization puts fire on this relationship as increasing urbanization increased the pollution. Similarly, Mahmood et al. (2020) found that increasing oil sector was enhancing pollution in Saudi Arabia. Mahmood and Furqan (2020) corroborated that oil rents were enhancing the pollution emissions with direct and spillover effects in GCC countries.

Most of literature examined the linear relationship between OP and growth. For example, Nyangarika et al. (2018) and Foudeh (2017) explored the asymmetric relationship between OP and income in Saudi Arabia. Exploring the symmetric effect of OP may create biasness in the results if asymmetrical is statistically prominent. Moreover, rising OP has different influences on the income growth than that of falling OP. Therefore, the present research is highly motivated in testing and differentiating the influences of positive and negative OP changes on the economic growth of Saudi economies and also wants to test the possible asymmetries as well.

### 3. METHODOLOGY

Literature has signified the role of OP in determining the growth of the oil-exporting country. But, the increasing and decreasing

OP do not compulsory to have symmetrical or the same effects on the growth. Therefore, asymmetrical analysis of the OP-growth relationship seems pertinent. Particularly, this kind of analysis is very important for oil-exporting Saudi Arabia whose major income is sourced from oil-sector. To assess the asymmetrical impact of OP on income, we are relying on the Non-Linear ARDL proposed by Shin et al. (2014). This technique is sufficient to investigate and to differentiate the positive OP movements and negative OP movements on the income growth of Saudi Arabia. Further, this technique is of Auto-Regressive Distributive Lag (ARDL) nature, which is dynamic in nature and control for possible endogeneity in the model, and hence it is very suitable to achieve our objectives of this research. We propose the following model for empirical investigation:

$$LGDPC_t = \alpha_0 + \alpha_1 LGDPC_t + \alpha_2 LOPP_t + \alpha_3 LOPN_t + \zeta_t \quad (1)$$

Where  $LGDPC_t$  is the natural log of per head GDP of Saudi Arabia and  $LOPP_t$  is the natural log of OP. Data is sourced from the Government of Saudi Arabia (2019).  $LOPP_t$  is divided into two  $LOPP_t$  and  $LOPN_t$  variables as per Shin et al. (2014) methodology to distinguish the positive OP movements and negative OP movements. Initially, the positive effects of both  $LOPP_t$  and  $LOPN_t$  may be expected as oil-exports' income and growth are supposed to be positively affected by OP due to its price inelastic nature of demand.

$$LOPP_t = \sum_{i=1}^t \Delta LOPP_t^+ = \sum_{i=1}^t \max(\Delta LOPP_t, 0) \quad (2)$$

$$LOPN_t = \sum_{i=1}^t \Delta LOPN_t^- = \sum_{i=1}^t \min(\Delta LOPN_t, 0) \quad (3)$$

The non-linear ARDL model of equation 1 considering asymmetrical effects of  $LOPP_t$  and  $LOPN_t$  variables on the  $LGDPC_t$  for the analysis is as follows:

$$\begin{aligned} \Delta LGDPC_t = & \delta_0 + \delta_1 LGDPC_{t-1} + \delta_2 LOPP_{t-1} + \delta_3 LOPN_{t-1} \\ & + \sum_{j=0}^p \phi_{1j} \Delta LGDPC_{t-j} + \sum_{j=0}^q \phi_{2j} \Delta LOPP_{t-j} \\ & + \sum_{j=1}^q \phi_{2j} \Delta LOPN_{t-j} + \psi_t \end{aligned} \quad (4)$$

At first, this research will ensure the relationship in the proposed model by applying the bound test and then can calculate the estimated impacts of our proposed  $LOPN_t$  and  $LOPP_t$  variables on income. After that, we will test the statistical significance of possible asymmetry. Further, short-run effects may be estimated from the following equation:

$$\begin{aligned} \Delta LGDPC_t = & \beta_0 + \beta_1 ECT_{t-1} + \sum_{j=0}^p \gamma_{1j} \Delta LGDPC_{t-j} \\ & + \sum_{j=0}^q \gamma_{2j} \Delta LOPP_{t-j} + \sum_{j=1}^q \gamma_{2j} \Delta LOPN_{t-j} + \upsilon_t \end{aligned} \quad (5)$$

The estimated gammas in equation 5 are the short-run effects of  $LOPN_t$  and  $LOPP_t$  variables. Further, the estimated beta-one would signify the existence of a short-run relationship and also directs the speed of convergence if the estimated value will be negative and significant.

### 4. DATA ANALYSIS

At first, we tested the unit root problem through Dickey and Fuller (1981) test to verify the order of integration. Table 1 showed the low negative values of estimated t-stat and/or positive t-stat at their level of variables. However, a high negative values of estimated t-stat are corroborated the stationarity at the first difference of variables so the order of integration is one in the proposed relationship.

After unit root results, Table 2 shows estimations of equations 4 and 5. At first, the bound test show a low F-value which could not validate the cointegration but it is corroborated with negative parameter of  $ECT_{t-1}$ . Further, the diagnostic tests are showing the econometric validity of the estimated model.

Table 2 showed that  $LOPP_t$  and  $LOPN_t$  are showing a positive effect on income. The elasticity showed that a 1% increase in the  $LOPP_t$  is increasing economic growth by 0.4113% and a 1% decrease in the  $LOPN_t$  is decreasing economic growth by 0.4972%. Both effects are not very different in magnitude and the Wald test is done on the null hypothesis of symmetrical effect which is accepted with estimates of 0.8748 and  $P = 0.3496$ . Hence, the Wald test favors the symmetrical effect of  $LOPP_t$  and  $LOPN_t$  on income in Saudi Arabia as statistical asymmetry is not proved in the empirical testing. However, the magnitude of the effect of  $LOPN_t$  on the economic growth of Saudi Arabia is minutely higher than that of the effects of  $LOPP_t$  and it showed the over-dependence on oil. The decreasing OP signals the low revenues from the oil sector in the Kingdom, and economic growth declines sharply. Further, a positive effect of  $LOPP_t$  on the income of Saudi Arabia is also significant and reasonably high. It shows that increasing OP reflects pleasant signals for the economy which provide the oil revenue

**Table 1: ADF results**

Variable	Intercept	Intercept and trend	None
$LGDP C_t$	-3.0800	-3.3940	1.2361
$LOPP_t$	1.3883	-2.9609	3.4562
$LOPN_t$	0.5834	-2.6481	2.8026
$\Delta LGDP C_t$	-5.1011	-5.1851	-4.8548
$\Delta LOPP_t$	-5.9386	-5.9697	-4.3525
$\Delta LOPN_t$	-6.6416	-6.7355	-5.5666

C is intercept and T is trend

**Table 2: Non-linear ARDL**

Regressor	Parameter	SE	t-Stat	Prob.
$LOPP_t$	0.4113	0.2367	1.7379	0.0908
$LOPN_t$	0.4972	0.1514	3.2845	0.0023
C	8.8868	0.3462	25.6711	0.0000
$\Delta LGDP C_{t-1}$	0.2858	0.1090	2.6218	0.0127
$\Delta LGDP C_{t-2}$	0.1981	0.0565	3.5051	0.0012
$\Delta LOPN_t$	0.1850	0.0648	2.8560	0.0071
$\Delta LOPP_t$	0.7140	0.0454	15.7236	0.0000
$\Delta LOPP_{t-1}$	-0.2189	0.0913	-2.3960	0.0219
$ECT_{t-1}$	-0.1629	0.0450	-3.6182	0.0009
Bound test		3.0210		
Heteroscedasticity		1.0911		0.3916
Serial correlation		0.5428		0.5861
Functional form		1.7192		0.1944
Normality		0.6727		0.7144

in the income of the country. It also has indirect positive growth effects through business activities because business activities would also accelerate because of increasing OPs as it is good news for the oil-exporting country. Therefore, higher aggregate demand is expected in the economy which would accelerate the economic and business activities and could support income.

The lagged effects of income found significant for two past years. Therefore, increasing income of the Kingdom shows positive effects on the next economic growth at least for two years in the short-run analysis. On the OP effects,  $LOPP_t$  and  $LOPN_t$  have positive effects. The elasticity shows that a 1% increase in the  $LOPP_t$  is increasing economic growth by 0.714% and a 1% decrease in the  $LOPN_t$  is decreasing economic growth by 0.185%. Both effects are quite different in magnitude and asymmetry is obvious therefore Wald test is not conducted. Hence, asymmetry can be claimed in the effects of  $LOPP_t$  and  $LOPN_t$ . The magnitude of the effect of  $LOPP_t$  on the economic growth of Saudi Arabia is more than 3 times higher than that of the effects of  $LOPN_t$ . It exhibited that OP is very important for income generation. Last but not least, the effect of  $LOPN_t$  is low but the importance of the oil sector is still existing in short-run. Because decreasing OPs may decrease the income even in the short-run.

### 5. CONCLUSION

The oil sector is the backbone of oil-exporting countries because of economic dependence on oil revenue. OP determines revenues as oil demand is inelastic in the world market due to its compulsory type of demand. Therefore, increasing OPs are signal for higher income and decreasing OPs may harm the growth process of any oil-exporting economy. Considering these arguments, the present study is tested the impact of OP on the income of the largest oil exporter in the world.

Further, we care about the possible asymmetry using nonlinear ARDL technique. But, we found the symmetrical effect of OP in long-run. It concludes that increasing (decreasing) OPs have equal pleasant (harmful) effects on income and this result also realized the importance of diversification of the Saudi economy from the oil sector in the low OP period. Contrarily, asymmetrical effects are corroborated on income in short-run and increasing OPs have more pleasant effects than that of decreasing OPs' harmful effect on economic growth.

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