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## Article

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# An ARDL investigation on the nexus of oil factors and economic growth: A timeseries evidence from Sultanate of Oman

Sarfaraz Javed<sup>1\*</sup> and Uvesh Husain<sup>1</sup>

**Abstract:** The study is conducted to comprehend the relation of the oil sector with Oman's economic growth. Oman is an abundant oil country, and the oil sector plays an influential part in its economic development. The data were gathered from a range of 1989 to 2018 from the National Center for Statistics and Information of Oman; it published the statistical year for variables including oil revenue, oil price, gross capital formation, total revenue, and production or export of Crude Oil. The data were analyzed with the help of the ARDL cointegration approach and Granger causality test. The results enlighten that economic performance is significantly affected by the oil price, crude oil production, and gross capital formation, and the total revenue and oil revenue insignificantly influence it. The impact of export has a substantial adverse influence on economic growth. The variables have long-run granger cause on each other while short-run causal bidirectional relation exists among economic performance, crude oil production, and export of Crude Oil. The



Sarfaraz Javed

### ABOUT THE AUTHORS

Dr Sarfaraz Javed (PhD) is a researcher devoted to conducting research on emerging issues and challenges in business, corporate finance, economics and various interdisciplinary areas, particularly in finance and accounting. His area of interest is Corporate finance, managerial implications, Intellectual capital, Corporate social responsibility, Financial and Management accounting. Along with his extensive research experience, his teaching experience is also remarkable which he gains through national and international exposure. He's handling Two funded projects from "The Research Centre" program named Block funded projects.

Owais Husain (PhD) having more than 14 years of teaching and research experience. I'm equipped with Extraordinary Caliber and appreciable academic potencies. Presently working with MAZOOON COLLEGE as a HOD of the Economics and Business Studies Department, appointed as Assistant Professor. My areas of specializations are Commerce (Accounting & Finance). Mine published Research and Article in various National and International Journals. Currently, I'm working on Two FUNDED projects along with the two books. Moreover, I'm actively participating in International Conferences and workshops. I'm also serving as a reviewer for numerous journals.

### PUBLIC INTEREST STATEMENT

The purpose of this study was to know how the Oil sector of Oman is impacting the economy of Oman. So, this study has focused on the fact that how the oil revenue, oil price, gross capital formation, total revenue and production or export of crude oil is impacting the economic growth of Oman. In this study, the researcher has used data regarding the factors under study through the National Center for Statistics and Information of Oman. The results of this study have revealed that the oil revenue can decrease the economic growth, the enhancement in oil price can enhance the economic growth, the oil production can enhance the economic growth of Oman while the enhancement in crude oil export can decrease the economic growth of Oman as well. This study can impact the focus of Omani government on the oil sector and the government can better make policies regarding investing in the sector for enhancement of the economic growth of Oman.

study helps Oman's Government understand the importance of the oil sector and aids in maintaining or forecasting the oil revenue and government spending to retain a stable economy.

**Subjects:** Economic Theory & Philosophy; Monetary Economics; Development Economics

**Keywords:** economic growth; oil revenue; ARDL estimation; Oman

## 1. Introduction

Several research types have revealed that the states' economic reforms depend on their naturally available resources in their soils. The growth hikes with numerous resources and Oil are the predominant sources. Oman is one of the blessed countries having Oil as a central reserve prevailing on their land and glorifying the Sultanate of Oman. The country's exports are comprised of 87.6%, which are linked to global crude oil exports. Over 85% of the state's revenue is produced from crude Oil of the Sultanate and contributes to the country's GDP growth. According to a national survey, a 2.6% increase in crude oil production has been observed on an annual basis; a 4.2% hike has been observed in crude oil production daily and 55.4% has been the sale ratio from the oil refineries and petroleum sectors of the country like Oman (WB, 2010). However, crude oil prices fell up to 7% in 2019 compared to the year 2018. Furthermore, the sector of crude oil has become the primary mode of GDP growth of the Sultanate as compared to other sectors such as the corporate sector, manufacturing sector, etc. consequently, facts and figures solidify the significance of Oil in the economic growth of the country at supreme level. According to the international data providing body, the exports of Oman crude oil have been higher in 2016 with 887.500 barrel/day (CEIC, 2020).

The oil and petroleum production of Oman helped to develop over the last five decades. Nonetheless, Oman has collaborated with various groups but still could not get the Organization of Petroleum Exporting Countries (OPEC). The history of oil production is dated back from 1964 in the region of Oman named Fahud. It is the predominant oilfield of the Sultanate of Oman, situated in the desert of the Western area. In the year 1967, the proper extraction and oil production was started by the Petroleum Development of Oman (PDO). This oil extraction body shares 60% ownership with the Government of Oman, and 40% ownership is held under foreign-based investment, including the Royal Dutch Company and Française des Pétroles. The reserves have been dwindling due to their depleting nature in the oil reserves. In the 1980s, the production of Oil fell to 285,000 barrels per day compared to 366,000 barrels per day in 1976. Price levels also fell, and Oman recovered by escalating the production. However, in 1986 the economy was severely affected due to uncertainty and changing oil prices, and to counter the situation, production was severely affected and decreased temporarily in response to the Organization of Petroleum Exporting Countries (OPEC). However, the production surge came by 1987 with 600,000 b/d, the revenue of the country increased. Ostensibly, by 2000, the oil extraction and production increased up to 900,000 barrels per day. By the year 2000, Oman faced a massive increase in Oil production at such a massive level and enhanced the economic growth of the Sultanate of Oman.

Following the report issued in yearly publication 2018 by Oman's Central bank, the price of crude Oil recorded up to US\$69.7 in the year 2018, which was more than the prior year. Moreover, the economic boost has been predicted by the World Bank report, and this growth would be hiking up to 2021 as various projects are estimated to contribute, such as Oil-based sectors and non-oil sectors. Owing to the Government expenditure has been more generous on the country's oil sector along with the social welfare spending and defense system of the region. Moreover, the debt to GDP ratio is estimated to increase by 58% by the year 2020. According to the National Statistics Centre, crude oil production has fallen at the end of the year 2019 with a rate of 3.4%, and this condensation in production affects economic performance. However, according to the PDO report, Oman's Oil sector faces various challenges ahead. The factors include the size of the industry, location, and operational maturity of the oil sector. These threats are of political, economic, as well as social nature. The main challenge is based on deliverability. Issues are prevailing based on costs and price hikes in the

industry of oil reserves and production declination in this particular sector. In addition to it, the current demands of Oil by the social communities have increased blatantly.

According to the World Bank, crude Oil production has been facing various troubles related to the country's current scenario. The Gross Domestic Product's growth is observed to flow downward with a ratio of 1.1% compared to the ratio of 3.1% for the year 2018. The significant hindrances have occurred due to the limitations carved by OPEC at an international venue. Contrarily, non-hydro-carbonated sectors such as tourism, fishing, and manufacturing are expected to enhance the GDP with a rate of 1.5% (WB, 2019). These challenges are consistent with the report published by the World Bank in the year 2010. The report predicted the upcoming hurdles occurring during the processing of crude oil extraction and production. Moreover, 20–25 years have been estimated as a lifespan for the whole oil reservoirs in Oman, and it would be hitting the sector of Oil in awful manners. The publication was named "Oman energy sector review," and the study has already predicted the forthcoming trials for the Oman energy sector (WB, 2010).

Several previous studies have laid out the importance of the oil sector for the countries that are directly dependent on their oil reserves and oil production for their economies. However, most of the studies have failed to significantly and separately explain all of the aspects of the oil sector and their importance for those countries' economies. Similarly, several studies that have been reviewed by the researcher as well have not shown any significant research being done on all of the factors of the oil sector of Oman and have also not empirically given exact figures according to which it can be determined that whether or not the contributions of the oil sector of Oman are significant for the economic performance of Oman as well. The researcher has closely observed all of these drawbacks and has carried out this study to highlight the impacts of each aspect like oil price, crude oil production, and oil revenue on Oman's economic performance. The researcher feels that the oil sector has significant importance in the economy of Oman. However, the researchers are undermining the importance as they are not conducting full-fledged research regarding each aspect of the oil sector that impacts the economic performance and economic growth of Oman (Al-Mawali et al., 2016). Despite the gaps present in the previous researches, the researcher has taken the essential variables from the oil sector of Oman in order to clarify that how the economy of Oman is getting impacted by these variables, so the researcher has used the latest tools, software, and techniques to analyze and interpret these impacts. The researcher has chosen this topic so that the Government of Oman can closely focus on those aspects of the oil sector that can enhance Oman's overall economic performance and growth.

The research has several significant contributions to the literature, as the researcher has highlighted and filled the gaps present in the past research, such as the absence of empirical evidence of the impacts of Oman's oil sector on the economy of Oman. There was an absence of suitable references and cross-study proofs to explain the relationship between Oman's oil sector and the economy. The researcher has also clearly mentioned the impacts cast by each factor of the Oil sector of Oman on economic performance so that those aspects can better be focused by the sector and companies to enhance revenue and economic growth. Moreover, the researcher has given proofs, adequately analyzed, and interpreted results for the Government of Oman, which can now significantly make policies and rules regarding the improvement and funding of the oil sector to enhance economic performance and growth of Oman.

## 2. Literature review

Economic growth is several times studied and explained by different researchers according to their perceptions (Nkalu & Edeme, 2019), this is a topic that has attracted most of the researchers, but there is still not a single definition that can satisfy all of the aspects that are involved in economic growth. However, when researchers talk about a specific country's economic development, the descriptions become precise and relate to that country's characteristics only. (Rafindadi, 2015) put forward the concept of economic growth as an increase in the production of the goods and services in a state-provided in a specific period and measured with the removal of inflation. Financial growth results in the enhancement of profits for the businesses present in a country; it also enhances the firms' stock prices

in a country. Also, it provides the companies and businesses present in a country with the necessary capital that can be invested for development and innovation. In all of this process, more employees can be hired, more jobs are created, and the overall income rises (Suliman et al., 2018).

On the other hand, the consumers become able to buy more of the services and the products that are produced within a country; when the purchases go up, they also enhance the economic growth with them, and the economic growth is then indicated positive (Al Samman & Jamil, 2018). Most researchers have mired the economic growth factor using the gross domestic product, exports, and imports of a country. At the same time, past studies do not effectively describe economic growth in relationships with different sectors present in a country (Li et al., 2018). Oil importing states have been discussed in various studies, while the oil-exporting states have significantly less focus in the research areas. However, a study conducted in the oil-exporting country has been keenly observed (Mahdi, 2019). The effect of fluctuation of oil prices on different variables has been examined by some researchers, GNP, exchange rates, unemployment level, and inflation rate using time series data (Saeed & Hatem, 2017). The study has found that prices of Oil have no impression in the shorter period. However, oil prices have a substantial impact on the inflation level of the country. Most of the research that the researcher has gone through has indicated different opinions of other researchers regarding different countries' economic growth. Still, there were the least researches based on economic growth in several specific sectors of a nation.

Most of the time, the economy and the GDP of a country are calculated based on the resource in which the Government is rich and abundant. For Oman, this product is its production of Oil. However, most of the researchers in the past studies have addressed both the oil and gas sector of Oman when it comes to discussing the economic growth of Oman. The survey of (Ahmed, 2018) has discussed sultan Qaboos' time, who reformed the oil and gas sector for the sole purpose of Oman's economic growth. The sultan invested billions of dollars in the oil sector of Oman for the sole purpose that this will result in 10 times the profit of the amount that is invested in the project; with this investment, it was made clear that most of the economic growth an GDP of Oman is based upon its oil sector. Results have identified that the proposed model has been harmonized with the theories of economics. There is mainly a statistically significant relationship between the country's economy and the rate of exchanges via numerous price factors.

Furthermore, a significant level of policy breakthroughs is demanded the economic sector's revival (Alkhateeb et al., 2016). Later on, most of the studies and surveys proved that Oman is an Oil abundant state and the only way to make the economic growth positive and the GDP go higher is to invest in this sector. The Government is making continuous efforts to enhance their reserves for the hydrocarbons and to sustain the oil production; it has also been proven through different studies that the resources that are present in Oman are much lower than other states in the Gulf, yet some of the researchers have confirmed that the reserves of hydrocarbons are enough to make the economic growth go higher than what the other gulf countries have (Şentürk & Ali, 2019). Some of the researchers have argued that Oman lacks the vision that is needed to consistently use and take advantage of the reserves of hydrocarbons present in the country; some of the researchers have also pointed out the fact that there is a lack of enough investment which is needed for proper oil extraction and refining, doing what Oman will be completely taking advantage of all of the reserves that it has.

Most of the studies have only pointed out the drawbacks of the oil sector of Oman, some reviews that the researcher has gone through include proving the abundance of oil reserves and the results of hydrocarbons present in Oman. Almost none of the past studies has discussed the oil sector factors that can be beneficial when it comes to the enhancement of economic growth and GDP of Oman. Almost none of the past studies has discussed the enhancement of economic growth with the help of different oil sector factors. None of the past reviews have concerned how oil price, oil exports, oil refining, and oil diversification can impact the economy of Oman. The researcher has strived to fill this gap and provide



enough empirical evidence regarding these factors in the present research. The study of (Zayed, 2016) has shown how the oil revenue can impact Oman's gross capital formation and revenue from Oman's oil sector. Still, the analysis yet is short of necessary pieces of evidence and factual data. The course has significantly enlightened how crude oil production is required for the growth of Oman's GDP and exports, but the study has not focused on the economic growth of Oman at all.

### 3. Research methodology

The study was done to evaluate the influence of the oil sector on Oman's economy. The data gathered for the analysis is drawn from a statistical years-book published by the National Center for statistical information of Oman. The data collected were from the year range of 1989 to 2018 based on the availability of statistics. The indicators used to measure the oil sector's contribution are export of crude oil, oil production, oil price, revenue generated by Oil, GCF, and total revenue, while GDP determines the economic growth.

### 4. Econometric approach

This research's primary objective was to show the impact of the oil segment on the economic development of Oman. The approach used to analyze the data is autoregressive distributive lag (ARDL), which is used to conduct an abound test and cointegration test proposed and developed (Pesaran et al., 2001). The core advantage of this approach is that it uses and takes the regressors stationarity at the first difference of I (1) or I (0) and maybe a mixture of both, which aid in evading the hurdles generated in the test of a unit root. Endogeneity issues are also efficiently resolved by the ARDL approach (Lin & Moubarak, 2014). The ARDL test can easily be applied to small sample size for substantially inspecting cointegration, while the Johansen technique needs a large sample size to run the analysis for cointegration. This approach quickly evaluates the variables even if they have different optimal lags (Ozturk & Acaravci, 2010). The model of ARDL bound approach of multivariate unrestricted error correction model (UECM) is as follows in equation 1:

$$\begin{aligned} \Delta GDP_t = & \alpha + \gamma^1 GDP_{t-1} + \gamma^2 OR_{t-1} + \gamma^3 OP_{t-1} + \gamma^4 COP_{t-1} + \gamma^5 COE_{t-1} + \\ & \gamma^6 GCF_{t-1} + \gamma^7 TR_{t-1} + \sum_{i=1}^n 1\phi_i \Delta GDP_t = i + \sum_{j=0}^{n1} \delta_j \Delta OR_t = j + \sum_{l=1}^{n2} \eta_l \Delta OP_t = 1 + \\ & \sum_{m=1}^{n3} \theta_m \Delta COP_t = m + \sum_{k=1}^{n4} \rho_k \Delta COE_t = k + \sum_{h=1}^{n5} \tau_h \Delta GCF_t = h + \sum_{s=1}^{n6} \omega_s \Delta TR_t = s + \mu t \end{aligned} \quad (1)$$

Here, GDP refers to the gross domestic product OR indicates oil revenue; OP stands for the oil price, COP stands for crude oil production, COE stands for crude oil export, GCF indicates gross capital formation, and TR stands for total revenue.  $\Delta$  is used to present the operator difference, the error is denoted by  $\mu t$  and the long-term multiplier is symbolized as  $\gamma t$ . The variables of equation 1 have been changed into a natural logarithm, which reduces the chances of heteroscedasticity in data. The bound test consists of three-steps and is based on joint F-statistics for the cointegration procedure. Step one is to analyze the possibility of long-run association among the series with the help of ordinary least square (OLS), which aids in identifying the joint significance of coefficient at the lagged level in equation 1. The null hypothesis of the series is shown as "H0:  $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = 0$ " and on the other hand, the alternative hypothesis is expressed as "H1:  $\gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq \gamma_6 \neq \gamma_7 \neq 0$ ." The bound test shows the values of I (1) and me (0) for regression, and it is also possible that it may be a combination of both of them or mixed integration. If the computed F-statistics value is less than the lower bound value, the rejection of the null hypothesis is impossible, which means no-cointegration exists among the variables. On the other hand, if computed F-statistics is more than the upper bound value, the null hypothesis of no integration is rejected, representing a long-run association and cointegration present among the variables. The test is inconclusive when the value of computed F-statistics falls amongst the bound values.

The next step in the ARDL approach is estimating long-run coefficients if cointegration is found among the variables. The ARDL model is presented as follows in equation 2:

$$\begin{aligned} \text{GDPT} = & \alpha + \sum_{i=1}^n \beta^1 \text{GDPT}^{-i} + \sum_{j=0}^{n1} \beta^2 \text{ORT}^{-j} + \sum_{l=0}^{n2} \beta^3 \text{OPT}^{-l} + \sum_{m=0}^{n3} \beta^4 \text{COPt}^{-m} + \\ & \sum_{k=0}^{n4} \beta^5 \text{COEt}^{-k} + \sum_{h=0}^{n5} \beta^6 \text{GCFt}^{-h} + \sum_{s=0}^{n6} \beta^6 \text{TRt}^{-s} + \mu t \end{aligned} \quad (2)$$

Here, GDP refers to the gross domestic product OR indicates oil revenue; OP stands for the oil price, COP stands for crude oil production, COE stands for crude oil export, GCF indicates gross capital formation, and TR stands for total revenue. The last step of this approach is the estimation of the short-run coefficient by applying an error correction model, which is shown below in equation 3:

$$\begin{aligned} \Delta \text{GDPT} = & \alpha + \sum_{i=1}^n \phi \Delta \text{GDPT}^{-i} + \sum_{j=1}^{n1} \delta j \Delta \text{ORT}^{-j} + \sum_{l=1}^{n2} \eta l \Delta \text{OPT}^{-l} + \sum_{m=1}^{n3} \theta m \Delta \text{COPt}^{-m} + \\ & \sum_{k=1}^{n4} \rho k \Delta \text{COEt}^{-k} + \sum_{h=1}^{n5} \tau h \Delta \text{GCFt}^{-h} + \sum_{s=1}^{n6} \omega s \Delta \text{TRt}^{-s} + \Psi \text{ECT}^{-1} + \mu t \end{aligned} \quad (3)$$

The symbol  $\Psi$  indicates the error correction term (ECT) utilized to adjust disequilibrium in each period, and it is statistically substantial with a negative sign. It is very beneficial and helps prove long-run relationship stability (Banerjee et al., 1998). While  $\Phi$ ,  $\delta$ ,  $\eta$ ,  $\rho$ ,  $\tau$ ,  $\omega$  and  $\theta$  are representing the short-run coefficients. Here, GDP refers to the gross domestic product, OR indicates oil revenue, OP stands for the oil price, COP stands for crude oil production, COE stands for crude oil export, GCF indicates gross capital formation, and TR stands for total revenue.

After implementing the cointegration by bound test, there is a need to inspect casual association among elements. It is accomplished by applying the Granger causality test because of cointegration purposes; the presence of causality in the elements is not enough to specify the direction (Eddrief-Cherfi & Kourbali, 2012). So, Granger (1988) suggested causal direction between variables if cointegration is found, then VECM should be applied instead of VAR. The VECM model is more appropriate in this study to estimate the Granger causality test by taking variables on the first difference and combining the long-run relationship as an error correction term in this model. The model of VECM is presented as follows in equations 4 to 10:

$$\begin{aligned} \Delta \text{GDPT} = & \lambda_{10} + \xi_1 \text{ECT}t - 1 + \sum_{i=1}^{m1} \lambda^{11} i \Delta \text{GDPT}^{-i} + \sum_{j=1}^{n1} \lambda^{12} i \Delta \text{ORT}^{-i} + \sum_{j=1}^{p1} \lambda^{13} i \Delta \text{OPT}^{-i} + \\ & \sum_{j=1}^{q1} \lambda^{14} i \Delta \text{COPt}^{-i} + \sum_{j=1}^{s1} \lambda^{15} i \Delta \text{COEt}^{-i} + \sum_{j=1}^{k1} \lambda^{16} i \Delta \text{GCFt}^{-i} + \sum_{j=1}^{h1} \lambda^{17} i \Delta \text{TRt}^{-i} + \mu^1 t \end{aligned} \quad (4)$$

$$\begin{aligned} \Delta \text{GDPT} = & \lambda_{10} + \xi_1 \text{ECT}t - 1 + \sum_{i=1}^{m1} \lambda^{11} i \Delta \text{GDPT}^{-i} + \sum_{j=1}^{n1} \lambda^{12} i \Delta \text{ORT}^{-i} + \sum_{j=1}^{p1} \lambda^{13} i \Delta \text{OPT}^{-i} + \\ & \sum_{j=1}^{q1} \lambda^{14} i \Delta \text{COPt}^{-i} + \sum_{j=1}^{s1} \lambda^{15} i \Delta \text{COEt}^{-i} + \sum_{j=1}^{k1} \lambda^{16} i \Delta \text{GCFt}^{-i} + \sum_{j=1}^{h1} \lambda^{17} i \Delta \text{TRt}^{-i} + \mu^1 t \end{aligned} \quad (5)$$

(6)

$$\begin{aligned} \Delta \text{COPt} = & \lambda_{40} + \xi_4 \text{ECT}t - 1 + \sum_{i=1}^{m4} \lambda^{41} i \Delta \text{GDPT}^{-i} + \sum_{j=1}^{n4} \lambda^{42} i \Delta \text{ORT}^{-i} + \sum_{j=1}^{p4} \lambda^{43} i \Delta \text{OPT}^{-i} + \\ & \sum_{j=1}^{q4} \lambda^{44} i \Delta \text{COPt}^{-i} + \sum_{j=1}^{s4} \lambda^{45} i \Delta \text{COEt}^{-i} + \sum_{j=1}^{k4} \lambda^{46} i \Delta \text{GCFt}^{-i} + \sum_{j=1}^{h4} \lambda^{47} i \Delta \text{TRt}^{-i} + \mu^4 t \end{aligned} \quad (7)$$



$$\Delta COE_t = \lambda_{50} + \xi_5 ECT_{t-1} + \sum_{i=1}^{m5} \lambda_{51}^i \Delta GDP_{t-i} + \sum_{i=1}^{n5} \lambda_{52}^i \Delta OR_{t-i} + \sum_{i=1}^{p5} \lambda_{53}^i \Delta OP_{t-i} + \sum_{i=1}^{q5} \lambda_{54}^i \Delta COP_{t-i} + \sum_{i=1}^{s5} \lambda_{55}^i \Delta COE_{t-i} + \sum_{i=1}^{k5} \lambda_{56}^i \Delta GCF_{t-i} + \sum_{i=1}^{h5} \lambda_{57}^i \Delta TR_{t-i} + \mu_t^5 \quad (8)$$

$$\Delta GCF_t = \lambda_{60} + \xi_6 ECT_{t-1} + \sum_{i=1}^{m6} \lambda_{61}^i \Delta GDP_{t-i} + \sum_{i=1}^{n6} \lambda_{62}^i \Delta OR_{t-i} + \sum_{i=1}^{p6} \lambda_{63}^i \Delta OP_{t-i} + \sum_{i=1}^{q6} \lambda_{64}^i \Delta COP_{t-i} + \sum_{i=1}^{s6} \lambda_{65}^i \Delta COE_{t-i} + \sum_{i=1}^{k6} \lambda_{66}^i \Delta GCF_{t-i} + \sum_{i=1}^{h6} \lambda_{67}^i \Delta TR_{t-i} + \mu_t^6 \quad (9)$$

$$\Delta TR_t = \lambda_{70} + \xi_7 ECT_{t-1} + \sum_{i=1}^{m7} \lambda_{71}^i \Delta GDP_{t-i} + \sum_{i=1}^{n7} \lambda_{72}^i \Delta OR_{t-i} + \sum_{i=1}^{p7} \lambda_{73}^i \Delta OP_{t-i} + \sum_{i=1}^{q7} \lambda_{74}^i \Delta COP_{t-i} + \sum_{i=1}^{s7} \lambda_{75}^i \Delta COE_{t-i} + \sum_{i=1}^{k7} \lambda_{76}^i \Delta GCF_{t-i} + \sum_{i=1}^{h7} \lambda_{77}^i \Delta TR_{t-i} + \mu_t^7 \quad (10)$$

Here, GDP refers to the gross domestic product OR indicates oil revenue; OP stands for the oil price, COP stands for crude oil production, COE stands for crude oil export, GCF indicates gross capital formation, and TR stands for total revenue. The coefficient of error correction term  $\xi$  used to explain the explanatory variable deviation from long-run equilibrium and lagged of error correction term ( $ECT_{-1}$ ) was also acquired by long-run relationship equilibrium. The coefficients  $m_i$ ,  $n_i$ ,  $p_i$ ,  $q_i$ ,  $s_i$ ,  $k_i$ , and  $h_i$  are used to pinpoint optimum lag length, and their basis of determination depends on Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), and Hannan–Quinn information criterion.

The coefficient significance of lagged error correction term helps VECM captures the long-run causality among variables that aid in showing how quickly disequilibrium adjusted between variables. Meanwhile, the Wald test or F-statistics helps in accessing the short-run causality, and the test is used to highlight the implication of all lagged dynamic terms, which help measure the short-run causal effect (Sulub et al., 2020). Another test helps in adjusting the disequilibrium among variables known as a joint test for short-run which give signs to a variable that can bear the short-run adjustments to maintain the equilibrium in the long run due to any shock in a structure (Asafu-Adjaye, 2000). The long run's causality was analyzed by accessing the  $H_0: \xi_i = 0$  and the short-run accessed through  $H_0: \lambda_i = 0$ . It means that if the null hypothesis is rejected, then the causal relationship is found among variables.

## 5. Results and discussion

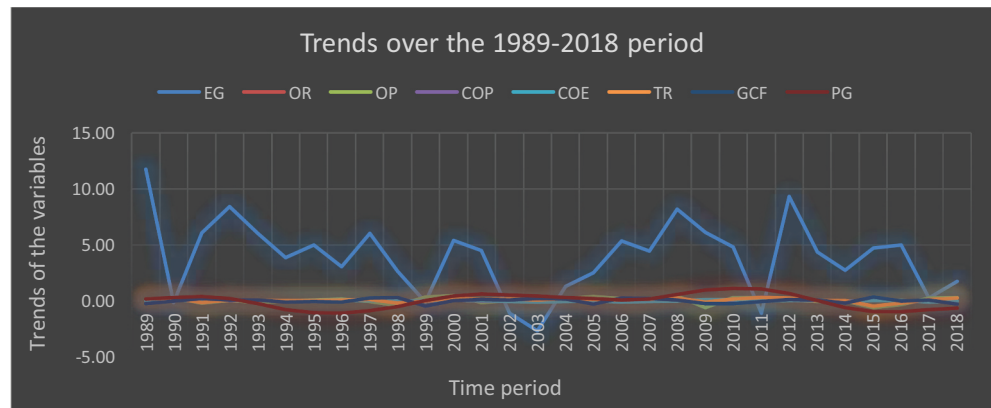
Subsequently, the analysis of the influence of oil division on economic reforms of Oman. Various tests and techniques applied to evaluate data's stationarity, con-integration and causal effect among economic growth, oil revenue, oil price, production of crude oil, the export of crude Oil, gross capital formation, and total revenue.

**Table 1** shows the descriptive statistics that illustrate the mean, median, highest, lowest values, and normality of all elements. The mean value of economic growth is 4.017, with the highest and lowest point in 11.757 and −2.669. As the maximum value of oil, revenue is 9.386, and the minimum is 6.901 and has a mean of 8.016. The peak level of oil price is 4.697 and the lowest level of 2.438 and has a mean of 3.544. The production of crude oil has a mean value of 5.721, while the peak point is 5.907 or the lowest point of 5.425 and so on. The normality of variables accessed through the threshold value of skewness, which ranges from −1 to +1. As the value of all variables flow within the threshold value of skewness which indicates that all variable has normality **Figure 1**.

It can be visibly seen from the results of the correlation test present in **Table 2** that there is a high level of correlation present between the variables under study, as the correlation between OR and OP can be seen to be equal to 0.666, which is considered to be a high value of correlation. Moreover, the value of the correlation between OR and GCF can be seen to be equal to 0.731, which is also a high value when it comes to correlation. So, it is clear that the value of correlation is high between the chosen variables that need to be fixed. As some of the researchers have debated that this value should

**Figure 1. Trends over the 1989–2018 period.**

Source: Author's Contribution, Calculations based on data from World Bank, produced on Software MS Excel.



be less than 5.0, and some of the researchers have agreed upon the fact that the correlation value must be lower than 10.0 so in order to fix the issue of high correlation and to find out the possible issue of multicollinearity (Nketiah et al., 2019), the test of variation inflation factor will be applied by the researcher. It can be seen that the values of VIF in Table 3, for all of the variables are lower than 5.0, which shows that no matter if the values of correlation among the variables are high, but the values of VIF test results show that there is no issue of multicollinearity present in the data of this research.

## 6. Unit root test—ADF

The unit root test was utilized to evaluate data's stationarity and level of integration between variables so augmented Dickey–Fuller test (ADF) (Dickey and Fuller, 1979) used for this purpose. As a bound test related to co-ingratiation does not need that all variables must integrate at I (1) but still is beneficial to ensure that variables did not exceed the order level with the help of unit root test. The regression analysis could be affected if variables exceed the order level like [I (2)]

The Phillips–Peron test was applied to know about the variables' stationarity properties, where the variables were represented in a logarithm form. The outcome of Table 4 assured that all variables are stationary. As OR, OP, COP, COE, GCF, and TR are not stationary on the level, rejection of null hypothesis is not possible and null hypothesis refers to non-stationarity of variables at a significance level of 1.5% and 10%. In contrast, variables become significant and stationary when they shifted to the first level difference. So, the null hypothesis is rejected. However, economic growth is stationary on both levels. This approves the validation of the ARDL cointegration approach.

**Table 1. Descriptive statistics**

	EG	OR	OP	COP	COE	GCF	TR
Mean	4.017	8.016	3.544	5.721	5.605	3.029	8.263
Median	4.482	7.785	3.332	5.754	5.629	3.069	8.103
Maximum	11.757	9.386	4.697	5.907	5.805	3.597	9.554
Minimum	−2.669	6.901	2.483	5.425	5.357	2.512	7.129
Std. Dev.	3.255	0.805	0.730	0.132	0.131	0.307	0.791
Skewness	0.018	0.321	0.243	−0.562	−0.453	0.046	0.248
Kurtosis	2.891	1.664	1.592	2.355	2.107	1.906	1.569
Jarque-Bera	0.017	2.837	2.864	2.171	2.089	1.556	2.961
Probability	0.992	0.242	0.239	0.338	0.352	0.459	0.228

Source: Author's Contribution, Produced through Software EViews, version 10.

**Table 2. Correlation test**

Correlation							
Proba- bility	EG	OR	OP	COP	COE	GCF	TR
EG	1.000						
	---						
OR	-0.085	1.000					
	0.649	---					
OP	-0.028	0.666***	1.000				
	0.880	0.000	---				
COP	-0.308	0.476**	0.322	1.000			
	0.092	0.007	0.077	---			
COE	-0.351	0.157	-0.003	0.419***	1.000		
	0.053	0.401	0.886	0.000	---		
GCF	-0.065	0.731***	0.712***	0.286	0.010	1.000	
	0.728	0.000	0.000	0.118	0.956	---	
TR	-0.106	0.698***	0.658***	0.502**	0.181	0.658***	1.000
	0.569	0.000	0.000	0.004**	0.329	0.000	---

Source: Author's Contribution, Produced through Software EViews, version 10.

\*\*0.005 \*\*\*0.001

According to Perron, there is a significant relevance between structural changes and the unit root, and different researchers also argue that structural breaks can result in the unit root (Table 5). So, the unit root test with structural breaks has been performed to make sure that the variables (Table 6) are actually following the order of integration obtained before. So, the following model of ADF is adopted by the researcher:

$$y = \mu + \beta t + \delta y_{t-1} + \alpha DU_t + \theta DT_t + \sum_{i=1}^k \eta_i \Delta y_{t-i} + \varepsilon_t \quad (11)$$

In the equation above,  $DU_t = 1$  if  $t \geq TB$ , and 0 for all of the previous dates before the break and  $DT_t = t - TB$  when  $t \geq TB$  and is equal to 0 for all previous dates before the break. All of the variables are stationary in levels except the variables OR and TR. Now, it can be seen that the break has occurred in 2010 and 2012; some of the events that might have caused it include the 2011 Omani protests that were a series of protests in the Persian Gulf country of Oman that occurred as part of the revolutionary wave popularly known as the "Arab Spring." The protesters demanded salary increases, lower living costs, more jobs, and a reduction in corruption.<sup>1</sup> The Sultanate's ninth five-year plan (FYP) was launched at the start of 2016 and is the final portion of Oman Vision 2020, and

**Table 3. Variance inflation factors**

Variables	VIF
OR	1.0606
OP	1.9259
COP	2.9302
COE	1.2699
GCF	2.1958
TR	2.0004

Source: Author's Contribution, Produced through Software EViews, version 10.

**Table 4. Unit root test**

Construct	ADF		PP	
	At level	At first difference	At level	At first difference
EG	-4.8455**	-7.0488***	-3.788**	-6.9933***
OR	-0.7903	-4.1256**	-0.6939	-5.2901**
OP	-1.2288	-5.1747***	-1.3288	-4.1983***
COP	-2.4559	-4.6132**	-2.1833	-5.0934**
COE	-2.5105	-3.5458**	-2.3993	-3.2094**
GCF	-0.7172	-4.0446**	-1.1882	-3.4388**
TR	-1.9259	-5.7727**	-1.2984	-4.2484**

Source: Author's Contribution, Produced through Software EViews, version 10.

\*\*0.005 \*\*\*0.001

**Table 5. Unit root with structural break**

Construct	At level	Break date	At first difference	Break date
EG	-5.4002***	2003	-	
OR	-2.5463	2003	-3.6988**	2010
OP	-2.3812*	2004	-	
COP	-3.5138*	2007	-	
COE	-3.6336*	2014	-	
GCF	-4.0655*	2002	-	
TR	-2.4532	1999	-4.9282**	2012

Source: Author's Contribution, Produced through Software EViews, version 10.

\*0.05 \*\*0.005 \*\*\*0.001

Oman joined the World Trade Organization in 2000; it made greater efforts to liberalize its markets and improve its standing in the global economy.

## 7. Cointegration test

Afterward, estimation of integration order in variables means evaluating the equation for accessing whether or not long-run relation is present between variables. The result of the bound test and the value of F-statistics reported long-run relationships among variables. As the cumulated value of F-statistics more than a critical value, as demonstrated before. This means rejection of the null hypothesis and acceptance of alternative hypotheses that show long-run relationships among variables.

The bound test result enlightens the presences of long-run association between OR, OP, COP, COE, GCF, TR, and GDP. The test of cumulative sum CUSUM and cumulative sum of square CUSUMQ are performed to show long-run, and short-run coefficients stability and also identify the excellent fitness of the bound test. The test applied to the residual of the estimated model and indicated the stability of the parameters. As both test flow under the significance level of 5%, which illustrates that model is a good fit and estimated parameters remain stable during the study period, as shown in [Figures 2 and 3](#).

## 8. ADRL-based short and long-run estimation

After analyzing the model fitness, stability of parameter, and cointegration among variables, the following phase is examining long-run coefficients, which is done with an estimation of

**Table 6. BondTest – Cointegration**

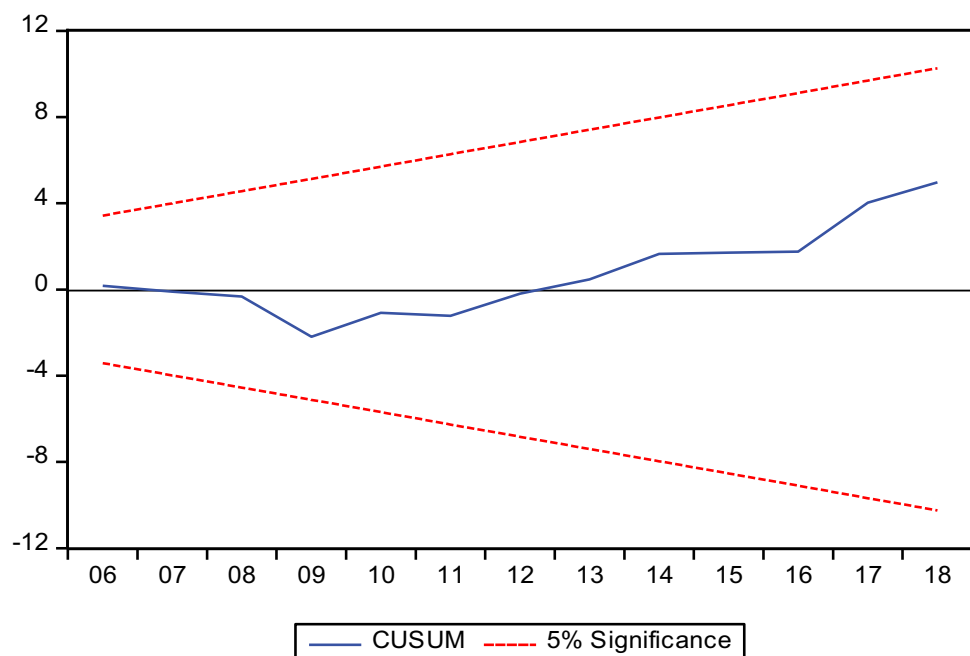
Test statistic	Value	Sig level.	I(0)	I(1)
F-statistic	13.05199	10%	1.99	2.94
		5%	2.27	3.28
ARDL Model	(1, 0, 2, 1, 1, 1, 2)	2.5%	2.55	3.61
		1%	2.88	3.99

Source: Author's Contribution, Produced through Software EViews, version 10.

equation 2. The figures in Table 4 implicate about variables have an impression on GDP in the long run. The value shows that oil revenue insignificantly and negatively influences economic growth and has a coefficient value of  $-5.244$ , which indicates that a one-unit change in oil revenue caused  $-0.05244\%$  change in the economy's growth in Oman. The impression of OP on GDP is substantial and optimistic and has a coefficient value of  $9.2778$ , which means that the rise in oil price also leads to rising economic growth by  $0.092778\%$ . Production of crude Oil significantly and positively associated with economic performance. The influence of COE is substantial but negatively affecting GDP, which demonstrates that an increase in the export of crude oil causes a  $-0.21265\%$  decrease in the economy's growth. Total revenue and gross capital formation are positive but total revenue insignificantly and GCF significantly associated with the economy.

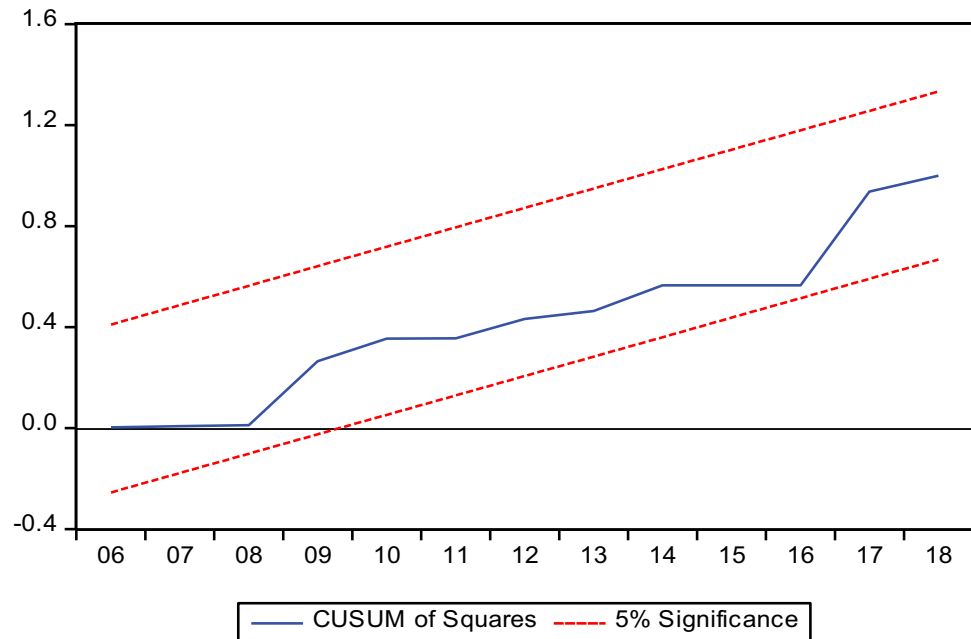
After examining the effect of variables on GDP in the long run, now analyze the influence of variables on the economy's performance in the short run with the help of evaluating equation 3. The figures in Table 7 explain that the impression of oil price is insignificant at its level, but it has a significant effect at first level. Still, the effect is negative, which means that the rise in oil prices causes the fall of economic growth by  $-5.647\%$ . The production of crude Oil optimistically and substantially related to GDP causes a rise in the economy by  $0.6581\%$ . The COE has a substantial negative impact, which decreases growth by  $0.10061\%$ . Meanwhile, total revenue and GCF positively and significantly influencing the economy in the short run.

**Figure 2. Cumulative sum of recursive residuals.**



**Figure 3. Cumulative sum of squares of recursive residuals.**

Source: Author's Contribution, Produced through Software EViews, version 10.



The adjusted R square value shows that 92.21% of economic growth explains by explanatory variables and diagnostic implicate the model's fitness in Table 4. The cointegration evidence also affirms by values of error correction (ECTt-1) in Table 8, which have a significant but negative sign. The negative sign accesses the adjustment swiftness or speed toward equilibrium

The test of Granger causality helps in analyzing the presence of causal relationships among variables. Due to cointegration, short-run, and long-run causal affiliation measures through the vector correction model. Table 8 represents the short-run and long-run Granger causality test results by estimating the equation from 3 to 10. The empirical analysis shows that bidirectional causal long-run relation exists among GDP and OR, OP, COP, and COE. Similarly, OR, OP, COP, and COE have a unidirectional causal relation with other variables.

On the other hand, economic growth has a causal association with Oil Price, Crude oil production, Crude oil export, and Oil revenue. It can be seen from the results presented in Table 9 that the impact of Oil revenue on Economic growth is significant and negative, equal to  $-3.202^{**}$ , showing that with every 1 unit increase in Oil revenue, Economic growth will decrease by 3.2%. The impact of Oil revenue on Oil Price is  $7.510^{***}$ , which is significant and positive. The impact of Oil Price on Economic growth, Oil revenue, Crude oil production, and Crude oil export is equal to  $3.073^{*}$ ,  $2.125^{*}$ ,  $2.203^{*}$ , and  $2.486^{**}$ , respectively, which shows that the impact of Oil Price on all of these variables is significant positive with every 1 unit increase in Oil Price there will be an increase in Economic growth, Oil revenue, Crude oil production, and Crude oil export, respectively. Crude oil production on Economic growth is equal to  $5.467^{***}$ , which is significant and positive; with every 1 unit increase in Crude oil production, there will be 5.4% in Economic growth. Oil revenue's impact is insignificant; the impact on Oil Price and Crude oil export is  $2.187^{*}$  and  $7.274^{***}$ , respectively, and both are positive and significant. Crude oil export on Economic growth is significant and negative and is equal to  $-2.135^{*}$ ; there is no impact of Crude oil export on Oil revenue and Oil Price. Crude oil export's impact on Crude oil production is significant and positive and equal to  $7.072^{**}$ , which means that with every 1% increase in Crude oil export, there will be an increase in Crude oil production by 7%.



**Table 7. ARDL-based short and long-run estimation**

**Long run estimation, Dep EG, ARDL (1, 0, 2, 1, 1, 1, 2)**

Variable	Coefficient	t-Statistic	Prob.
OR	−5.244042	−0.559708	0.5852
OP	9.277891	2.645747	0.0202
COP	86.10463	4.688816	0.0004
COE	−21.26549	−1.503842	0.1565
TR	1.476315	0.120301	0.9061
GCF	11.57246	3.184318	0.0072
C	2.422119	6.322249	0.0000

Short Run Estimation: Dep EG, ARDL (1, 0, 2, 1, 1, 1, 2)

D(OP)	−0.140203	−0.111003	0.9133
D(OP(−1))	−5.647946	−7.046294	0.0000
D(COP)	65.81778	7.401514	0.0000
D(COE)	−10.06178	−1.941491	0.0742
D(TR)	11.13217	5.804124	0.0001
D(GCF)	6.117313	6.513944	0.0000
D(GCF(−1))	−4.589934	−4.190480	0.0011
CointEq(−1)*	−1.188483	−12.67438	0.0000

Source: Author's Contribution, Produced through Software EViews, version 10.

\*0.05

**Table 8. Estimated model and diagnostic tests**

Estimated model	Appraise	P-value
R-squared	0.9423***	0.0000
Adjusted R-squared	0.9221***	0.0000
S.E. of regression	1.0719	−
Durbin-Watson stat	1.5861	−
Diagnostic tests	F-statistics	P-values
X <sup>2</sup> SC	2.0939	0.1696
X <sup>2</sup> HET	0.4835	0.4932
X <sup>2</sup> N	0.3148	0.8543
X <sup>2</sup> FF	0.0704	0.7952

Source: Author's Contribution, Produced through Software EViews, version 10. Granger causality test.

\*\*\*0.001

## 9. Conclusion

Being a country highly dependent on the oil abundance and prices when it comes to the economy is highly challenging if the oil sector prices fluctuate continuously. Oman has been facing the same situation as the economy of Oman is based upon the oil sector to a great extent as well. However, this study and its results have shown that the impact of oil revenue on Oman's economic growth is insignificant (Osuoka, 2007; Santillán-Salgado & Venegas-Martínez, 2016) and (Odularu, 2008) are also of the same opinion. It is because of the reason that practically it is believed that the reason behind this is improper utilization of oil revenue in Oman, and misuse of revenue at the different administrative levels has been observed in Oman. As Oman is an oil-rich country and Oil prices have an influential part in supporting the economy of Oman, the outcomes of this research have also

shown that the oil prices will significantly and positively affect the economy of Oman in the long run. It has been depicted this way because, in the long run, Omani Government might take a look into how the oil revenues can be utilized in a significant way, thus enhancing the revenues and impacting the country's economy as well. According to the study of (Ogbonna & Appah, 2012; Ogbonna & Ebimobowe, 2012), price enhancement in the oil prices leads to GDP enhancement of the countries that have their economy highly dependent on the oil sector. According to the results of this study, it has been confirmed that when prices of Oil start to trend upwards, the GDP of Oman will also start to trend upwards as well, so in short, it will enhance. (Bouchaour & Al-Zeaud, 2012) also observed a significant long-run association among oil prices and Oman's economic growth as in the long run, if the oil prices enhance in Oman, the economic growth will enhance (Atil et al., 2020). The production of oil has occupied the economies of oil-rich states like Oman. It has been found that crude oil production positively and significantly co-integrates with the development of Oman's economy in the short and long run. (KILISHI, 2010) also concluded that Oman's economic development is positively and significantly supported by the production of crude Oil in Oman, so it can be said that if Crude oil production is enhanced in Oman, the economic development will enhance as well. It is also proven that crude oil export has a significant and harmful influence on Oman's economic performance. Previous studies also concluded this result and showed that GDP is substantially and negatively influenced by Crude oil export (Eravwoke et al., 2014) (Ogbonna & Appah, 2012). The impact of total revenue on the performance of the economy of Oman is positive but insignificant. (Myles, 2000) also claims that the impression of total revenue on GDP is insignificant. This study analyzed that gross capital formation is positively and significantly associated with the economy. (Onyinye et al., 2017) examined substantial and positive impacts of gross capital formation on Oman's economic growth (Pirlogea & Cicea, 2011).

Oman is blessed with the natural resource of Oil, and its economy is expected to be impacted by any rise and fall-related to this sector. The data is gathered from 1989 to 2018 from the National Center for Statistics and Information of Oman published a statistical year. The effect and association among variables have been assessed through the ARDL approach and Granger causality. The outcomes highlight that oil prices, crude oil production, and gross capital formation positively and significantly affect Oman's economy (Yusuf et al., 2020). Crude oil export has a substantial and adverse effect on Oman's economy, while oil revenue and total revenue are insignificantly influencing Oman's economy. The results of the Granger causality test illustrate the long run and bidirectional causality present among the variables. Although bidirectional causal relation exists among economic growth, production of crude oil, and export of Oman's crude oil. The link among oil price, economic growth, and crude oil production is also observed to be bidirectional; however, Crude oil export has a unidirectional link with Oil Price and GDP with oil revenue. Oil revenue only has a bidirectional relationship with the oil price in Oman.

**Table 9. Granger causality test**

Variables	Short run causality					Long-run causality
	EG	OR	OP	COP	COE	ECT <sub>-1</sub>
EG	-	-3.202**	3.073*	5.467***	-2.135*	-1.1152***
OR	1.462	-	2.125*	-0.758	0.689	-1.0241***
OP	-2.299*	7.510***	-	2.187*	-2.050	-1.3146***
COP	5.496***	-1.169	2.203*	-	7.072**	-1.0534***
COE	-2.668**	0.989	2.486**	7.274***	-	-1.2989***

Source: Author's Contribution, Produced through Software EViews, version 10.

\*0.05 \*\*0.005 \*\*\*0.001

The research has several significant contributions to the literature, as the researcher has highlighted and filled the gaps present in the past research, such as the absence of empirical evidence of the impacts of Oman's oil sector on the economy of Oman. There was an absence of suitable references and cross-study proofs to explain the relationship between Oman's oil sector and the economy. The researcher has also clearly mentioned the impacts casted by each factor of the Oil sector of Oman on economic performance so that those aspects can better be focused by the sector and companies to enhance revenue and economic growth. Moreover, the researcher has given proof, properly analyzed, and interpreted results for the Government of Oman, which can now significantly make policies and rules regarding the improvement and funding of the oil sector to enhance economic performance and growth of Oman. With this research's help, while the Government will invest in the oil sector, more jobs will be created, and the earnings per capita will enhance.

Oman should develop a long-run strategy for reducing its dependence only on the oil sector. The Government should diversify the revenue on the different sectors and provide investment opportunities in the different sectors that grab investors' attention and enhance their ability and competitiveness on a world level. The Government should also promote small and medium scale industries and work on the development of tourism activities. The Government would improve the agriculture sector, which would bring more revenue for country and advancement in the financial sector that can grab foreign investors' attention if the loan is available at a moderate rate. Investors make more investment in non-oil products, which aid in diversifying the economy. The research can be further extended by examining the effect of the oil sector on business and comparing the effect of the oil or non-oil sector on the economy. The role of Government in the oil and non-oil sector and how Government diversifies their economy. A study conducted with limited variables and a short period that mostly highlights increasing oil price trends, further study can be extended with an extensive period that shows rise fluctuation in prices and more variables like political, domestic, government expenditure, etc.

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#### Note

1. Goals: Salary increases; Lower living costs", "Methods: Demonstrations; Riots; Sit-ins". Date: 17 January 2011–8 April 2011.

#### Disclosure statement

The author declares that they have no conflict of interest.

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