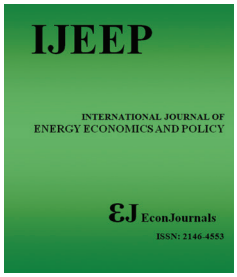

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The Impact of the Volatility in Oil Prices on Saudi Arabia's and Algeria's Military Expenditure: A Comparative Study

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ABSTRACT

By using time-series data in respect of the period from 1985 to 2019, this study aims to compare how the changes in Yearly Oil Prices (YOP) affect both Saudi Arabia's and Algeria's military expenditure. This study applies the Vector Error Correction Model (VECM) to measure the relationships between the variables. On the one hand, this study's findings indicate that changes in YOP have had a great causal impact on both countries' military expenditure, On the other hand, the link to Growth Fixed Capital (GFC) has had an insignificant effect on Saudi Arabia's military expenditure. However, in the case of Algeria, the causal effect has been significant but, nevertheless, at a particularly low level ($\alpha = 10\%$). In conclusion, the two countries should pay closer attention to the dominant YOP when formulating their policies to maintain their much-needed security systems and protection umbrellas.

Keywords: Military Expenditure, Gross Fixed Capital, Yearly Oil Price, Vector Error Correction Model, Saudi Arabia, Algeria.
JEL Classifications: Q4, Q48, Q43, Q430

1. INTRODUCTION

1.1. Background

Oil is an essential commodity in the global economy since it is the primary source of energy relied upon to generate electricity; to power vehicles, aeroplanes and machinery; and to facilitate domestic activities such as cooking and heating. Therefore, any changes to the Yearly Oil Prices (YOP) are likely to have a drastic effect on the country's economy. According to Prest (2018), there has been a significant reduction in the global YOP since 2014. Moreover, it is noteworthy that the instabilities in the YOP have had a negative impact on countries' economic development. For instance, between 2019 and 2020, the oil price per barrel reduced from $115 to $45 per barrel and, thereby, meant an overall 60% decrease in oil prices over this period. This reduction has had an adverse effect on oil-producing countries such as Saudi Arabia (Freeman, 2020). While there is frequent volatility in the YOP decisions on government expenditure are made usually on an annual basis. Accordingly, this makes it difficult to plan for and make any necessary changes. Although the oil revenues can change dramatically due to fluctuations in the YOP each country's military expenditure remains constant. Consequently, this creates a wide gap between revenue and expenditure and, in turn, requires the country's government to borrow from either external and or internal sources (Emara et al., 2019). The constant increases in levels of debt due to losses in oil revenues is disastrous and, therefore, for governments to fund their projects, they can cut future annual expenditure future as witnessed in the Middle East countries such as Saudi Arabia and Algeria (Bouri et al., 2020). Given that the losses in oil revenues are greater than those reductions in government expenditure, the debt element of GDP is more likely to rise in MENA nations. Therefore, these governments are forced to prioritize projects in line with their budgetary allocations (An et al., 2018) and, consequently, the loss of oil revenues affects military expenditure.

1.2. Problem Statement

The major problem, which this study addresses, is the challenge of falling oil revenues due to the reduction in the YOP and its associated economic challenges that have pushed oil-exporting nations to reduce their military expenditure. The coronavirus pandemic containment measures have meant that there is less global demand for oil and this has had a negative impact on its price. Arezki et al. (2020) argue that the dual shock of the coronavirus pandemic and the drop in the YOP revenues have reduced citizens' living standards and that this is especially so in GCC countries where the governments have been forced to either borrow monies or increase taxes. In 2014, the global YOP plummeted significantly. This loss of oil revenues has led to oil-exporting nations incurring increased levels of debt (Stocker et al., 2018). More specifically, the YOP price dropped from $96.29 per barrel in 2014 to $49.49 per barrel in 2015 and has represented the largest drop over the past 50 years. Figure 1 shows the changes in the YOP per barrel from 1985 to 2020.

The oil-export-dependent nations' need to fund recurrent military expenditure has led to increased levels of debt. In line with Khan and Haque's (2019) findings, most nations, which have huge levels of debt, have reported a significant importation of firearms since 2014. In addition, the increased levels of debt have forced GCC countries to cut back on other important projects and, in turn, this has had a negative impact on their GDP.

1.3. Aims and Objectives

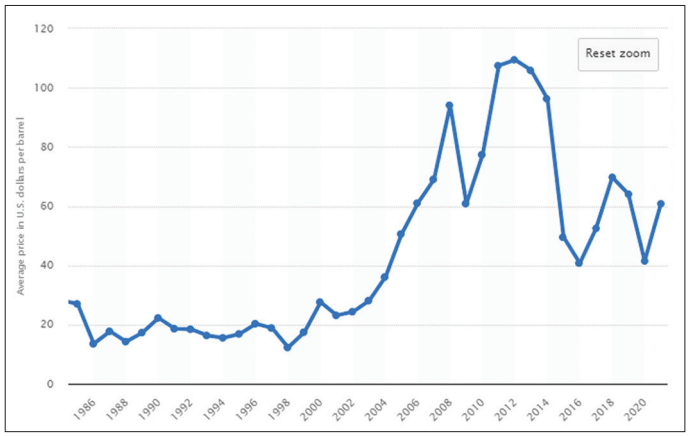
This study seeks to investigate the impacts of fluctuations in the YOP on government expenditure and, more especially, on military expenditure. In this regard, the study focuses on Saudi Arabia and Algeria. More specifically, it assesses and explores the mitigation measures that governments can adopt amidst the shocks to the YOP to ensure that their military operations proceed as normal. Therefore, this study's objectives are as follows:

- To investigate the impact of the volatility of the YOP on Saudi Arabia's and Algeria's military expenditure
- To assess the oil-export-dependent nations' patterns of military expenditure
- To conduct a comparative analysis of Saudi Arabia and Algeria.

1.4. Significance of Study

Primarily, these study findings will be important to Saudi Arabia's and Algeria's policy planners since it will enable them to develop effective policies to respond to the economic challenges and inflations resulting from shocks to the YOP. The policy planners will be in a better position to put in place frameworks and strategies to mitigate disruptions to these countries' oil supplies. In addition, this study's findings will make a significant contribution to the existing literature on the association between volatility in the YOP and economic activity and finance and, more especially, the rates of inflation. Also, the study's findings will be helpful to both governments since they will be able to create appropriate monetary policies which will prevent them from borrowing excessively. The general significance of this study's findings is that they allow these countries' financial institutions to assist the governments by developing appropriate interest rates to make it possible for them to fund recurrent military expenditure amidst fluctuations in the YOP.

Figure 1: Changes in oil price per barrel from 1985 to 2020 (Statista, 2021)



1.5. Rationale for Choosing Algeria and Saudi Arabia

We chose to study Saudi Arabia given that it is an oil-export-dependent nation and is, also, heavily engaged in armed conflict. More essentially, Tian's (2018) findings indicate that Saudi Arabia's oil revenues contribute 40% to the national economy. Therefore, this suggests that any slight change in the YOP has a significant effect on the country's entire budget including military expenditure. Most importantly, Saudi Arabia has been involved in Syria and Yemen wars which, in 2015, prompted the government to increase the country's military expenditure (Fakude, 2017). Although Saudi Arabia reduced its military expenditure in 2016, it has emerged that it increased significantly again in 2017 due to threats from Qatar. As shown in Figure 2, by 2016 Saudi Arabia's military expenditure was the country's second highest expenditure after education, (Haque and Khan, 2019).

The drop in the global YOP has increased Saudi Arabia's debts because, while running a deficit, the Government has still needed to fund military expenditure. According to data on the global YOP per barrel it dropped by 35% from $107.46 in 2011 to $69.78 in 2018 (Anis, 2021). As shown in Figure 3, when compared to Algeria, Saudi Arabia spends comparatively more on military expenditure as a percentage of GDP.

Meanwhile, although there was a reduction in oil production translating to approximately 800,000 barrels a day, Algeria is one of the largest oil-producing nations in Africa (Benramdane, 2017). We chose Algeria for this study because, although it produces oil, by implementing expansionary policies it minimizes the country's dependency on oil, and its oil revenues form only about 16% of its GDP (Tian, 2018). The net effect is that in the event of a slump in the global YOP, this has an insignificant effect on government expenditure. Algeria has continued to increase its military expenditure with reports indicating that from 2004 to 2013, the country's yearly funding was about $10 billion (Lefèvre, 2017). By 2019, Algeria's military expenditure had increased from 3.5% in 2010, to 6% in 2019 (World Bank, 2020). As shown in Figure 3, the trend over the past decade has seen an increase in Algeria's

Figure 2: Saudi Arabian Government expenditure in different sectors (Haque and Khan, 2019)

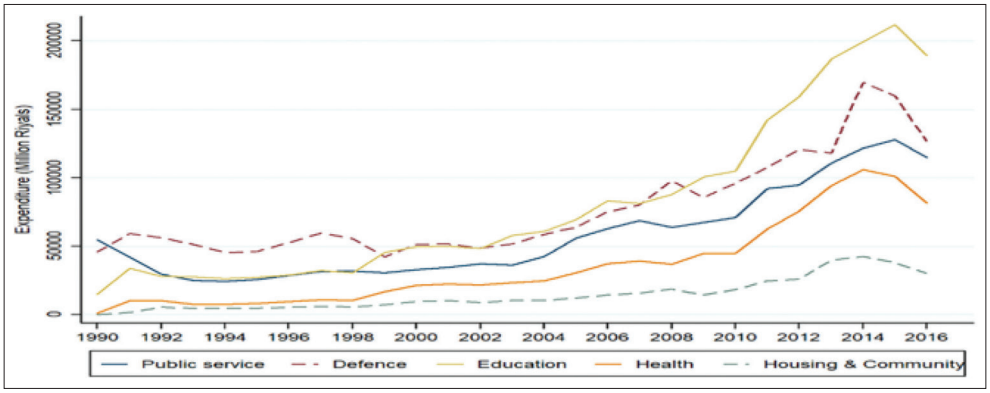
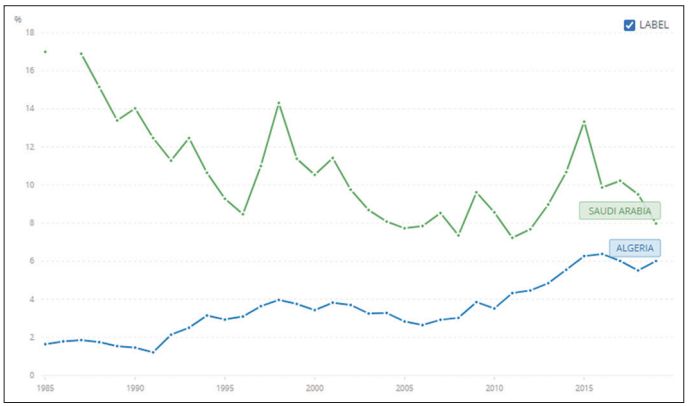


Figure 3: Saudi Arabia's and Algeria's military expenditure as a percentage of GDP (World Bank, 2020)



military expenditure while, over the same period, Saudi Arabia has reduced its military expenditure.

Like Saudi Arabia, Algeria has continued to witness civil war that has prompted the Government to equip its military in a bid to fight the countries' enemies. Algeria's peace has continued to be threatened by unlawful groups, such as Al-Qaeda, that have forced the Government to increase military expenditure (Chelin, 2020).

2. LITERATURE REVIEW

2.1. Theoretical Framework

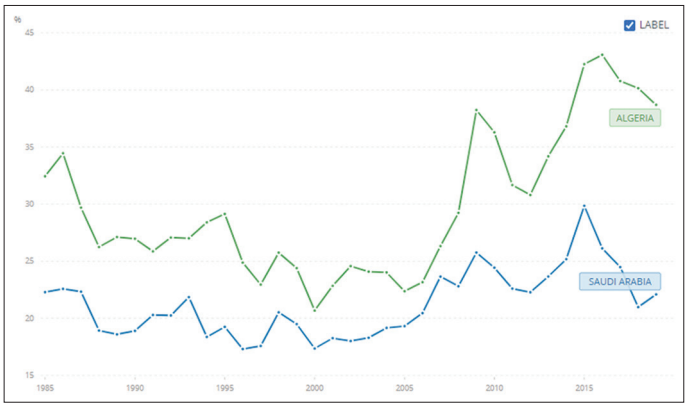
We based this study on the neoclassical growth theory, which Robert Solow and Trevor Swan developed initially in 1956 (Solow, 1999). The neoclassical growth theory focuses largely on the long-term economic development that is emphasized by neoclassical economics. Notably, according to this theory, economic growth and development are observed by taking into consideration numerous aspects which are: capital factors; labor development; and rise in productivity. This theory further indicates that, for productivity to be realized, there is a need to allocate more resources to the workforce. Resources requires among other things knowledge and technological advancements. In other words, economic growth and development are facilitated through the incorporation of factors of production. Therefore, the government can influence economic development by investing in various sectors of the economy such as education and research. Public expenditure can prevent economic growth and development by increasing the levels of taxation. As demonstrated by Grossman et al.'s (2017) findings, a rise in factor productivity can lead to an increase in GDP and labor productivity. In line with Assous and Legrand's (2020) findings, whenever the YOP increases, there is an increased likelihood of more public and private investments. Also, a drop in the YOP is more likely to reduce the country's capital and labor productivity due to it causing a decrease in consumption (Istiak and Alam, 2019). The neoclassical growth theory's major limitation is that, when it comes to a country's economic growth and development, it does not take account of the internal aspects because it puts more emphasis on external aspects. Therefore, we can apply the neo-classical theory in this study since its aim is to explore the effects of fluctuations in the YOP on military expenditure. Therefore, under this theory, it is possible to understand the implications of how variations in the YOP impact on government investments and expenditure since productivity is dependent on the YOP.

2.2. Relationship between Gross Fixed Capital (GFC) and Military Expenditure

Gross Fixed Capital (GFC) is one indicator of economic growth because it reveals the net increase in a country's net fixed assets that include commercial and residential buildings, road networks, and railways (Kanu and Ozurumba, 2014). Figure 4 shows the GFC trends for Saudi Arabia and Algeria.

Figure 4 shows that in the period from 1985 to 2020 and when compared to Saudi Arabia Algeria's GFC is a consistently higher percentage of GDP (World Bank, 2021). This finding suggests that, when compared to Saudi Arabia, Algeria is more committed to building GFC and diversifying its economy and reducing the country's reliance on oil. Moreover, several studies have investigated the relationship between military expenditure and economic growth factors such as GFC (Dunne and Tian, 2015; d'Agostino et al., 2017). Dunne and Tian 's (2015) findings provide different evidence on the topic by noting that high military expenditure promotes security and peace and, thereby, stimulates economic growth in 20% of the analyzed countries. Moreover, the authors realize, also, that high military expenditure has had negative economic impacts on 35% of the analyzed countries. The Dunne and Tian's (2015) views are supported by d'Agostino et al. (2017) due to their observations that high military expenditure has had a significant negative impact on economic growth and, more especially, among OECD countries. d'Agostino et al.'s

Figure 4: Gross fixed capital (GFC) trends for Saudi Arabia and Algeria as a percentage of GDP (World Bank, 2021)



(2017) findings are consistent with those of Chang et al.'s (2011) following their analysis of 90 countries' panel data from 1992 to 2006. Their findings demonstrate that military expenditure has had a significant negative effect on Middle Eastern, South Asian and European countries. The findings suggest that military expenditure and GFC are often inversely related so that high military expenditure reduces the available resources that governments can use to invest and expand their countries' economic opportunities.

2.3. Effects of Military Expenditure on Oil-Export Dependent Nations' Debts in

According to Mason (2018), some of the countries, which have spent heavily on their military, include the United States of America, China, Russia and Saudi Arabia. Further the authors have noted that the increased government spending on military operations has affected the country's economies. This finding is consistent with that of Rahman and Siddiqui (2019) who have established that America has continued to enjoy favorable debt terms and, therefore, borrow constantly from internal and external sources. Moreover, Asongu and Amankwah-Amoah's (2018) findings reveal that military expenditure contributes to the country's debts which, in turn, can affect the nation's performance. These sentiments are echoed by Fourkan (2021) who have noted that sound borrowing can be of economic importance since it is more likely to increase a country's investments and capital mobility. In other words, huge levels of investment and high levels of return can boost the economy significantly since there is more time to repay the loan facilities. Meanwhile, Moulton et al. (2019) have noted that increased military expenditure can raise the mortgage rates for citizens. This suggests that a country's government increases the mortgage rates in a bid to meet the annual military expenditure. In developing countries, military expenditure implies that more emphasis is put on the country's priorities. This finding suggests that the country's government can leave out essential infrastructure projects at the expense of its citizens. From their study, Driouche et al.'s (2020) findings show that, although the country continues to report high levels of debt due to a drop in the YOP, Algeria has put more focus on national security. This finding is consistent with that of Dunne et al. (2019) who have noted that a reduction in military expenditure is more likely to reduce debt burdens and increase the country's GDP. The increase in a nation's debts due to the need to fund military operations can have a negative impact on the citizens' living standards. More specifically, the burden of borrowing is passed on to the citizens in the form of increased taxes on commodities.

2.4. Mitigation Measures and Strategies Against Oil Price Shocks

The 2014 drop in the YOP was characterized by huge levels of government expenditure that drained both Saudi Arabia's and Algeria's finances. Numerous studies' findings have revealed the measures and strategies that the GCC countries have implemented to respond effectively to shocks in the YOP. Hemrit (2021) has established that amidst the oil price volatility, the Saudi Arabia Government has diversified its economy in a bid to meeting the increasing annual military expenditure. This finding is supported by Hamdan and Hamdan (2020) who have noted that the country has aimed to invest in other sectors of the economy such as construction tourism and construction. In addition, Moussa (2019) have noted that the Saudi Arabian Government has introduced new tax measures which, given the loss of oil revenues from 2014, aim to uplift the income from non-oil activities. However, Alharbi (2020) have argued that the new taxes can have a negative impact on Saudi Arabia's economic activities and, thereby, disrupt other sectors of the country's economy such as healthcare. Following the drop in the YOP, the Algeria Government has developed a series of strategies which include increasing taxes on fuel, car imports and power usage (Zeid and Lee, 2017). These findings are consistent with those of Azubuike et al. (2018) who noted that, given the fluctuations in the YOP, the consumers need to embrace more fuel-efficient vehicles and that this is only possible through increased taxes. Also, Algeria has made it possible for private investment in parastatals, and, due to tax breaks, has lowered equally the barriers to the investments that generate revenues. These sentiments are echoed by Allaoua and Achouche (2017) who have noted that government restrictions are a hindrance to the efficiency of the market and, more specifically, that the open market promotes private investments.

2.5. Research Gaps

The literature has provided us with crucial insights on the effects of excess military expenditure on oil-exporting dependent countries' economies. Nonetheless, there are a series of knowledge gaps that this study seeks to fill in attempting to clarify the relationship between volatility in the YOP and oil-producing countries' military expenditure in. The existing literature has analyzed comprehensively the effects of fluctuations in the YOP on these countries' stock markets. More particularly, while previous studies' findings have stressed the possible implications of fluctuations in the YOP on their stock markets, they have failed to examine critically how the stock markets affect military expenditure. To fill the knowledge gap, this study explores the implications of the fluctuations in the YOP on each country's level of debt that, in turn, is its likely effect on military expenditure. Moreover, while some studies have been conducted on oil-producing countries' patterns of military expenditure, few studies have investigated the determinants of the YOP and its impact on Saudi Arabia and Algeria. This study fills the knowledge gap by exploring the YOP's effect on the specific factors that are more likely to affect these countries' military expenditure.

3. VARIABLES OF MODEL

For this study, military expenditure is the dependent variable and the independent variables are GFC and YOP. The latter is a key independent variable because this study focuses on oil-producing countries and, more specifically, on Saudi Arabia and Algeria. This study's underlying goal is to determine how changes in the YOP affect military expenditure. As the other independent variable, GFC shows the net increase in fixed capital, such as construction of rails, roads, and industrial buildings, which provide a country with more economic opportunities. We selected this variable because it helps to show if more fixed investments affect the decisions to expand military operations to protect such investments. We chose military expenditure as this study's dependent variable because it helps to show how the extent of which the YOP and GFC affect oil-producing countries' military expenditure. In this regard, we obtained the statistical model used to project the extent of oil-producing countries' future military operations.

Through this study's framework, we seek to identify the extent through which the explanatory variables, as represented by the changes in the YOP and GFC, influence military expenditure. We analyzed this by taking the following steps.

First: Unit Root Test

Economic theory is concerned with exploring the equilibrium relationships between the study variables and, accordingly, applied econometrics assume that without testing them, these variables are stable in mean and variance. Since the assumption data stability is often not fulfilled, recent new trends in econometrics have been concerned primarily with testing for non-stationarity in time series data. This can be presented as follows:

We conducted the Stationarity Test by using *ACF* and the Ljung – Box (Q) test to test the following hypothesis:

$$H_0 : all\ \rho_k = 0 \qquad if\ Q \le x^2(k) \quad ; \quad Stationarity$$
$$H_1 : not\ all\ \rho_k = 0 \qquad if\ Q > x^2(k) \quad ; \quad Non-Stationarity$$

The Ljung-Box test examines whether there is significant evidence of non-zero correlations at given lags, with the null hypothesis of independence representing a specific time series (A non-stationary signal has a low P-value.).

We used the following equation to calculate the autocorrelation statistics:

$$\rho(p,q) = \frac{cov(y_t, y_{t-p_{or}q})}{var(y_t)} = \frac{\gamma_{p_{or}q}}{\gamma_0} \quad , t, p, q = 1, 2, 3, \ldots\ldots, T, P, Q \qquad (1)$$

By conducting the stationarity test using the autocorrelation function, it became clear that some of the autocorrelation coefficients went beyond the zero boundary, and the Ljung - Box (Q) statistic was greater than the Chi - Square tabulated value. This confirms the P-value at each autocorrelation coefficient; all are smaller than 0.05 and, therefore, we can reject the null hypothesis in favor of the alternative hypothesis. This states that at least one of the autocorrelation coefficients differs significantly from zero, and, consequently, the time series of the variables in question are nonstationary.

We confirmed this by conducting the Unit Root Test (Tables 1 and 2) and by using the Augmented Dickey Fuller Test which is commonly known as ADF. This test proposes adding the successive differences of the variable to the regular Dickey Fuller models and, by doing so, this gives better results in the analysis. In addition, we conducted the *Phillips – Perron* (PP) test and Kwiathowski-Phillips-Schmidt-Shin (KPSS) test to confirm the obtained results.

From our analysis of the previous results presented in (Tables 1 and 2), it is evident that the studied variables under study are all non- stationary in the level form. This necessitates taking the first differences to convert them into stationary ones. We performed a stationarity test for the first differences of these series and we used the correlation function to confirm these results. After taking the first differences and conducting those unit root tests again, we transformed these variables into stationary ones where the P-values are less than 0.05. This led us to reject the null hypothesis in favor of the alternative hypothesis. This states that, when taking the first differences, the time series of the variables under investigation are stationary.

Second: Optimal lag selection

There are many criteria for choosing optimal lag selection and determining the degree of distribution of lags within the regression models. This is despite the difference in information criteria between them in terms of the estimation methods and the statistics used to test for the degree of significance. However, criteria, such as *Akaike, Schwarz, Hannan – Quinn, Modified Akaike, Modified Schwarz, Modified Hannan – Quinn and* the final prediction error, FPE, agree among themselves that the variable is to be estimated in terms of the variable itself with one lag period. Next, according to the selected informatics criterion, we analyzed its significance. If this lagged explained variable showed a significant impact, we entered the variable again with two lag periods and so on until the variable in one of the lag periods appeared insignificant. Then, the preceding period would be the optimal lag period.

Throughout the results given by the various information criteria including (*AIC- SC - HQ*), it turned out that one lag was the optimal number of lags that could be taken. However, to determine the extent of the impact of YOP and GFC on Saudi Arabia's and Algeria's military expenditures in, this required passing through a set of steps supported by diagnostic tests before conducting the Vector Error Correction Models (VECMs). Our objective was to ascertain the extent of the safety of these models and their abilities to predict the nature of the relationship between the dependent variable and the independent variables. Also, we conducted the necessary tests to identify the direction of the causal relationships between those variables and to determine the extent of the correlation between those variables not only in the short term

but, also, in the long term. Accordingly, we conducted two VAR models and applied one to Saudi Arabia and the other to Algeria. This can be illustrated as follows.

Third: The Estimation Results regarding the VAR Models

3.1. The 1st VAR Model (As applied to Saudi Arabia)

All the individual equations have a coefficient of determination with a value exceeding 90% other than YOP that has a coefficient of determination greater that 80%; this is still considered to be high. The model managed to pass all the required diagnostic tests to identify its validity. The results confirmed the absence of serial correlation by accepting the null hypothesis. This states that "No Serial Correlation" where the P-values are greater than 0.05 in all lag periods. On the other hand, following a normal distribution where the Joint P-value is greater than 0.05, the Residuals Normality Test results confirm that the variables do not face any Skewness problem.

3.2. The 2nd VAR Model (Applied to Algeria)

All the individual equations have a coefficient of determination with a value exceeding 90% other than YOP that has a coefficient of determination greater that 70% (71.8%); this is still considered to be high. The model managed to pass all the required diagnostic tests to identify its validity. The results confirm the absence of serial correlation by accepting the null hypothesis. On the other hand, following a normal distribution with a Joint P-value greater than 0.05, the Residuals Normality Test results confirm that the variables do not face any Skewness problem.

Fourth: Granger Causality Test

The Granger Causality Test is a way to find out the causality relationship between the two sets of variables X and Y in a time series and to identify, also, the direction of this causation. Accordingly, if a causality relationship between the two variables emerges, this means that the change in the x variable's past and current values of the variable X leads to a change in the Y variable's values or vice versa according to the direction of this causal relationship. Consequently, it can be said that the Granger Causality test determines if the joint lagged coefficients of a certain variable at different lags are zero. We formulated this by using the following hypotheses:

H_0: The joint lagged coefficients of a certain variable = 0
H_A: The joint lagged coefficients of that variable ≠ 0

We set out below the results from implementing the Granger Causality test on the various variables.

3.2.1. Granger causality test results for VAR (1) model (in the case of Saudi Arabia)

The Granger Causal analysis results show that Saudi Arabia's *YOP* has a strong causal impact on the country's military expenditure *MEXP* at a high degree of significance $\alpha = 5\%$. However, the GFC does not have the same causal impact on the country's military expenditure. Moving to the impact and causation of *MEXP* on each explanatory variable, there is a highly significant causal relationship at a degree of significance α=1% on *YOP*. However, it has no causal impact on *GFC*. On the other hand, the analysis shows that *GFC* has a greater causal impact on *YOP* with a degree of significance $\alpha = 1\%$. Also, *YOP* has the same high causal impact on *GFC* with a high degree of significance of $\alpha = 1\%$.

3.2.2. Granger causality test results for VAR (2) model (in the case of Algeria)

The Granger Causal analysis results show that the Algeria's *YOP* has a strong causal impact on the country's military expenditure *MEXP* at a high degree of significance α =5%. In the same way, Algeria's *GFC* has causal impact on the country's military expenditure but with a less degree of significance (α =10%). This is contrary to Saudi Arabia's situation where there is no causal impact. Moving to the impact and causation of *MEXP* on each explanatory variable, there is no obvious causal impact on both explanatory variables. This is different from Saudi Arabia's situation where there is a particularly significant causal impact on *YOP*, at (α =1%), and no causal impact on *GFC*. On the other hand, unlike Saudi Arabia where *GFC* has a particularly strong causal impact on *YOP*, this is not the case in Algeria. From the, However, *YOP* has strong causal impact on Algeria's *GFC* with a high degree of significance of α=1%. In conclusion our analysis shows that *YOP* has a strong causal impact on both Saudi Arabia's and Algeria's *MEXP* and *GFC*.

3.3. The Impulse Response Functions of the VAR (1) Model

Figures 5 and 6 show for Saudi and Algeria respectively the *MEXP*'s degree of responsiveness to a one standard deviation shock that occurs in each explanatory variable (*YOP* and *GFC*); *reaction to one of the Innovations*.

3.4. Variance Decomposition

We can interpret this analysis as the identification of the percentage of unexpected change that may occur in each variable due to shocks that occur in the other variables. In other words, we can present from this analysis the relative effect of one variable on another variable. The variance decomposition enables us to evaluate the economic significance of this effect by expressing it as a percentage of the forecast error of a certain variable due to the presence of external shocks.

We conducted the analysis by dividing the period of analysis into two terms, namely, short term and long term. We assumed that the first ten periods would represent the short term and that the eleventh to the twentieth periods would represent the long term.

We analyzed the explanatory variables according to the strength of their short and long term impacts on *MEXP* in the, i.e. in their ability to explain the change that has occurred in the FEV of the dependent variable As illustrated in Table 3, it is clear that in the case of Saudi Arabian both *YOP* and *GFC* have the ability to explain the change occurring in the FEV of *MEXP* over the different time periods. However, *YOP*'s ability is greater than *GFC*. In period 10 *YOP* can explain 33.25% of the change occurring in the FEV of *MEXP* and only 24.8% can be explained by *GFC*. Also, in period 20, 30.8% of the change can be explained by *YOP*

Figure 5: The degree of responsiveness of *MEXP* to (one standard deviation shock) in Saudi Arabia's YOP and GFC

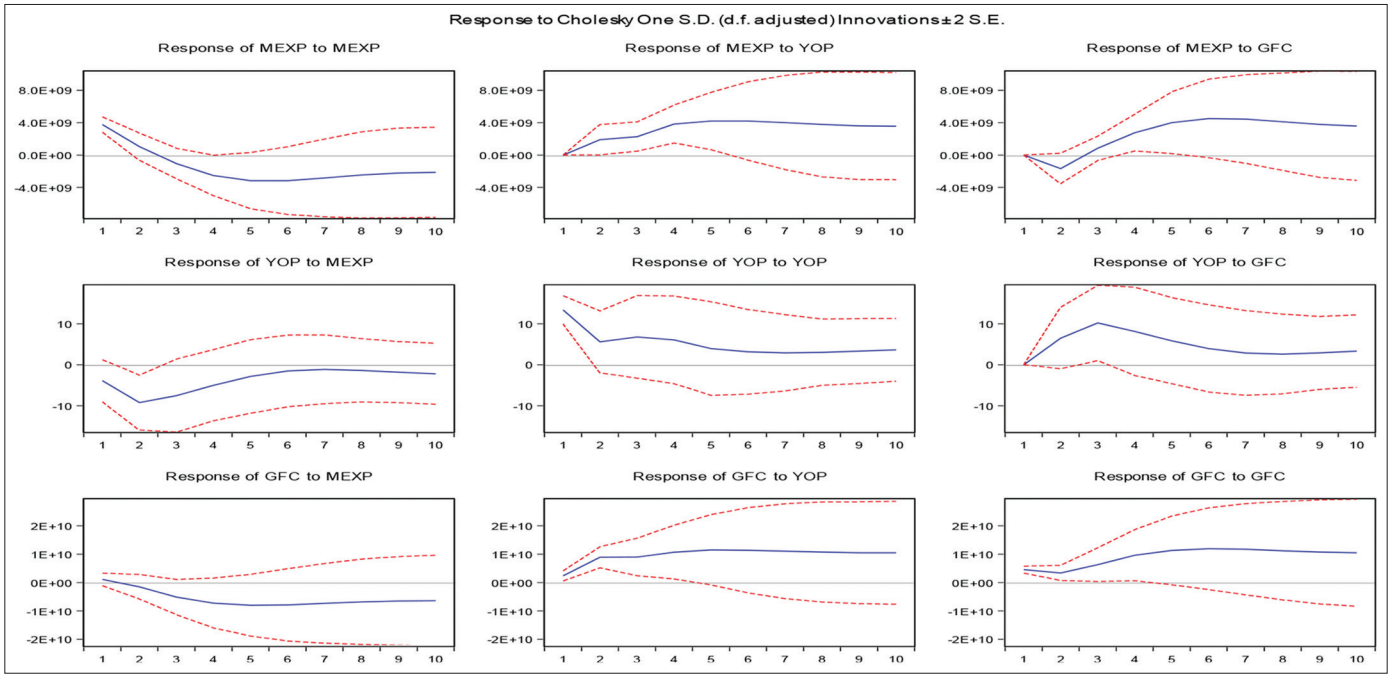
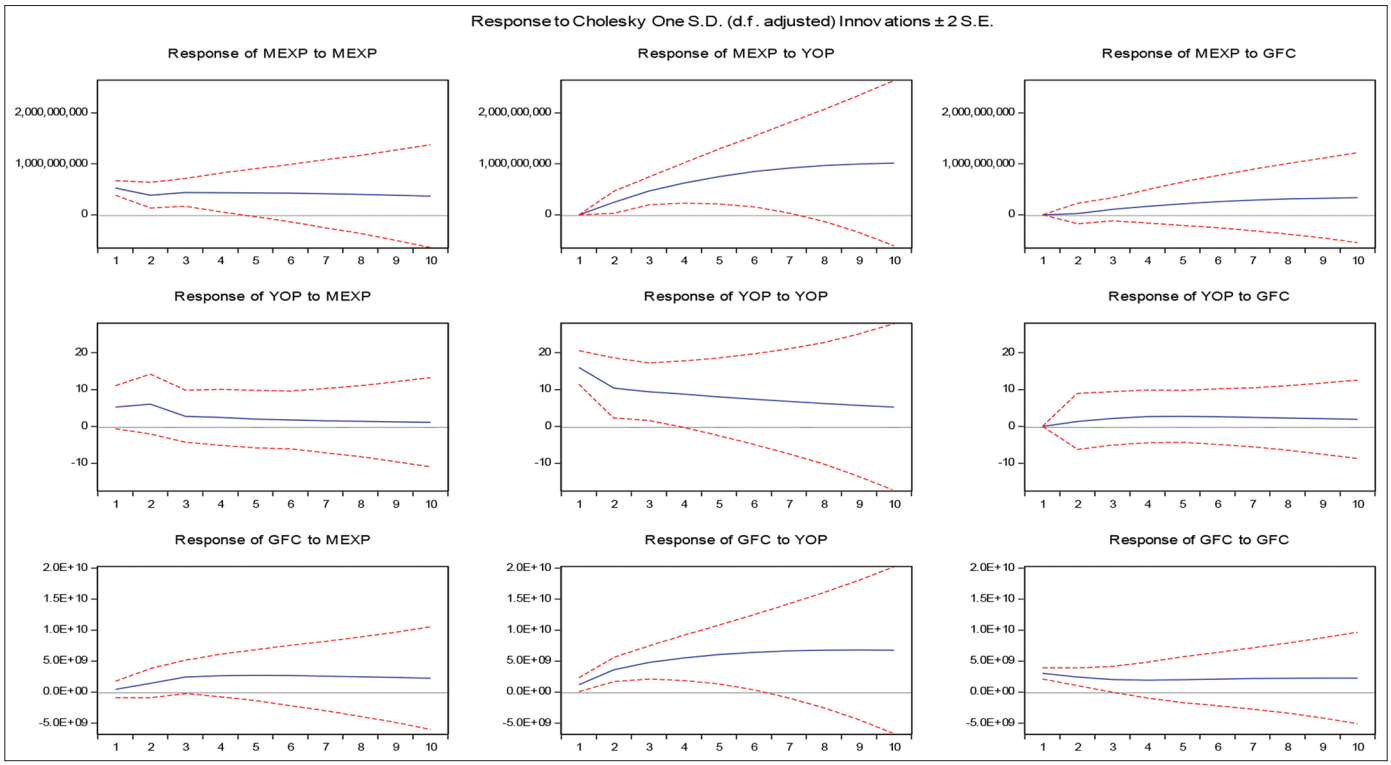


Figure 6: The degree of responsiveness of *MEXP* to (one standard deviation shock) in Algeria's YOP and GFC



and only 26.12% can be explained by *GFC*. This is supported by the Granger Causality Test results since YOP has a strong causal impact on *MEXP*. In the case of Algeria, *YOP* is a strong endogenous variable since it has a greater ability to explain the change occurring in the FEV of *MEXP*. This can be seen clearly whether in the short or long term. In period 10 in the case of Algeria, *YOP* can explain 72.7% of the change occurring in the FEV of *MEXP* and in year 20 *YOP* can explain 80.1% of the change occurring in the FEV of *MEXP* and *GFC* can explain only 5.4% of the change. These confirm and support the Granger Causality Test results.

Fourth: Cointegration Tests

We based the cointegration test on a basic hypothesis that, if a linear combination of two random variables is neither static nor

Table 1: Summary for the unit root tests (ADF- PP- KPSS) applied on Saudi Arabia data

The variables	ADF - Test						PP- Test						KPSS-Test					
	Level			Diff			Level			Diff			Level			Diff		
mexp	C	0	–0.36	C	0	–5.15*	C	2	–0.42	C	2	–5.14*	C	5	0.57	c	2	0.17*
mexp	C,t	0	–2.02	C,t	0	–5.09*	C,t	2	–2.07	C,t	1	–5.09*	C,t	4	0.17	C,t	1	0.10*
YOP	c	0	–1.63	c	0	–7.07*	c	1	–1.52	c	4	–7.28*	c	4	0.57	C	4	0.10*
YOP	C,t	0	–2.63	C,t	0	–6.96*	C,t	1	–2.60	C,t	5	–7.31*	C,t	12	0.12	C,t	4	0.10*
GFC	C	0	0.53	C	0	–3.87*	C	3	0.15	C	3	–3.88*	C	3	0.85	c	3	0.24*
GFC	C,t	3	–1.87	C,t	0	–3.93**	C,t	3	–1.87	C,t	3	–3.95**	C,t	4	0.17	C,t	3	0.11*

Note: (*) and (**)indicate that the variable is stationary at α=1% and 5% respectively

Table 2: Summary for the unit root tests (ADF- PP- KPSS) applied on Algerian data

The variables	ADF-Test						PP-Test						KPSS-Test					
	Level			Diff			Level			Diff			Level			Diff		
mexp	C	0	0.66	C	0	–4.75*	C	3	0.44	C	3	–4.79*	C	3	0.84	c	3	0.28*
mexp	C,t	0	–1.62	C,t	0	–4.99*	C,t	1	–1.643	C,t	0	–4.99*	C,t	2	0.27	C,t	1	0.10*
YOP	c	0	–1.63	c	0	–7.07*	c	3	–1.52	c	3	–7.18*	c	3	0.68	C	3	0.09*
YOP	C,t	0	–2.62	C,t	0	–6.96*	C,t	1	–2.6	C,t	0	–7.31*	C,t	1	0.16	C,t	8	0.12*
GFC	C	1	–0.28	C	0	–3.71*	C	3	–0.13	C	3	–3.80*	C	3	0.77	c	3	0.27*
GFC	C,t	6	–3.41	C,t	0	–3.82**	C,t	3	–1.74	C,t	3	–3.94**	C,t	2	0.27	C,t	3	0.11*

Note: (*) and (**) indicate that the variable is stationary at α=1% and 5% respectively

Table 3: The variance decomposition analysis for VAR (1) and VAR(2)

The variance decomposition of MEXP in Saudi Arabia				The variance decomposition of MEXP in Algeria			
Period	MEXP	YOP	GFC	Period	MEXP	YOP	GFC
1	100	0	0	1	100	0	0
2	79.23424	19.69894	1.066821	2	86.61223	12.0284	1.359373
3	55.67458	35.92326	8.402166	3	68.12709	28.95772	2.915194
4	44.63973	39.92316	15.43711	4	53.10829	42.92278	3.96893
5	41.46127	39.02487	19.51385	5	42.54858	52.86953	4.581892
6	40.8984	37.35856	21.74304	6	35.29736	59.77635	4.926287
7	41.05865	35.90258	23.03877	7	30.23827	64.64119	5.120539
8	41.37563	34.77196	23.85241	8	26.61254	68.15576	5.231696
9	41.68871	33.91167	24.39961	9	23.94046	70.76329	5.296242
10	41.95877	33.25235	24.78888	10	21.91968	72.74619	5.334128
11	42.18253	32.73896	25.07852	11	20.356	74.28753	5.356468
12	42.36625	32.33187	25.30188	12	19.12151	75.5089	5.369591
13	42.5176	32.00323	25.47918	13	18.12968	76.49315	5.377175
14	42.64332	31.73345	25.62323	14	17.32052	77.29808	5.381401
15	42.74885	31.5086	25.74255	15	16.65143	77.96498	5.383583
16	42.83837	31.31864	25.84299	16	16.09156	78.52392	5.384522
17	42.91511	31.15621	25.92868	17	15.6181	78.99718	5.384713
18	42.98153	31.01584	26.00263	18	15.21394	79.4016	5.384461
19	43.03952	30.89337	26.06711	19	14.866	79.75004	5.383959
20	43.09056	30.78563	26.12381	20	14.5642	80.05248	5.383325

stationary, these two variables have a cointegration between them This is the case even if either the relationship between them or the combination is characterized by stationarity where it is said that the two variables (Y_t) and (X_t) are cointegrated with degree of (d, p).

We used three different models to test the existence of cointegration between the studied variables. These are: namely, the unit roots tests for residuals; the Durbin Watson tests for cointegration; and the Johansen cointegration test. We applied the Johansen cointegration test to determine the cointegration between the variables. The results are as follows.

Throughout the results of the first and second model, it turned out that in both cases there was at most one cointegrated equation between the variables. Accordingly, we rejected the null hypothesis that there is no co-integration between the variables of the model in favor of accepting the alternative hypothesis that there is a cointegration between the model's variables.

In conclusion, we conducted two VECM models and applied one to Saudi Arabia and the other to Algeria.

Fifth: The Vector Error Correction Models

After the assurance of the presence of cointegration between the variables (Y_t) and (X_t), and after identifying the rank of this cointegration between the two variables, it became appropriate

for us to use the VECM to estimate the short- and long-term relationships. This can take the following forms:

$$\Delta Y_t = \varphi_1 + \sum_{i=1}^{P} \alpha_i \Delta Y_{t-i} + \sum_{j=1}^{q} \beta_j \Delta X_{t-j} + \delta_1 EC_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta X_t = \varphi_2 + \sum_{i=1}^{R} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{S} \varphi_j \Delta Y_{t-j} + \delta_2 EC_{t-1} + \varepsilon_t \quad (3)$$

From the previous equations, it is obvious that the VECM enabled us to identify the causal relationship between the two variables (Y_t) and (X_t). In addition, by using this model, we were able to estimate the previous parameters that illustrated the short and long-term elasticities. On the one hand, (Y_t) is the vector of all the independent and dependent variables and (X_t) is the vector of the independent and dependent variables. On the other hand (X_{t-1}) is the vector of the independent and dependent variables with one lag period as well as (Y_{t-1}).

EC_{t-1} refers to the error correction term, whose value indicates the extent to which the error of the previous period is corrected in the current period. This is done in such a way that the policymaker can develop the time plan and policies required to correct short-term conditions and deviations to reach either the equilibrium position or the correct path in the long term. This is because since the deviation, which occurs in the last period- away from the equilibrium position in the long term, - affects the short run dynamics of the dependent variable. Accordingly, the error correction term reflects the speed taken to make of the adjustment. This is the speed at which the dependent variable can return to the equilibrium position after a change in the independent variable has occurred.

$$VECM\ \Delta Y_{t=} = \beta_{\circ} \sum_{i=1}^{n} \delta_i \Delta X_{t-i} + \varphi Z_{t-1} + \mu_t \quad (4)$$

Cointegrating Equation $Z_{t-1}=ECT_{t-1}=Y_{t-1}-\beta_1 R_{t-1}-\beta_2 X_{t-1}$ (5)

3.5. The First Vector Error Correction Model (Applied to Saudi Arabia)

We estimated the second VECM by using as a dependent variable. Our aim was to predict the relationship between it and the independent variables (and). Consequently, we achieved the following results:

$$\underset{(SE)}{MEXP_{t-1}} = \underset{}{-0.237} \underset{(2.2E+08)}{-\ 1.15E+09\ YOP_{t-1}} + \underset{(0.08503)}{0.0426\ GFC_{t-1}} \quad (6)$$

The error correction term appeared in the model results with a negative sign. This was a good indication of the possibility of the VECM returning to the equilibrium situation. Moreover, having regard to its value of (-0.350615). this represents a 3.5% adjustment of speed of adjustment. For the significance level, it turned out to be significant at $\alpha = 5\%$.

Table 4 summarizes the direction of the relationship with the military expenditure MEXP and the degree of significance of each explanatory variable on the dependent variable.

According to the above results of the VECM model, the explanatory variable (YOP) in the case of Saudi Arabia has an impact on MEXP. This is clarified through the coefficient of determination that came with a value of 0.685 and indicated that 68.5% of the changes that occurred in MEXP can be explained by both Saudi Arabia's YOP and GFC.

3.6. The Second Vector Error Correction Model (Applied to Algeria)

We estimated the second VECM by using MEXP as a dependent variable. Our aim was to predict the relationship between it and the independent variables (YOP and GFC). Consequently, we achieved the following results:

$$\underset{(SE)}{MEXP_{t-1}} = \underset{}{-0.237} \underset{(1.2E+08)}{-\ 6.37E+08\ YOP_{t-1}} + \underset{(0.11819)}{0.344430\ GFC_{t-1}} \quad (7)$$

The Error Correction Term appeared in the model results with a negative sign. This was a good indication of the possibility of the VECM returning to the equilibrium situation. Having regard to its value of (–0.038550). This represents a 3.9% adjustment of speed. For the significance level, it turned out to be significant at $\alpha = 5\%$.

Table 5 summarizes the direction of the relationship with the military expenditures MEXP and the degree of significance of each explanatory variable on the dependent variable.

According to the above results of the VECM model, the explanatory variables (YOP and GFC) in the case of Algeria have an impact on MEXP.This is clarified through the coefficient of determination that came with a value of 0.323882 and indicated that 32.4% of the changes that occurred in MEXP can be explained by both Algeria's YOP and GFC.

Sixth: Diagnostic Tests

The first and second VECM models were able to pass through the diagnostic tests required to find out their validity. The results confirmed the absence of autocorrelation by accepting the null

Table 4: Summary of VECM (1) results

The Explanatory Variable	The resulted relationship	The % change in MEXP resulting from a 1% change in the Exp. Variable (in the LR)	The degree of significance
YOP	*Direct*	–1.15E+09%	α=5%
GFC	*Inverse*	0.042624%	Insignificant

Table 5: Summary of VECM (2) results

The Explanatory Variable	The resulted relationship	The % change in MEXP resulting from a 1% change in the Exp. Variable (in the LR)	The degree of significance
YOP	*Direct*	–6.37E+08	α=5%
GFC	*Inverse*	0.344430%	5%

hypothesis that states No Serial Correlation is where P-Values turned out to be greater than 0.05 in all lags. The Residuals Normality Test results confirmed the normal distribution where P-values were greater than 0.05. This assured us that the variables did not face any Skewness or Kurtosis problems. In addition, the VECMs did not suffer from a heteroscedasticity problem.

4. CONCLUSION

Military expenditure is of crucial importance to the developing countries and. more specifically, for Arab countries because it plays the protective role by supplying them with the necessary resources to prevent any external threats that could cause their destruction. Accordingly, some of those countries have a desperate need to search for the factors that can greatly impact their protective umbrella as represented by MEXP. This is an essential factor if the necessary policies are to be undertaken to implement the necessary measures to protect such that countries. Throughout the study we tried to examine whether the YOP and the GFC could be considered as those factors that had a potential causal impact in affecting Saudi Arabia's and Algeria's MEXP. This is because these two countries are characterized by the previously mentioned features in addition to being oil exporting countries where any fluctuations in the YOP can have serious potential impacts on their protective umbrellas. Therefore, we tried to link the two principal factors of oil and military expenditure in both countries with a view to examining their potential impact. Therefore, we conducted two VECM models corresponding to the prevailing situations in both countries. Their results demonstrated that in both countries YOP could have a great causal impact on MEXP in addition to being a strong endogenous variable in the case of Algeria. On the other hand, while GFC had an insignificant relationship with MEXP in Saudi Arabia, the results demonstrated that in Algeria it could have a significant causal impact but at a particularly low level of significance (α =10%). In conclusion, both countries must pay greater attention to the prevailing YOP when formulating their policies that aim to maintain their safety nets and protective umbrellas of which they are greatly in need.

4.1. Limitations of the Study

Usually, it is vital to describe the limitations of a research study before proceeding any further. One of the limitations is that this study only puts more emphasis on two variables, namely: oil price volatility; and military expenditure. Therefore, it becomes challenging to understand the other underlying factors that are likely to affect the military expenditure. Also, this study focused on two oil-producing countries, namely: Algeria and Saudi Arabia. In doing so, this implies that it would be impossible to obtain an overview of how the oil prices affected globally other countries' military operations and expenditures. Therefore, given that oil prices largely affect the world economy we recommend that it is essential for future research studies to examine the relationship between oil price shocks and military expenditure from a global perspective. Furthermore, another limitation is that this study's findings emphasize only the implications of the oil price fluctuations on countries' stock markets and opportunities for economic development. Therefore, this study took no account oil price variations on economic development. As mentioned earlier in the introductory section, constant reductions in the oil price have resulted in lower oil revenues for oil exporting countries and, in turn, increased levels of debt. Therefore, it is important that future studies assess how the level of debt affect the military expenditure. The other limitation of this study is that, given the tight work plans, we were unable to obtain responses from the participants during the fieldwork.

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