



Oil Price Shocks And Macroeconomic Performance Of The Algerian Economy: A Structural Var Approach

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Abstract

This study delves into the intricate relationship between oil prices and key macroeconomic variables (gross domestic product (GDP), government spending, and inflation) in the context of Algeria. Utilizing annual data spanning from 1990 to 2020 and employing the SVAR methodology, the research elucidates the nuanced responses of these variables to oil price shocks. The findings underscore that a 1% positive shock in oil prices results in a noteworthy 0.24% increase in public spending,. Furthermore, the study reveals a remarkable 1.67% decrease in the inflation rate following a 1% increase in oil prices, attributed to sustained state intervention aimed at bolstering purchasing power and the prudent monetary strategies executed by the Central Bank. Notably, the research highlights a concerning aspect; the 1% positive shock in oil prices corresponds to a 0.17% decline in GDP, attributed to the persistent diminishing contribution of the fuel sector to GDP growth since 2006. To navigate these challenges, policymakers are urged to consider diversifying revenue streams, implementing prudent fiscal measures, and adopting strategies that reduce reliance on oil exports. Additionally, proactive steps to stimulate growth in non-oil sectors should be prioritized to enhance economic resilience and mitigate the adverse effects of oil price volatility.

Keywords: Oil price volatility , Macroeconomic Variables , Structural VAR , Impulse responses function

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Introduction

Oil stands out as a pivotal energy resource, playing a crucial role in driving global growth, particularly in industrialized nations where the demand for this indispensable substance is on the rise. According to [Ross \(2014\)](#), petroleum and its derivatives constitute a significant 14.2% of the world's merchandise trade. In 2018, petroleum emerged as the world's most exported product in terms of value, surpassing refined petroleum oils and cars in second and third place, respectively. Undoubtedly, the petroleum industry is the most capital-intensive, as evidenced by a study on American companies[†]. Operating abroad reveals that textile companies invest a modest \$13,000 per employee, making it the least capital-intensive industry. In stark contrast, oil and gas companies spend a staggering \$3.2 million for each employee, underscoring its role as a substantial source of income. While this makes oil-exporting countries reliant on the revenue generated from this resource, it often comes at the expense of industry and economic diversification. Many oil-producing and exporting nations experience disruptions in their incomes and growth rates, leading to a lower standard of living and weak economic development indicators. This, in turn, contributes to social and economic challenges within these regions.

The oil market exhibits a notable degree of instability and price fluctuations, stemming from its profound impact on political and economic conditions due to the crucial role this energy resource plays across various sectors. The repercussions of these price fluctuations extend to all involved parties. While escalating prices are perceived as advantageous for oil-exporting nations, signifying increased revenues, they concurrently lead to heightened production costs for countries reliant on oil consumption. Conversely, reduced prices benefit consuming nations by lowering costs but pose a challenge for exporting countries, impacting their economic stability and various economic indicators negatively.

While the short-term effects of surging oil prices may seem positive for the economies of exporting nations, there exists a long-term risk known as the "resource curse." Numerous studies have delved into the impact of oil shocks on economies, both exporters and importers. [Hamilton \(1983\)](#) study, for instance, examined the relationship between oil shocks and macroeconomic indicators, such as gross domestic product. Recent contributions to this field include [Dogah Kingsley Etonam \(2015\)](#) study, revealing a significant adverse impact on production and economic activities in Ghana, a developing oil-importing country.

Further insights are provided by [Shahriyar Mukhtarov et al. \(2019\)](#) study, affirming the positive impact of oil prices on economic growth, exports, and inflation, while highlighting a negative influence on the exchange rate in Azerbaijan. In the case of Russia, [Anthony Nyangarika et al. \(2019\)](#) study establishes a long-term positive relationship between oil prices and gross domestic product. An examination of Algeria by [Asma et al.\(2021\)](#) underscores a strong and clear impact of oil price fluctuations on the growth of gross domestic product, oil and gas exports, and public

[†] <http://www.worldstopexports.com/worlds-top-oil-exports-country/>

spending.

Similar to many oil-exporting nations, Algeria heavily relies on its oil sector, dominating over 98% of its total exports and constituting the primary source of income. This significant reliance underscores a lack of diversification in its economy, leading to a decline in industrial activity. Approximately 60% of the state budget depends on oil revenues, creating a scenario where financial comfort during rising oil prices encourages expanded spending. Conversely, a mere decline in oil prices prompts the implementation of rationalization policies to control expenditure, as witnessed in the aftermath of the 2014 shock.

The vulnerability of Algeria's economy to external shocks becomes evident in its heavy dependence on the fuel sector. The fragility and lack of diversification are exposed when oil prices experience a downturn, as was the case in the second semester of 2014. Following an average barrel price of \$109.55 in the first semester, it plummeted to \$75.38 in the second semester of 2015 and further to \$54.31 in the first semester of 2015. This decline in prices coincided with reduced exported quantities, leading to a substantial drop in export revenues from \$15.6 billion in the first semester of 2014 to \$8.7 billion in the first semester of 2015 [CNUCED\(2017\)](#). Consequently, this downturn contributed to an increased budget deficit, a significant decline in the trade balance, and various macroeconomic indicators.

This study seeks to assess the impact of oil price shocks on spending, heavily reliant on revenue from oil resources, and on gross domestic product (GDP), given the significant role this resource plays in its formation. Additionally, the research aims to explore how these shocks contribute to the emergence of inflationary pressures, a prevalent issue in many countries, including the world at large and Algeria, which experienced notably high inflation rates, surpassing 30 points in the initial years covered in the study period. Employing the SVAR methodology, the study analyzes the intricate relationship between oil shocks and the aforementioned variables. The paper is organized into distinct sections: Section Two delves into Previous Studies, Section Three details the Description of the Variables and Data, Section Four elucidates the Explanation of the SVAR Model Methodology, Section Five engages in the Discussion of the SVA Model Estimation Results, and the Final Section offers the Conclusion.

Literature review

The repercussions of oil shocks exhibit distinct manifestations in oil-exporting and oil-importing nations, thereby influencing diverse economic indicators within each context. In oil-exporting countries, fluctuations in oil prices intricately affect national incomes, with an upswing in prices bolstering these incomes and a downturn precipitating a corresponding decline. Conversely, oil-importing nations experience a converse dynamic, where elevated oil prices may escalate production costs, and reduced prices result in cost mitigation. Numerous scholarly investigations have delved into the multifaceted impacts of oil shocks on both exporting and importing countries. This article aims to synthesize and encapsulate the findings of relevant studies, categorically addressing the

repercussions in exporting countries, followed by importing countries, and subsequently, providing a focused researchs on Algeria.

Exporting countries :

[Audu Isah et al. \(2015\)](#), systematically examined the effects of oil price shocks on key economic indicators in Nigeria. The research comprehensively assessed the impact on the exchange rate, external reserves, gross domestic product (GDP), inflation, foreign trade, and monetary supply, utilizing tripartite data spanning the years 2000 to 2014 and employing VAR and GARC models. The findings of the study revealed that, in the short term, oil shocks did not contribute to inflationary pressures within the Nigerian economy. Moreover, these shocks exhibited a positive influence on the level of GDP, although the repercussions on foreign reserves and foreign trade were pronounced due to a decline in crude oil exports. Additionally, the study highlighted the positive impact of oil shocks on the money supply, underscoring the imperative for Nigeria to actively diversify its economy for sustained growth.

The research conducted by [Mukhriz and Jauhari.\(2015 \)](#) investigated the impact of oil shocks on real economic activities in ASEAN-5 from 1991 to 2014, employing a PANEL-VAR approach. The findings revealed that positive oil shocks had adverse effects on production in both the short and long term. Conversely, following a decline in oil prices, real production exhibited a negative response in the short term but eventually returned to pre-shock levels in the long term. These observations underscore the contrasting effects of positive and negative oil shocks on economic activities.

The study conducted by [Basnet and Kamal. \(2015\)](#) examined the repercussions of oil shocks on real output, inflation, and the real exchange rate in Thailand, Malaysia, Singapore, Philippines, and Indonesia. Employing the VAR structural model, the research uncovered a cointegration relationship among the macro variables of these countries, suggesting a shared long-term trend. The shock response functions further revealed that fluctuations in oil prices did not exert a lasting impact on the economies of these nations; any discernible effect dissipated between 5 and 6 triads. Additionally, the analysis of variance substantiated that oil shocks failed to account for significant variation in the study variables.

The research conducted by [Saeed Moshiri \(2015\)](#) delves into the asymmetric effects of oil price shocks on the economic performance of oil-exporting countries. The study focuses on two groups comprising nine major oil-exporting countries, categorized into six developing and three developed nations, spanning the period from 1970 to 2010. Employing the VAR model and utilizing the GARC method for estimating price shocks, the model incorporates oil price shocks and economic growth as principal variables, with investment, inflation, and the exchange rate serving as intermediate variables. The findings unveil distinctive responses to oil shocks among these countries. In developing oil-exporting nations, a decline in oil prices leads to economic stagnation and a significant reduction in revenues. Conversely, the upswing in prices accompanied by increased

revenues fails to spur sustainable growth, exhibiting no significant effect. Moreover, such price increases do not markedly impact economic growth in developed countries. The variations in response to shocks are attributed, in part, to differences in institutional quality among these nations, particularly the effectiveness of their respective governments.

The examination conducted by [Nguyen et al. \(2017\)](#) assessed the repercussions of oil price fluctuations on various economic indicators in Vietnam, a nation that not only imports but does not exclusively export oil. Utilizing the VAR model over the timeframe from 2000 to 2015, the study unveiled that elevated oil prices in Vietnam were associated with increased inflation rates and a widening budget deficit. However, the impact on gross domestic product and unemployment did not exhibit a clear pattern. This stands in contrast to oil-exporting countries, particularly OPEC members, where fluctuations in oil prices wield significant influence on the economy. In these exporting nations, a mere decrease in oil prices triggers direct negative effects such as inflation, a downturn in economic growth, and a rise in unemployment.

[Adebayo Adedokun \(2018\)](#) explored the influence of oil shocks on the dynamic interplay between government spending and public revenues in Nigeria. The research further examined how this impact transmits to key macroeconomic variables, utilizing data spanning from 1981 to 2014. The study employed a comprehensive analytical approach, incorporating the SVAR model, as well as the VAR and VEC models, along with the error correction model. Across an expanded set of variables, the SVAR results underscored the robust predictive capacity of oil price shocks for the short-term variations in government spending. This finding was corroborated by the outcomes of both VAR and VECM analyses, highlighting the consistent nature of this predictive power.

The study of [Shahriyar et al. \(2019\)](#) delved into the repercussions of oil prices on economic growth, exports, inflation, and the exchange rate in Azerbaijan over the span from 2005 to 2019. Employing the Johansen and VECM methodology, the study arrived at noteworthy findings. It determined a positive and statistically significant impact of oil prices on economic growth, exports, and inflation in Azerbaijan. Additionally, the study revealed a negative influence of oil prices on the exchange rate in the country.

Importing countries

The research by [Dogah \(2015\)](#) examined the ramifications of oil price shocks on the macroeconomy of Ghana, a developing oil-importing nation, spanning from 1970 to 2012. Utilizing the restricted VAR model and the Johansen cointegration test, the study yielded noteworthy insights. It identified a substantial adverse impact on production and economic activities in Ghana resulting from oil price shocks. This finding aligns with traditional studies that generally indicate a negative effect of oil shocks on gross domestic product. However, it contrasts with contemporary research, often conducted on advanced oil-importing economies, which suggests a diminishing intensity of this relationship. This disparity raises the prospect of divergent conclusions when comparing the impact of oil shocks on developing oil-importing countries.

The research conducted by [Carolyn et al. \(2016\)](#) investigated the influence of oil shocks on the South African economy spanning the years 1975 to 2011, utilizing the SVAR model. The study's findings indicated that supply shocks exerted a noteworthy impact on inflation in the short term. Specifically, supply disturbances were associated with an increase in domestic inflation. Conversely, the study revealed that demand shocks led to a positive effect on domestic product and the real exchange rate in the medium term.

The research conducted by [Fenghua et al. \(2018\)](#) investigated the influence of crude oil price shocks and monetary policy on the Chinese economy over the period from 1996 to 2017. The study's key finding suggested that an augmentation in money supply could partially offset the adverse effects of crude oil prices on economic growth in China. This underscores the significant role played by monetary policy in shaping the relationship between oil price shocks and the Chinese economy.

The research conducted by [Gershon et al. \(2019\)](#) investigated the impact of oil price shocks on the macroeconomic indicators of selected African countries, specifically developing nations that include Cape Verde, Liberia, Sierra Leone, and Gambia, all of which are oil-importing economies. The study employed the VAR model over the period spanning from 1980 to 2015. The findings indicated that, according to Granger causality tests, oil prices had a causal relationship with per capita GDP in Liberia and Sierra Leone. Moreover, the shock analysis results revealed that elevated oil prices contributed to a medium-term increase in per capita GDP across the selected countries.

The research by [Donghui et al. \(2020\)](#) employed the SVAR model with monthly data spanning from 1999 to 2018 to examine the impact of oil shocks on macroeconomic fluctuations in China. The study revealed that positive oil price shocks had adverse effects on both economic growth and money supply. Furthermore, the findings suggested that Chinese economic activity played a crucial role as a significant source influencing changes in oil prices.

Studies about Algeria

The research by [Brini et al. \(2016\)](#) investigated the effects of oil price shocks on inflation and the real exchange rate in six MENA countries: Tunisia, Morocco, Algeria, Bahrain, Saudi Arabia, and Iran. Utilizing the SVAR model over the period from 2000 to 2015, the study yielded several key findings. In the long run, the study highlighted that the most substantial impact of oil price fluctuations on the real exchange rate occurred in importing countries, specifically Morocco and Tunisia. Moreover, the study noted a comparatively lesser impact on inflation, attributing it to price stability (rigidity) in supported products. The analysis of variance results indicated that oil price shocks did not significantly account for the variation in the two variables under consideration in Algeria and Iran. Contrarily, the study revealed a significant, both statistically and economically, impact on the remaining countries.

[Anissa Benramdane\(2017\)](#) examined the repercussions of oil price fluctuations on economic growth in Algeria over the period from 1970 to 2012, utilizing the VAR model. The study's conclusion highlighted a nuanced dynamic: the adverse effects of oil price fluctuations offset the positive

impact of the oil boom. Consequently, the study suggested that it is the volatility in oil prices, rather than the abundance of oil resources itself, that gives rise to the paradoxical phenomenon known as the "resource curse" in Algeria.

The research conducted by [Lakhdari et al. \(2018\)](#) examined the influence of external shocks on the performance of Algerian exports, employing the VECM model over the period from 2002 to 2013 with quarterly data. The findings underscored that external shocks, encompassing variables such as oil prices, global GDP aggregates, euro-dollar exchange rates, and the financial crisis, exerted a discernible impact on the performance of Algerian exports. Additionally, the study identified a causal relationship emanating from oil prices and the financial crisis towards the dynamics of Algerian exports.

The research conducted by [Miloud Lacheheb and Abdella Sirag \(2019\)](#) examined the correlation between oil price fluctuations and the inflation rate in Algeria spanning from 1970 to 2014, utilizing the NARDL model. The study's findings highlighted a non-linear impact of oil prices on inflation. Specifically, the research revealed a substantial relationship between rising oil prices and the inflation rate. Conversely, it found no significant correlation between low oil prices and inflation.

[Hicham Ayad \(2021\)](#) sought to assess the long-term relationship between oil prices and the Algerian dinar exchange rate, encompassing both negative and positive shocks, over the period from 1995 to 2020. The research employed a comprehensive approach, incorporating traditional co-integration analyses through Engle-Granger, Phillips-Ouliaris, and Johansen-Juselius tests, along with hidden co-integration as proposed by Granger and Yoon (2002). The study's outcomes revealed an absence of evidence indicating co-movement and correlation between oil prices and the exchange rate in Algeria throughout the study period.

The research conducted by [Asma et al. \(2021\)](#) explored the macroeconomic repercussions of oil price fluctuations in Algeria, employing the Structural Vector Autoregressive (SVAR) model over the period 1999-2019 and utilizing tripartite data. The study uncovered a pronounced and unmistakable impact of oil price fluctuations on various economic indicators, including GDP growth, total exports, oil and gas exports, and public spending.

Variables' definitions and data sources

This paper uses annual data consisting of 31 observation during the period 1990-2020 for the Algerian economy. The selection of the analysis period was based on the availability of data. The paper attempts to study the impact of oil price shocks on certain macroeconomic variables in Algeria such as: gross domestic product, public expenditure, oil revenues and inflation. Details on the variables: their definition, coding, measurement units and data source are described in [Table 1](#). All variables were transformed into their logarithms. [Shahbaz \(2010\)](#) and [Mukhtar and Abubakr \(2019\)](#) have demonstrated that log-linear specification offers better results than simple specification and enables one to represent them as elasticities since it minimizes heteroskedasticity by reducing the size of the series.

Table 1: Data sources and definitions.

Variables	Full name	Description	sources
<i>OP</i>	Oil price	Average annual price of a barrel of Brent crude in US dollars	BP
<i>GDP</i>	Gross domestique product	Gross domestic product in current prices of the local currency	World Bank
<i>PE</i>	Public expenditure	Total annual of public expenditure	Ons and bank of algeria
<i>INF</i>	inflation	Consumer Prices at annual % change	Worl bank

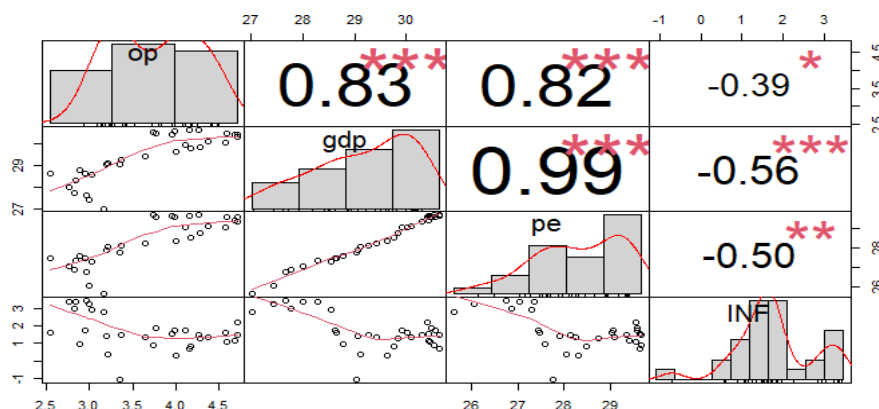
Table 2 presents descriptive statistics for the study variables. The means for *lgdp*, *linf*, *lop*, and *lpe* are 29.38, 1.65, 3.67, and 4.54, respectively, with corresponding standard deviations of 1.06, 1.02, 0.68, and 0.11. The Jarque-Bera test results confirm the normal distribution of all variables, indicated by p-values exceeding 0.05.

Figure 1 illustrates the linear correlation matrix, showcasing Pearson correlation coefficients between study variables along with their statistical significance. Notably, a positive and strong correlation (0.83) is observed between oil prices (*OP*) and gross domestic product (*GDP*) in Algeria, which is statistically significant at the 1% level. Similarly, the correlation coefficient between oil prices and public spending is a robust 0.82, demonstrating a very strong and direct correlation, also significant at the 1% level. Conversely, the relationship between oil prices and inflation reveals an inverse correlation (coefficient: -0.50), with statistical significance at the 5% level. Furthermore, the figure indicates a compelling and statistically significant positive correlation (0.99) between public spending and *GDP*.

Table 2 : descriptive statistics

	LDEP	LGDP	LINF	LOIRE	LOP	LTC
MEAN	28.32860	29.38117	1.654949	27.75108	3.670789	4.131266
MEDIAN	28.33193	29.63543	1.508490	28.19044	3.731455	4.286900
MAXIMUM	29.68290	30.63214	3.453177	29.04401	4.712568	4.839370
MINIMUM	25.62340	27.02660	-1.080591	25.04080	2.541229	2.191107
STD. DEV.	1.167875	1.066588	1.025943	1.139046	0.682980	0.590158
SKEWNESS	-0.498381	-0.573664	-0.041880	-0.782495	0.047190	-1.644001
KURTOSIS	2.278737	2.191190	3.320736	2.413083	1.624201	5.533518
JARQUE-BERA	1.955266	2.545273	0.141938	3.608482	2.456403	22.25499
PROBABILITY	0.376201	0.280092	0.931491	0.164599	0.292819	0.000015
SUM	878.1866	910.8164	51.30340	860.2835	113.7945	128.0692
SUM SQ. DEV.	40.91795	34.12828	31.57678	38.92277	13.99383	10.44858
OBSERVATIONS	31	31	31	31	31	31

Figure 1 : Boxplot of variables



Methodology

This paper uses Structural Vector Autoregressive (SVAR) model to examine the response of certain macroeconomic variables (pe , inf and gdp) to oil price shocks (op). The (SVAR) model is considered one of the most preferred standard models for analyzing the impact of oil shocks on macroeconomic variables (see for example, [Peersman, 2005](#), [Kilian, 2009](#), [Kang et al.\(2015](#), [Kim et al.2017](#), [Yildirim et al.2021](#)). the (SVAR) model is one of the most important methods used to extract information from macroeconometric data. The uses of the (SVAR) model can be summarized in three main points: (1) for measuring impulse responses to macroeconomic shocks, (2) to determine the degree of uncertainty of impulse responses or other quantities that can be derived therefrom, (3) for determining, through variance decompositions, the contribution of various shocks to business cycles and forecast errors [Fry and Pagan \(2011\)](#). The (SVAR) model is an extension of Vector Autoregressive (VAR) model proposed by Sims (1980). Instead of using the (so-called) atheoretic Sims (1980) VAR model, (SVAR) attempts to find a collection of independent disturbances by means of restrictions often supported by an economic theory [Mukhtar and Abubakar \(2019\)](#). To evaluate the relationship between the series, we begin with general specification of a (SVAR) model:

$$A_0 y_t = \sum_{i=1}^n A_i^* y_{t-i} + B \varepsilon_t$$

Where $y_t = (\Delta op, \Delta pe, \Delta inf, \Delta gdp)$ is a (4×4) vector endogenous variables, while, A_0 and $A_i^* (i = 1, \dots, p)$ are (4×4) matrix of autoregressive coefficients of vector y_{t-i} for $(i = 1, \dots, p)$, B is the matrix of structural form parameter of the model. $\varepsilon_t = (\varepsilon_t^{op}, \varepsilon_t^{pe}, \varepsilon_t^{inf}, \varepsilon_t^{gdp})$ are the structural shocks, which are serially uncorrelated, $E(\varepsilon_t) = 0$ and $\sum_{\varepsilon} = E(\varepsilon_t \varepsilon_t') = I$. The (SVAR) can be presented in the reduced form by multiplying both sides with A_0^{-1} and that:

$$y_t = \sum_{i=1}^p A_i y_{t-i} + e_t$$

Where, $A_i = A_0^{-1} A_i^*$, $e_t = A_0^{-1} B \varepsilon_t$ and the reduced form error structure is given by :

$$e_t = A_0^{-1} B \varepsilon_t = S \mu_t$$

The reduced form of the errors e_t are linear combinations structural error ε_t with $E(e_t e_t') = \sum_e = A_0^{-1} B B' A_0^{-1'} = S S'$. Thus we have in order to estimate SVAR model and impose constraints on it, we use $\hat{\Sigma}_e$ obtained from the reduced form VAR. in this study, we will limit ourselves to imposing short-term constraints, because the impact of oil shocks on the macroeconomic variables of a small oil-exporting country is confined to the short term. Following [Lutkepohl \(2005\)](#), we may consider the so called AB-model $A_0 e_t = B \varepsilon_t$ with $(k(k+1))/2$ equations and $2k^2$ elements of A_0

and B at least locally, we need $2K^2 - \frac{1}{2}K(K + 1)$ restrictions.

We impose constraints on the SVAR model taking into account the structural characteristics of the case of the Algerian economy, which is a small oil-exporting country. This form of economy is described by macroeconomic theory as follows: a typical small oil-exporting country has little effect on the global crude oil market and considers oil prices to be exogenously determined, yet oil price fluctuations have a big impact on them Yildirim and arifili (2021). Considering the existence of four endogenous variables $y_t = (\Delta op, \Delta pe, \Delta inf, \Delta gdp)$ relationships among the reduced form disturbances and the structural shocks can be written in the form of equations as follows:

$$e_t^{op} = \mu_t^{op} \quad (1)$$

$$e_t^{pe} = \alpha_0^{pe} e_t^{op} + \mu_t^{pe} \quad (2)$$

$$e_t^{inf} = \alpha_{op}^{inf} e_t^{op} + \alpha_{pe}^{inf} e_t^{pe} + \mu_t^{inf} \quad (3)$$

$$e_t^{gdp} = \alpha_{op}^{gdp} e_t^{op} + \alpha_{pe}^{gdp} e_t^{pe} + \alpha_{inf}^{gdp} e_t^{inf} + \mu_t^{gdp} \quad (4)$$

Eq.1 states that oil prices are affected by an instantaneous structural shock in oil prices and not by other macroeconomic variable shocks. This hypothesis is based on the fact that oil prices are exogenous to Algerians macroeconomic variables, thus we assume that $(\alpha_{pe}^{op} = \alpha_{inf}^{op} = \alpha_{gdp}^{op} = 0)$. Eq.2 indicates that a shock in oil prices directly affects public expenditure. Many studies confirm this hypothesis Faheem et al.(2022), Abdel-Latif et al.(2018). A small oil exporting country like Algeria, its exports are characterized by a lack of diversity, more than 97% of its exports are oil, its public expenditures are closely linked to oil prices, while we assume that public expenditure is not affected by a shock in inflation or a shock in gdp , as a result we write $(\alpha_{inf}^{pe} = \alpha_{gdp}^{pe} = 0)$. Eq.3 assume that inflation is affected by a shock in oil prices, as well as by public expenditure, while it is not affected by a shock in gdp . Thus, we write $(\alpha_{gdp}^{inf} = 0)$. Eq.4 indicates that the gross domestic product is affected by the shocks that may occur in : the oil price, public spending and inflation, and therefore we do not impose any restrictions on this equation. The short-term pattern of (SVAR) can be shown as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -\alpha_{op}^{pe} & 1 & 0 & 0 \\ -\alpha_{op}^{inf} & -\alpha_{pe}^{inf} & 1 & 0 \\ -\alpha_{op}^{gdp} & -\alpha_{pe}^{gdp} & -\alpha_{inf}^{gdp} & 1 \end{bmatrix} \begin{bmatrix} e_t^{op} \\ e_t^{pe} \\ e_t^{inf} \\ e_t^{gdp} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} \mu_t^{op} \\ \mu_t^{pe} \\ \mu_t^{inf} \\ \mu_t^{gdp} \end{bmatrix}$$

Empirical results:

Unit root test

The first step in any empirical analysis based on time series data is to study the stationarity of these series in order to avoid spurious regression problem, as well as in selecting the appropriate statistical model for analysis. There are a large number of stationarity tests, in our study we use a parametric test ADF Dickey and Fuller (1981) and a non-parametric test PP Philips and Perron (1988). When the structural break is ignored, Perron (1989) argued that standard unit root tests had low power to reject the unit root null hypothesis. In order to ensure the robustness of the obtained results, we use a ZA Zivot and Andrews (1992) structural break test. The results are shown in Table 3. According to the results of ADF and PP tests presented in table 2, it is clear that the unit root null hypothesis cannot be rejected for all variables at level. The results of the ZA test, which was used in order to

check the robustness of the results obtained from the ADF and PP tests, show that the unit root null hypothesis cannot be rejected at 1% , 5% and 10% for all variables except *linf* which is stationary at 10%. After having made the first differences on the time series, we find that all variables are stationary except *inf*, which did not appear stationary according to the PP test, but it is stationary according to ADF test and ZA test. Thus, it can be concluded that all the variables are $I(1)$.

Table 3: Unit root tests without structural break

Variables	ADF Test		PP Test		Zivot Andrews Unit Root Test				Order of integration
	At Level	First diff.	At Level	First diff.	At Level	Break point	First diff.	Break point	
<i>lop</i>	-1.295	-4.423***	-1.500	-4.414**	-3.514	2015	-6.007	2009	$I(1)$
<i>lgdp</i>	-1.541	-5.279***	-1.450	-9.870***	-3.922	2012	-5.855	2004	$I(1)$
<i>lpe</i>	-1.847	-5.329***	-1.677	-7.194***	-4.328	2009	-5.737	2009	$I(1)$
<i>linf</i>	-2.686	-7.878***	-2.706	-7.982	-4.974	1997	-11.504	2001	$I(1)$

Note: ***, ** and * indicate statistical significance at the 1% , 5% and 10%. All variables are tested with intercept and trend. For the Z-A test Critical values for the test 1% : -5.57, 5% : -5.08, 10% : -4.82

In order to estimate the VAR model, we first choose the appropriate lag period so that there is a balance between the lag period and the degrees of freedom. [table 4](#) shows the different lag selection criteria with $Max\ lag = 3$. the results of LR , FPE and AIC suggest 1 lag as the optimal lag, SC and HQ suggest 0 lag, According to the results of the majority of criteria we choose 1 lag .

Table 4 : lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	51.26625	-	2.24e-08	-3.427130	-3.187160*	-3.355774*
1	78.28758	42.03318*	2.00e-08*	-3.576858*	-2.137039	-3.148724
2	92.51920	16.86711	5.49e-08	-2.779200	-0.139532	-1.994288
3	119.8054	22.23322	8.79e-08	-2.948550	0.890966	-1.806861

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The next step is to estimate the Var model. According to [Chris Brooks \(2019\)](#), in order to perform various statistical test, either singly or jointly, to examine the statistical significance of the coefficients of the Var model, stationary series must be used. After estimating the Var model, we tested the validity of this model through a set of statistical tests.

Table 5 : Diagnostic tests for VAR(1)

Test	Stability test		Jarque-Bera test	Autocorrelation LM test	Heteroskedasticity Chi-sq test
	Roots	modulus			
	0.610	0.610			
	-0.207-0.150i	0.256	14.215	10.001	64.458
	-0.207+0.150i	0.256	(0.0763)	(0.866)	(0.897)
	0.252	0.252			

Note: p-values in parentheses.

[Table 5](#) shows the diagnostic results of VAR(1) model. The stability condition is satisfied if and only if all the eigen values will be less than unity, From the table 5 it is clear that all eigen values lie within the unit circle. Hence, the VAR(1) satisfies the stability condition. Jarque-Bera statistic of normality test shows that errors follow a normal distribution at the 10 % level. The

Lagrange Multiplier test shows that there is no serial correlation, the probability of LM statistic 0.866 indicate that the null hypothesis of no serial correlation cannot be rejected. The probability of the Chi-squared statistic of Heteroskedasticity indicates that the residuals are homoskedastic.

We depend on the restriction in the equations (1), (2), (3) and (4) We can estimate the elements of the A matrix, which represent the structural coefficients in SVAR model. The estimation is denominated as $\hat{A}$:

$$\hat{A} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0,2428^* & 1 & 0 & 0 \\ -1,671^* & -10,054^* & 1 & 0 \\ -0,174^* & 0,4821 & -0,018 & 1 \end{bmatrix}$$

An increase in oil prices by 1% leads to an increase in public expenditure by 0.24%, and this corresponds to the case of Algeria, in which public expenditure is closely linked to oil revenues. As for inflation, the value of the coefficient is -1.67, meaning that a 1% increase in oil prices leads to a decrease in inflation by -1.67%, and this contradicts economic theory , as it is assumed that the rise in oil prices will lead to sudden capital flows to the national economy, thus increase government expenditure, which in turn leads to an increase in demand, thus increase the general level of prices. On the other hand, and in front of the rise in oil prices, the value of imports will increase, this will constitute inflationary pressures reflected in the rise in the general level of prices, i.e. the transition of imported inflation, which plays a major role in feeding inflationary pressures in the Algerian economy by flowing inward through prices. The appearance of the inflation parameter with a negative sign may be explained by the state's intervention by subsidizing prices to maintain purchasing power on the one hand, and the monetary policy pursued by the central bank to maintain the stability of the general level of prices on the other hand.

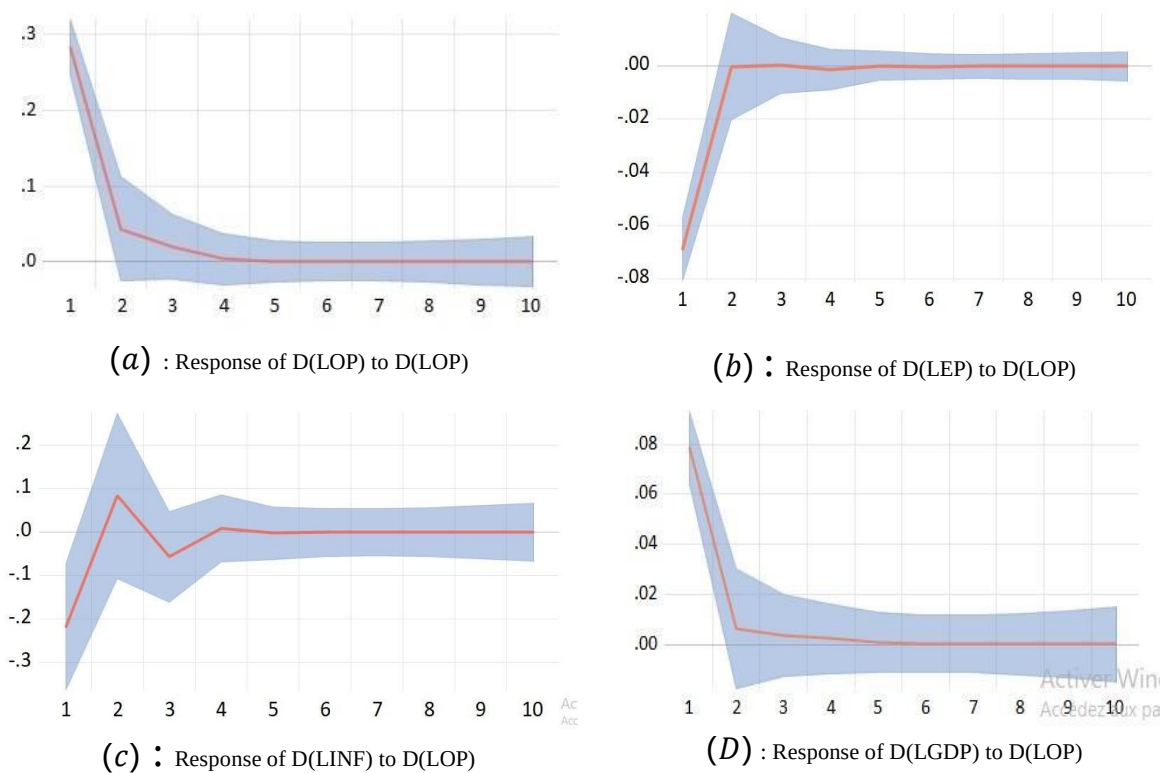
Oil price negatively affect economic growth, as an increase in oil price by 1% leads to a decrease in real economic growth by 0.17%. This can be explained by the continuous decline in the contribution of the oil sector and its poor performance in growth, its recording of negativates since 2006, in contrast to the large expansion of other sectors such as public works, construction and the services sector. This negatively affected economic activity and decreased growth. Despite its contribution to increasing the gross domestic product, this is offset by a decrease in the growth rate on the basis of volume.

Impulse response functions (IRFs) analysis

Analysis of the impulse response functions helps us to understand the dynamic response to the current and future values of each variable depending on the change of one unit in the current value of one structural shock in the oil price variable with the assumption that the other shocks are equal to zero. [Figure 2](#) illustrates the different impulse responses of $lgdp$, lpe , $linf$ to a

positive shock in oil prices over a ten-year horizon, It also shows the type of response - negative or positive - and the period required for these effects. [Runkle \(1987\)](#) stresses the building and report of confidence bands around the impulse responses in the VAR models. To construct these confidence bands 1000 Monte Carlos simulations were employed. Confidence intervals were calculated at 68% level instead of 95%, [Sims and Zha \(1999\)](#) has been proven that a 68% confidence level provides a more accurate estimate of the probability of covering the true impulse response, when compared with a 95% confidence level. Confidence bands are shown in blue in the [Figure 2](#). The red lines within the confidence intervals represent point estimates. The impulse responses are not statistically significant when the zero line in the IRFs falls between confidence bands. [Galadima \(2019\)](#).

Figure1: Impulse responses to the oil shock



The first thing that can be seen from the Figure1 is the immediate response of the macro variables *lgdp* , *lpe*, *linf* to any shock of one standard deviation in oil prices, Also, the impact of these shocks becomes statistically insignificant, starting from the second year, meaning that the impact of the shock is in the short term. This is consistent with the case of Algeria, in which macroeconomic variables are closely linked to oil prices, as the average proportion of hydrocarbons as exports out of total exports amounted to nearly 97%.

[Fig.2 \(a\)](#) shows that the impact of a shock on oil prices by one standard deviation has a significant and positive effect on oil prices in the short term, as it begins to decline starting from the fourth year.

Fig.2 (b) shows that the impact of a shock in the oil price by one standard deviation unit has a significant and negative impact on public expenditure in the short term. However, starting from the second year, this effect becomes statistically insignificant. This is consistent with the case of Algeria, in which the degree of public spending's vulnerability to oil prices is instantaneous and extends over the short term. Fig.2 (c) shows the inflation response to a shock in oil prices, as it becomes clear that the impact of the shock fluctuates between positive and negative during the four years following the initial shock, where the effect is negative until the end of the first year, when the effect becomes positive, then turns negative in the third year and begins to fade starting from the fourth year. This fluctuation in the response of inflation to any shock in oil prices can be explained by the sudden impact of the shock on inflation and the reaction of the state by supporting prices on the one hand and the monetary policy pursued by the Central Bank on the other hand in order to maintain the general level of prices. Fig.2 (d) shows the response of the raw GDP to a shock in oil prices, as it becomes clear that the effect is positive and significant and continues in the short term as this effect begins to disappear from the second year. Analysis of the impulse response functions shows that the impact of a shock in oil prices on the macroeconomic variables is significant only during the first year after the initial shock. There are many studies that concluded that there is no significant effect of oil prices on macroeconomic variables like Darby (1982) and Hooker (1996).

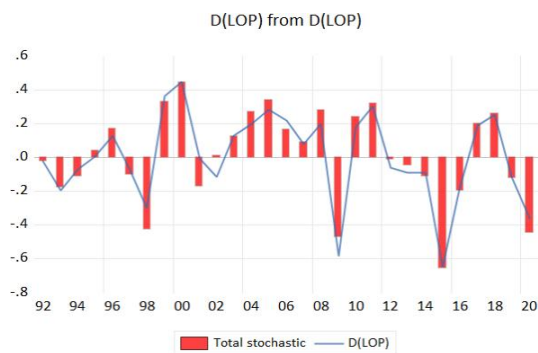
Variance decomposition

The objective of the analysis of the decomposition of the variance of the forecast error is to calculate the contribution of each of the innovations to the variance of the error. In other words, we write the variance of the forecast error at a horizon h according to the variance of the error attributed to each of the two variables, we then calculate the ratio between each of its total variance to obtain its relative weight in percentage Lardic and Mignon (2002). The results relating to the study of the decomposition of the variance are reported in table 6. As presented, about 95,9 % of the variance in oil prices can be explained by the variable itself over a period of ten years that is inductive of their exogenous nature. Although none of the variation in other variables could be explained by themselves in the same degree. As for the variance in public expenditure, it can explain only 30,69% of the same variable over a period of ten years, while the price of oil explains about 68,27% of the change in the variance of public expenditure, and therefore the largest share of the change in public expenditure is explained by the shocks it was exposed to oil prices over the past ten years. 60% of the change in the inflation variance is due to the variable itself, about 32,23% to public spending, and 7,19% to oil prices in the first year. In the second year, public expenditure explains 36,49% of the inflation variance, while oil prices explain 6,80. Starting from the year Third, until the tenth year, the contribution of public expenditure will remain stable at 36,71%, while oil prices will contribute 7,11%, and the remainder will be explained by the same variable. Regarding GDP variance, on average, 59,82% is due to oil prices, 4,89% is due to government expenditure, 1,95% is due to inflation, and 33,31% is due to the same variable.

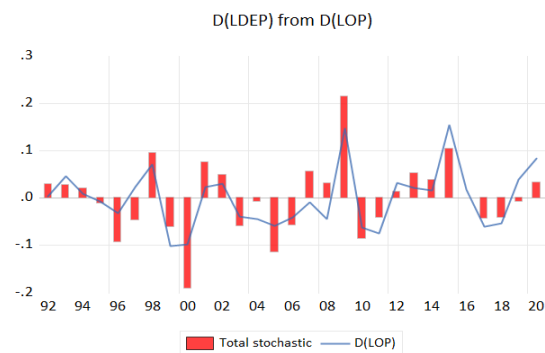
Figure 3 presents a historical analysis of the cumulative random errors. In Figure 3B, it is evident that oil price shocks play a substantial role in inducing fluctuations in the levels of public spending in Algeria. Similarly, these shocks significantly contribute to causing fluctuations in gross domestic product, as depicted. However, in Figure 3D, the impact of oil price shocks on inflation levels is comparatively minimal, as illustrated in Figure 3C.

Table 6 : Variance decomposition

	<i>lop</i> (%)	<i>Lep</i> (%)	<i>linf</i> (%)	<i>lgdp</i> (%)
Variance decomposition of <i>Lop</i>				
1 year	100	0,00	0,00	0,00
2 years	94,62	3,58	1,72	0,06
5 years	94,50	3,60	1,75	0,14
10 years	94,49	3,60	1,75	0,14
Variance decomposition of <i>lep</i>				
1 year	69,14	30,85	0,00	0,00
2 years	68,40	30,52	0,99	0,06
5 years	67,78	30,71	1,41	0,09
10 years	67,78	30,70	1,41	0,09
Variance decomposition of <i>linf</i>				
1 year	7,19	32,23	60,56	0,00
2 years	6,80	36,49	56,68	0,02
5 years	7,11	36,71	56,14	0,02
10 years	7,11	36,71	56,14	0,02
Variance decomposition of <i>lgdp</i>				
1 year	69,08	2,08	1,50	27,31
2 years	59,82	5,01	1,61	33,53
5 years	55,30	6,22	2,34	36,12
10 years	55,10	6,25	2,36	36,28



(A)



(B)

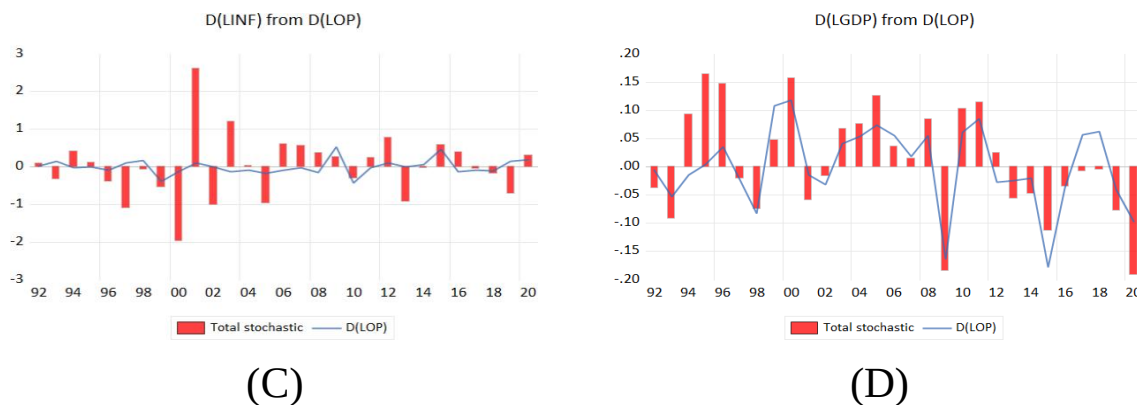


Figure 3 : Historical decomposition of the impact of oil price shocks on study variables

Conclusion

Countries that suffer from excessive dependence on oil exports are witnessing many disturbances in macro variables and economic indicators as a result of shocks that occur at the level of oil prices in scientific markets. This study aimed to elucidate the impact of oil price shocks on macroeconomic variables (gross domestic product, government spending, and inflation) in Algeria, utilizing annual data spanning from 1990 to 2020 and employing the SVAR methodology tailored for this investigation. The SVAR model estimates unveiled that a 1% positive shock in oil prices is associated with a remarkable 0,24% surge in public spending in Algeria. Additionally, such a positive shock leads to a corresponding 1,67 decrease in the inflation rate, elucidated by the state's consistent intervention to bolster purchasing power and the Central Bank's monetary policy. Moreover, a 1 percent positive shock in oil prices results in a substantial 0,17% decline in gross domestic product, attributed to the ongoing decrease in the growth rates of the fuel sector's contribution to GDP since 2006.

Recommendations based on the study's findings:

- Given the significant increase in public spending following positive oil price shocks, policymakers in Algeria should consider implementing strategies to ensure responsible fiscal management and resource allocation to prevent potential budgetary imbalances.
- Acknowledging the impact of oil price shocks on inflation rates, policymakers should collaboratively develop adaptive monetary policies that account for these fluctuations while safeguarding the purchasing power of the population.

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