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Empirical Study of the Impact of Oil Revenues on the Algerian Gross Domestic Product Growth during the Period 1985-2022

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Abstract:
This study aims to determine the impact of oil revenues on GDP growth in Algeria during the period between 1985 and 2022, based on the error correction model (VECM), and the results showed that there is a common integration relationship between GDP. There is also a positive relationship between the two variables in the long term, and there is no relationship between them in the short term, and the results confirmed the delay in responding to the state's camouflage policy, and a set of recommendations were proposed, the most important of which is the need for economic diversification outside the hydrocarbon sector, which is the main determinant of economic activity in Algeria.
Keywords: oil revenues, GDP, economic diversification, economic growth.

Introduction

Oil-exporting countries that rely on revenues from oil and fossil products to finance economic development activities are vulnerable to shocks from their price changes. This vulnerability stems from the dependence of the economic development process on oil revenues. Oil revenues are not considered permanent income because they are not generated by periodic renewable economic activity but are affected by supply and demand factors determined by the conflicting interests between oil-exporting countries and the interests of importing industrial countries to meet their energy needs, in order to build their economic growth base and maintain their industrial and technological superiority. Algeria, like other countries, is vulnerable to these shifts, especially after politics has become a key role in the short-term oil market transformations before the forces of supply and demand rebalance the market.

In Algeria, oil revenues are the main source of foreign exchange reserves and the main source of financing for public expenditures as an oil exporter, which has made real GDP growth contingent on fluctuations in international oil prices. The increase in oil revenues helped improve economic growth and living standards through the adoption of an expansionary development policy to which the state allocated huge financial allocations, but the Algerian economy was affected by the global financial crisis beginning in 2008. The rapid decline in oil prices starting in the second half of 2014 greatly affected the implementation of various

development programs, proving the fragility of the rentier economy and the need to search for alternatives outside the hydrocarbon sector. This search aims to build a diversified economy that depends on several productive sectors to diversify the sources of income of the national economy and get rid of dependence on hydrocarbons.

Oil revenues are an important resource for Algeria that affects economic activity. As observed, increasing oil revenues lead to an increase in GDP growth. Furthermore, increasing state resources allows it to increase its expenditures on productive sectors, which in turn leads to higher GDP growth. This paper examines the extent to which oil revenues could affect Algeria's GDP growth during the period (1985 – 2022).

The concept of Gross domestic product

Gross domestic product (GDP) is defined as the total market value of final goods and services produced within an economy over a given period, usually a year (Baumol, Blinder, & Solow, 2021, p. 21). It is also defined as the sum of the value added in an economy during a certain period, usually a year. Value added is defined as the value of production minus the value of intermediate goods used in its manufacture. This concept suggests that the value of final goods and services can also be considered as the sum of the value added by all enterprises in the economy (Blanchard, MACROECONOMICS, 2017, p. 41). Additionally, GDP is defined as the sum of income in an economy over a given period, usually a year (Blanchard, MACROECONOMICS, 2021, p. 44). According to the definition of GDP, we conclude the following characteristics (O'Sullivan, Sheffrin, & Perez, Macroeconomics: PRINCIPLES, APPLICATIONS, AND TOOLS, 2014, p. 101): If an economy produces two cars at a price of 25,000 dinars per car, and three computers at a price of 2,000 dinars per computer, the total value of these goods will be:

2 (quantity of cars) × 25,000 (price of each car) = 50,000 dinars,

3 (quantity of computers) × 2,000 (price per computer) = 6,000 dinars.

Therefore, GDP = 50,000 + 6,000 = 56,000 dinars. "Final goods and services" refer to those goods and services that are sold to final buyers. If a car manufacturer buys steel used in the manufacture of cars, this steel is not considered a final commodity in GDP calculations; it is an intermediate commodity used in the production process, and intermediate goods are not considered final goods or services. GDP is expressed as the rate of production, i.e., as an amount per year. Even if one consumer sells a house or car to another in that year, only newly produced products are included in GDP.

Methods for calculating GDP

Any good or service produced will be purchased and used by an economic agent, and the users of the final goods and services that make up the GDP in a given year are divided into four categories: households, businesses, government, and the foreign sector. All final goods and services produced in a country in a given year will be purchased and used by one or more of these categories. The amounts spent by buyers on different goods and services must be equal to the market value of those goods and services. Thus, GDP can be calculated in one of the following ways:

Production method: that is, to calculate the gross domestic product (GDP), we collect the market values of all final goods and services produced locally. To measure the production of the entire economy, we need to gather a wide range of goods and services with the aim of summarizing the production of the entire economy in one number, which is the GDP.

GDP = ∑ PF_i = PF_1 + PF_2 + PF_3 +…..+ PF_n …… (01)

PF_1: Final production of Sector 1;

PF_2: Final production of Sector 2;

1 + 2 + 3 + …. + n: Number of finished products in the economy.

The production method is called the value-added method, and the main principle in this method is that GDP is calculated as the sum of the value added of goods and services across all productive units in the economy. This means that we add the value of all goods and services produced in the economy and then subtract the value of all intermediate goods used in the production process to obtain the total value added. If the value of intermediate goods used in production is not subtracted, it is calculated more than once.Accordingly:

GDP =∑Vai = Va1 + Va2 + Va3 +…..+ Van…… (02)

Va_i: Added value of production unit No: *i*;

∑Vai: The sum of the value added of all production units in the economy;

1 + 2 + 3 + ……. + n: Number of production units.

Method of spending

GDP for a given year is calculated by adding up the expenses necessary to purchase the final products produced in that year. This involves calculating the total amount spent by each of the four categories (households, firms, government, external sector) on final goods and services and subtracting expenditure on imported goods and services. This process can be summarized as follows:

Consumer spending: It is the spending of households on goods and services such as food, clothing, and entertainment. Consumer spending is divided into three subcategories (RAGAN, 2019, p. 462):

- **Consumer durables**: They are long-lived consumer goods, such as cars and furniture. New homes are not treated as consumer durables but are part of the investment.
- **Non-durable consumer goods:** They are goods with a shorter lifespan, such as food and clothing;
- **Services**: It is an element of consumer spending and includes any service such as haircuts, use of taxis, legal advice, financial services, etc.

Depreciation expenditure is denoted by the symbol **C**.

Investment spending:

It is the business sector's expenditure on final goods and services not intended for current consumption, and on capital goods. Investment spending is divided into (Frank, Bernanke, Antonovics, & Heffetz, 2019, p. 450):

Fixed Investment for Business:

It is the purchase of production units for new capital goods such as machinery, factories, buildings... Long-lived capital goods are treated as final goods rather than intermediate goods, and the business sector buys capital goods to increase its production capacity. The creation of new capital goods is an investment factor called fixed commercial investment, often shortened to fixed investment;

Residential Investment:

It involves the construction of new houses and residential buildings, which represent capital goods that provide long-term benefits. The construction of new homes and buildings is classified as investment expenditure by the business sector, rather than consumption expenditure, as these properties are subsequently sold to families. However, when a person purchases a house from another individual, ownership of an existing asset is transferred, and this transaction does not contribute to gross income. Conversely, when a new house is built, it is recorded as residential investment in the national accounts;

Inventory Investment: It is the addition of unsold goods to the company's inventory, and the goods produced by the production unit but not sold during the current period are treated as if the company had purchased those goods from itself. Investing in inventory can be positive or negative, depending on whether the value of inventory rises or falls throughout the year.

Total and Net Investment:

The total investment is divided into two parts: alternative investment and net investment. Alternative investment is the amount required to replace the part of capital that loses its value, a loss referred to as depreciation. Net investment is equal to total investment minus depreciation. When net investment is positive, the capital stock grows; when it is negative, the stock of economic capital shrinks.

Purchases of financial assets, such as stocks or bonds, are often called investments. When someone buys shares of a company, they acquire partial ownership of the existing physical and financial assets the company controls. However, buying shares usually does not lead to the creation of new physical capital and is therefore not considered an investment calculated in GDP.

The production of new investment goods contributes to a country's GDP and leads to income, whether the goods are part of net investment or just alternative investment. The total investment expenditure is denoted by the symbol **I**.

Government Expenditures

When governments provide goods and services such as street cleaning and firefighting, they contribute to GDP. This includes paying public servants to design and implement social programs or soldiers to defend the homeland. All government expenditures on goods and services are included in GDP. However, government transformation expenditures and payments to individuals unrelated to the production of goods and services, such as social security and welfare payments and interest on government debt, are not included in GDP calculations. Total government expenditure is denoted by G.

Government output is typically valued at cost rather than market value. This means that while it's challenging to determine the market value of services like courts, police protection, or

economic analysis conducted by economists in the Ministry of Finance, their value can be calculated based on the cost of production.

However, using cost-based valuation for government activities has its challenges. For instance, if an employee becomes more productive and moves to the private sector, the government's contribution to GDP decreases (while the private sector's contribution rises). Conversely, if two workers now perform the job that one worker used to do, the government's contribution to GDP increases. These changes can occur even if the actual production of the country remains unchanged.

Government spending on currently produced goods and services is only calculated as part of GDP. Thus, many government expenditures, such as pensions to retired persons, labor insurance, welfare payments, and interest on public debt, are not considered part of GDP because they are not exchanged for currently produced goods and services. However, recipients of transfer payments often spend their money on consumer goods, which then contribute to GDP as any other consumption expenditure (GWARTNEY, STROUP, SOBEL, & MACPHERSON, 2022, p. 134).

Net exports:

The fourth category of total expenditure originates from foreign trade, as imports represent domestic spending on goods and services produced abroad, while exports represent foreign spending on domestically produced goods and services.

Exports: If local enterprises sell goods to households in a foreign country, these goods are included in foreign consumer spending but constitute expenditure on domestic production. Therefore, all locally produced goods and services sold to foreigners must be considered part of the gross domestic product (GDP). They generate income for the residents who produce them and are not purchased by local residents, so they are not considered part of consumer spending (C), investment spending (I), or government spending (G). To determine the actual value of the output, GDP must add the value of exports of goods and services. Total exports are denoted by **x**.

Imports: If a person buys a car made in a foreign country, only a small part of this value will represent spending on domestic production, which represents payment for the services of local merchants and transportation, and the rest is spending on foreign products. If another person vacations in a foreign country, a large part of their spending will be on goods and services produced abroad, thus contributing to foreign output rather than GDP. Similarly, when a local company spends on an investment in a machine that is partially manufactured using imported raw materials, only part of the expenditure is on domestic production; the rest is spending on foreign production. The same principle applies to government spending, such as road construction or dam construction. Part of government spending is allocated to imported materials, and part is allocated to locally produced goods and services. The same applies to exports, most of which use imported intermediate goods. Consumption (C), investment (I), government spending (G), and exports (X) all contain a portion of imports. To determine the total spending on domestic products, we need to subtract total expenditure on imports from total domestic expenditure. The value of actual imports is denoted by M. Net exports are

defined as total exports minus total imports, also called the trade balance, which is symbolized by the symbol NX. When the value of exports exceeds the value of imports, net exports are positive, indicating a surplus in the trade balance. Conversely, when the value of imports exceeds the value of exports, net exports are negative, indicating a deficit in the trade balance. GDP can be represented by a simple equation that combines its four components as follows:

GDP = C + I + G + (X – M) ……. (03)

Income method

GDP can be viewed as a measure of total production or total spending, and there is a third way to calculate GDP, which is the income method. When a good or service is produced and sold, the proceeds of the sale are distributed to workers and venture capitalists involved in the production of the good or service. Thus, GDP is also equal to labor income in addition to capital income.

Labor income includes wages, salaries, and the income of the self-employed. Capital income consists of payments to owners of physical capital (e.g., plants, machinery, office buildings) and intangible capital (e.g., copyrights, patents). The components of capital income include items such as profits earned by business owners, rents paid to owners of land or buildings, interest received by bondholders, and royalties received by copyright or patent holders.

In this method, all the income received by the economic agents contributing to the production process is collected, and includes income from profits made by companies, employee compensation (wages, salaries, benefits), owner's income (self-employed company owners), rental income, corporate profits, net interest, and indirect business taxes, in addition to depreciation (depreciation of fixed capital). Depreciation represents the value of productive capital (machinery and equipment) that is destroyed during the production period. Depreciation is excluded when calculating profits, so it should be added when calculating GDP (WILLIAMSON, 2018, p. 42).

GDP can be represented by a simple equation that combines its four components as follows:

GDP = Wa + Sa + Be + BP + De……(04)

Wa: wages;

Sa: salaries;

Be: Benefits;

BP: Business profits;

De: depreciation.

GDP growth rate:

GDP is an important indicator that shows the state of economic activity of a country, as a country with a weak GDP compared to another country is economically weaker. In evaluating the performance of a country's economy from year to year, the GDP growth rate index is relied upon, and the GDP growth rate is calculated as follows (Johnson & Blanchard, 2015, p. 24):

$$G = \frac{GDP_2 - GDP_1}{GDP_1} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (05)$$

View study variables and test the stability of chains:

In this section, we will attempt to measure the dynamic impact of oil revenues on GDP growth in Algeria during the period (1985-2022) using economic measurement tools that have become widely used to study the relationships between various economic variables. This is important due to the significant contribution of these results to the formulation of economic policies and the adoption of optimal decisions, which have often proven effective in practice.

View study variables and sources

We will describe the most important variables included in the study and then determine the degree of stability of each representative time series of the study variables. The description of the model under study was based on a set of previous studies that dealt with the impact of oil revenues on the productive sectors, either wholly or partially. After reviewing the applied literature on the subject of the study, we attempted to adopt a model that suits the specifics of the Algerian economy.

Study variables

Dependent variable: It is considered one of the most important indicators of internal balance. We have chosen to rely on the annual values of GDP, symbolized by the symbol Y, with data obtained from sources approved by the Bank of Algeria.

The independent variable: It is represented in oil revenues, and it is considered one of the most important factors affecting economic activity in Algeria. Based on its prices, strategic plans for economic development and annual budget fees in Algeria are determined. This is due to the strategic role of fossil products in energy and industries in developed countries, as well as the universal need for fuel and its uses in providing energy. The volatility of oil prices directly affects the economic activity of any country. Algeria's economic expansion is linked to the performance of the hydrocarbon sector, which is the main determinant of growth in economic activity due to its significant weight in GDP. Oil revenues also affect all productive sectors because of their direct impact on state revenues and the financial allocations allocated to each sector. It will be denoted by the symbol x, and the data was obtained from the accreditation of the Bank of Algeria.

Sources of variables:

The sources of data for the study variables were obtained from the official reports of the Bank of Algeria, covering the period from 1985 to 2022.

Submission of forms

After identifying and defining the variables, and determining the dependent and independent variables that express the phenomenon of this study, the natural logarithm will be introduced to the study variables. This is done in order to interpret the estimation parameters based on elasticities, and to eliminate the problem of instability of residual variance.

To study the relationship between oil revenues and GDP growth in Algeria during the period (1985-2020), we relied on previous studies and arrived at the following model:

$$\mathbf{LY_1 = \alpha_0 + \alpha_1 LX + } \varepsilon_t \text{ ……(05)}$$

Whereas:

LY_1: The logarithm represents Algeria's GDP over the t period, which is the dependent variable in the model.

LX: The logarithm represents Algeria's oil revenues during the period t and serves as the independent variable in the model.

ε_t : represents random error;

α_0 : represents the constant term;

α_1: Represents the response coefficient of the dependent variable of the independent variable.

Statistical characteristics of the studied variables and chain stability:

In this requirement, we focus on the most important statistical properties of the studied variables and the stability of the series through the tests developed by Dickey-Fuller and Phillips-Perron.

Statistical characteristics of the study variables:

The following table displays the statistical characteristics of the variables in this study.

Table 01: Statistical characteristics of study variables

Statistical variable	Y	X	Statistical variable	Y	X
Mean	880.892	1762.232	Kurtosis	2.109811	2.24895
Median	5698.950	1460.350	Jarque-Bera	3.626657	2.938745
Maximum	27688.80	5657.700	Probability	0.136110	0.290070
Minimum	291.6000	20.50000	Sum	329873.9	66964.80
Std. Dev.	2.109811	2.248925	Sum Sq. Dev.	2.300000	91655028
Skewness	0.611981	0.568317			
Observations	38	38	Observations	38	38

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

It is evident from the table above that the arithmetic mean of all variables differs from their median, indicating asymmetry in their distribution. This is further supported by their skewness coefficients, which are not equal to zero. Since these coefficients are positive, the distribution curves are skewed to the right. Additionally, the kurtosis coefficients for all study variables are less than three, suggesting that their curves are flatter than the normal distribution.

Regarding the critical probabilities of the Jarque-Bera statistics, they all exceed the 5% significance level. This implies that these variables do not follow a normal distribution.

Time Series Stability Test:

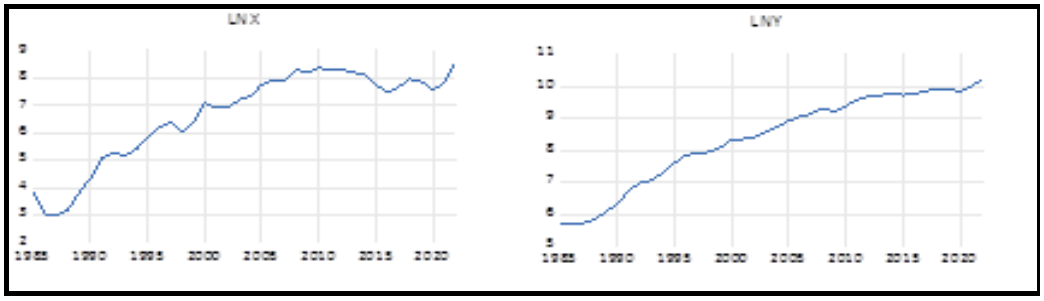
The stability of a time series is a prerequisite for applying the VAR methodology, where the time series must be stable at the level or at the first difference or a combination of both. To test this, we perform the Phillips-Perron test, which is based on the following two hypotheses:

Null hypothesis: instability of time series, i.e. the presence of a unit root;

Alternative hypothesis: the stability of time series, i.e. the absence of the unit root.

Before testing the stability of the series under study, we will highlight the graphical curves of the study variables as follows:

Figure nº 01: Graphical representation of the variables of the study



Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

The significance level of 10% is the maximum threshold for rejecting the null hypothesis and accepting the alternative hypothesis. The results of this test are shown in the following table:

Table 02: Results of Philippe Perron test for time series stability

UNIT ROOT TEST TABLE (PP)

			LNY	LNX
At Level				
With Cons...	t-Statistic		-2.5525	-1.2117
	Prob.		***0.1119***	***0.6591***
			n0	n0
With Cons...	t-Statistic		-0.7214	-1.3346
	Prob.		***0.9638***	***0.8632***
			n0	n0
Without C...	t-Statistic		4.0862	1.9262
	Prob.		***1.0000***	***0.9854***
			n0	n0
At First Difference				
			d(LNY˜)	d(LNX)
With Cons...	t-Statistic		-3.9355	-4.7666
	Prob.		***0.0045***	***0.0005***
			***	***
With Cons...	t-Statistic		-5.9466	-5.4890
	Prob.		***0.0001***	***0.0004***
			***	***
Without C...	t-Statistic		-1.9233	-4.0636
	Prob.		***0.0530***	***0.0002***
			*	***

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

We note from Table (01), which presents the results of this test, that all the variables in the study are unstable time series at level I(0), as evidenced by the p-value greater than 10% in all cases (constant presence, constant presence and general trend, absence of constant and general trend). To stabilize the variables, we took the first difference I(1) for all variables, as indicated by the p-value less than 10% in all cases (constant presence, constant presence and general trend, absence of constant and general trend). Therefore, we reject the null hypothesis and accept the alternative hypothesis, i.e., there is no unit root; since all series are stable at class I(1), this indicates the possibility of cointegration between variables in the long term.

Cointegration and causality test between study variables

After studying the stability of the chains under study, it was found that the chains were unstable at the level among the variables to be studied, but became stable after first

differences were applied. In this case, we proceed to the cointegration test using the Vector Error Correction Model (VECM) to estimate the long-term equilibrium relationship. This test enables the examination of cointegration existence regardless of the integration degree of the time series of the study variables, as long as it does not exceed the first degree.

Determine the degrees of delay in the form

The lowest value for time deceleration periods in the autoregressive model was selected using the delay degree determination criteria, where the minimum values of both AIC and Schwarz SC criteria were adopted, which are suitable for time deceleration examples. These two criteria have been applied, and the results revealed, as shown in the table below, that the lowest value of the AIC standard occurs when the time decelerations are equal to 1. Similarly, for Schwarz SC, the time decelerations are also equal to 1. Therefore, the degree of time delay is equal to 1, and accordingly, this period will be relied upon in the model.

Table 03: Determination of the number of degrees of delay in the VAR model

VAR Lag Order Selection Criteria
Endogenous variables: LNY6 LNX
Exogenous variables: C
Date: 03/25/24 Time: 23:45
Sample: 1985 2022
Included observations: 35

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-74.12663	NA	0.265636	4.350093	4.438970	4.380773
1	48.24144	223.7587*	0.000307*	-2.413796*	-2.147165*	-2.321755*
2	50.14892	3.269979	0.000347	-2.294224	-1.849839	-2.140823
3	54.01226	6.181341	0.000352	-2.286415	-1.664276	-2.071653

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

Granger's causality test of the relationship between oil revenues and GDP growth

We conducted the Granger causality test to measure the degree to which variables affect each other. The results of this test are presented in the following table:

Table 04: Granger's causality between oil revenues and GDP growth

Pairwise Granger Causality Tests
Date: 04/11/24 Time: 20:28
Sample: 1985 2022
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
DLNY6 does not Granger Cause DLNX	36	0.19499	0.6617
DLNX does not Granger Cause DLNY6		3.1E-05	0.9956

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

From the previous table, we notice that the p-value of the F-statistic is less than 0.1 in both the first and second cases. Therefore, we reject the null hypothesis in both cases, indicating that

there is no effect in either direction between hydrocarbon revenues and GDP growth. Consequently, we conclude that oil revenues do not cause a change in GDP growth in the short term, and vice versa.

Johansen test to determine integration relationships

Johansen's method of determining cointegration relationships is one of the most modern, as it relies on estimating the self-regression ray using maximum likelihood. This method assumes the presence of P economic variables in a single ray for a self-regression of degree (K). The application of this method is based on two hypotheses, as shown in the table below.

Table 05: Johansen test to determine cointegration relationships

Date: 03/25/24 Time: 23:46
Sample (adjusted): 1987 2022
Included observations: 36 after adjustments
Trend assumption: Linear deterministic trend
Series: LNY6 LNX
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.191544	13.53956	15.49471	0.0965
At most 1 *	0.150808	5.884907	3.841466	0.0153

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

It can be seen from the table above that the calculated value of the impact test, estimated at 13.53956, is lower than the tabulated value of 15.49471 at a significance level of 5% for the first hypothesis (None). It is noted that the calculated value of the impact test, estimated at 5.884907, is greater than the tabulated value of 3.841466 at a significance level of 5% for the second hypothesis (Atmost1), indicating the existence of a common complementarity between oil revenues and GDP growth according to the impact test. This leads us to accept the alternative hypothesis, suggesting a long-term equilibrium relationship, which allows us to utilize the VECM model to estimate this long-term equilibrium relationship.

Estimation of the short- and long-term error correction model:

Since the study variables exhibit stationarity at the first difference, the Johansen Cointegration Test indicates the presence of at least one relationship. Therefore, the criteria for applying the error correction model are met for estimating the relationship between GDP growth and oil revenues in Algeria, as presented in Table 06.

Long-term relationship analysis:

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The table above demonstrates a long-run correlation between GDP and oil revenues, showing a direct relationship. Specifically, higher oil revenues correspond to an increase in GDP growth by 0.052 units, which is economically significant. Oil revenues play a crucial role in Algeria, impacting GDP directly from the income perspective. Moreover, the rise in oil revenues results in an increase in the state's resources allocated to productive sectors, thereby boosting gross product, whether viewed from the spending or production side.

Table 06: Results of estimating the equation of the random error correction model VECM

Vector Error Correction Estimates
Date: 03/25/24 Time: 23:50
Sample (adjusted): 1987 2022
Included observations: 36 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LNY6(-1)	1.000000
LNX(-1)	-0.925409 (0.08997) [-10.2861]
C	-2.220636

Error Correction:	D(LNY6)	D(LNX)
CointEq1	0.052362 (0.04759) [1.10039]	0.294546 (0.12587) [2.34004]
D(LNY6(-1))	0.371848 (0.27028) [1.37580]	0.374255 (0.71494) [0.52348]
D(LNX(-1))	0.020534 (0.09512) [0.21587]	0.275145 (0.25162) [1.09349]
C	0.079022 (0.03077) [2.56798]	0.079196 (0.08140) [0.97294]
R-squared	0.665933	0.213882
Adj. R-squared	0.687740	0.140184
Sum sq. resids	0.367793	2.573467
S.E. equation	0.107208	0.283586
F-statistic	2.122087	2.902122
Log likelihood	31.42580	-3.593017
Akaike AIC	-1.523656	0.421834
Schwarz SC	-1.347709	0.597781
Mean dependent	0.126011	0.154927
S.D. dependent	0.112245	0.305831

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

The table above indicates that the error correction coefficient (CointEq1) is positive and significant at a 5% significance level, suggesting that short-term errors (0.052362) are automatically corrected over time to reach long-term equilibrium. Specifically, it requires approximately 19 years, one month, and five days (1/0.052362 = 19.09), which is a considerably long period for reaching their equilibrium value in the long term.

Short-term relationship analysis

From the table above, it is clear that there is no relationship between oil revenues and GDP in the short term. This lack of relationship can be attributed to the State's slow response, which is due to delays in issuing legislative and regulatory texts that allocate funds to the productive sector (such as finance laws and regulatory texts), as well as administrative procedures that delay the disbursement of financial allocations to the productive sectors. Additionally, the calculation of GDP by specialized bodies also takes time.

Initially, it is clear that the model as a whole is statistically acceptable. This is indicated by Fisher's test and the percentage of the corrected coefficient of determination, which is 66.59%. This percentage indicates that the explanatory variable (oil revenues) accounts for 66.59% of the variation in the dependent variable (GDP) as a result of changes in oil revenues. The remaining variation is attributed to other variables (random) that are not included in the model. This percentage serves as an indication of the model's validity.

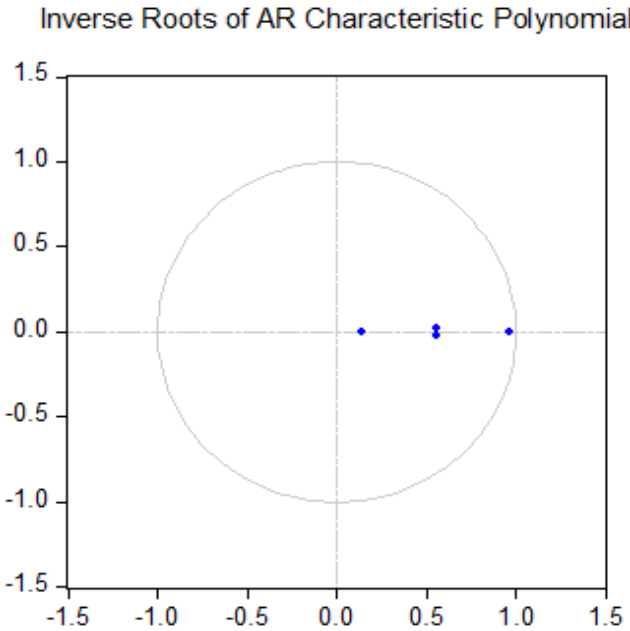
Testing the validity of models in the study

After conducting Granger's causality test between the study variables, including stable variables, and estimating the models for each of the study variables using the VECM methodology, we proceeded to test the validity of the model through a series of tests.

Model stability test:

From the figure shown below, we can ascertain the stability of the model:

Figure nº 02: Stability test of the model



Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

The model satisfies the condition of stability, as all its roots are located within a single circle, which can be seen in the diagram shown above.

Normal distribution of residues:

The distribution of residues is assessed by testing the hypothesis that "residues follow a normal distribution." This is achieved by extrapolating and examining the statement, observing the accumulation of residues around the center and their decrease as they deviate

from the center towards the periphery. It is also important to verify that residues do not cluster around the center. Furthermore, a statistical comparison can be conducted using the Bera-Jarque test and the tabular value of the chi-squared test with two degrees of freedom and a significance level of 0.05.

Table 06: Bera-Jarque test for normal distribution of residues

Component	Skewness	Chi-sq	df	Prob.*
1	-0.032401	0.006299	1	0.9367
2	0.114484	0.078640	1	0.7791
Joint		0.084939	2	0.9584

Component	Kurtosis	Chi-sq	df	Prob.
1	2.564062	0.285063	1	0.5934
2	2.513472	0.355064	1	0.5513
Joint		0.640127	2	0.7261

Component	Jarque-Bera	df	Prob.
1	0.291362	2	0.8644
2	0.433704	2	0.8050
Joint	0.725066	4	0.9482

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

From it, according to the results, we found that the test result is insignificant because (α > 0.05). Thus, the residuals are subject to a normal distribution, and by a value of J - B = 0.72 less than $\chi 2$ = 5.99, which also confirms that the remainders of the model are subject to a normal distribution.

The Autocorrelation Problem

The autocorrelation test (LM test) ensures that there is no autocorrelation in errors, as shown in the following figure:

Table 07: Results of self-test for errors

VAR Residual Serial Correlation LM Tests
Date: 03/25/24 Time: 23:49
Sample: 1985 2022
Included observations: 36

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	8.044384	4	0.0900	2.122033	(4, 56.0)	0.0901

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

From the results shown above, we can see that the p-value is greater than 0.05. Therefore, we accept the null hypothesis that there is no autocorrelation between errors.

Error Variance Stability Test:

To test the consistency of error variance, we use the White test, as shown in the following table:

Table 07: White results for constant error variance

VAR Residual Heteroskedasticity Tests (Includes Cross Terms)
Date: 03/25/24 Time: 23:49
Sample: 1985 2022
Included observations: 36

Joint test:

Chi-sq	df	Prob.
38.37738	42	0.6308

Source: Prepared by researchers based on the outputs of the statistical program Eviews 10.

According to the results above, we find that the probability of "sq-Chi" is greater than 0.05. Thus, we accept the null hypothesis that the variation of errors is constant.

Conclusion

Oil revenues impact internal and external macroeconomic balances. Their increase boosts GDP and improves the trade balance, while their decrease hampers economic growth and leads to deficits in both the state budget and trade balance. Oil prices, unlike regular commodities, are determined by a variety of factors including economic, geopolitical, climatic, monetary, and scarcity factors, controlled by nature, producing countries, consuming countries, and major international companies.

An econometric study on oil revenues' impact on Algeria's GDP from 1985 to 2022 revealed several findings:

There is a relationship of integration between the variables of the study, and by estimating the error correction model; we found that there is a relationship between oil revenues and GDP.

In the long run, GDP is directly related to oil revenues, and the higher the oil revenues, the GDP growth will increase, as oil revenues are considered important revenues for Algeria if we look at GDP from the income side and affect it directly. On the other hand, increasing oil revenues leads to an increase in the resources of the state that allocates it to the productive sectors, thus increasing the total output (whether viewed from the spending side or from the production side).

There is no relationship between oil revenues and GDP in the short term, and this is explained by the lack of rapid response of the state as a result of the delay in issuing legislative and regulatory texts through which the state allocates appropriations to the productive sector (finance laws, regulatory texts), in addition to administrative procedures that delay the arrival

of financial appropriations to the productive sectors, and the calculation of GDP by the allocated bodies requires time.

The rise in prices generates a surplus of oil revenues, which is used to form the GDP of countries, but it is not considered a productive resource, but rather the result of the sale of a depleted natural commodity.

Resources in rentier states may turn into a curse that threatens economic development, especially in countries whose export structure depends on a single commodity, oil.

Oil resources determine how development programmes proceed, meaning that the development of the Algerian economy depends on fluctuations in oil prices.

Therefore, we must note the need for a policy of economic diversification, increasing support for productive sectors such as agriculture, industry, services, construction and public works, and reducing the dependence of the Algerian economy on the hydrocarbon sector.

Eliminating the problem of delayed response of factors of production to the planned development plans, as a result of the delay in the issuance of legislative and regulatory texts, and administrative problems, through the digitization of public administration, the strengthening of the information system, in addition to relying on a long-term economic development strategy.

The way oil countries spend their revenues must be well-studied, specific, and announced transparently. Because, transparency in government spending can be useful. Most resource-related transparency initiatives focus on how revenues arecollected, not how they are spent.

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Appendices:

Years	GDP	Oil revenues	Years	GDP	Oil revenues
1985	291.6	46.7	2004	6150.4	1570.7
1986	296.6	21.4	2005	7564.6	2352.7
1987	312.7	20.5	2006	8514.8	2799
1988	347.7	24.1	2007	9408.3	2796.8
1989	442	45.5	2008	11043.7	4088.6
1990	554.4	76.2	2009	9968	3676
1991	862.1	161.5	2010	11991.6	4392.4
1992	1074.7	193.8	2011	14588.5	3979.7
1993	1189.7	179.2	2012	16209.6	4184.3
1994	1487.4	222.1	2013	16647.9	3678.1
1995	2005	336.1	2014	17228.6	3388.4
1996	2570.4	495.9	2015	16712.7	2353.7
1997	2780.2	592.5	2016	17406.8	1781.1
1998	2830.5	425.9	2017	18876.2	2177.0
1999	3238.2	588.3	2018	20452.3	2887.1
2000	4123.5	1213.2	2019	20501.1	2668.5
2001	4260.8	1001.4	2020	18383.8	1921.6
2002	4541.9	1007.9	2021	22079.3	2609.2
2003	5247.5	1350	2022	27688.8	5657.7

Source: Prepared by researchers based on:

Bank of Algeria, Annual Report on Economic and Monetary Development for 2021, December 2022, pp. 101-112.

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