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Hydrocarbon Revenues and Their Impact on Economic Diversification in Algeria: An Econometric Study Using the NARDL Model for the Period 1970-2024.

Dr. Alili Abd El Hakim [1]

Email:Hakimilila1@gmail.com

University Ali Lounici Blida 2 (Algeria)

Dr. Kerkeb Aissa [2]

Email: aissaker47@gmail.com

Université Kasdi Merbah Ouargla (Algeria)

Dr. Bentaiba-Mahdia[3]

Email: bentaiba.mahdia@gmail.com

University Ali Lounici Blida 2 (Algeria)

Abstract

This research paper aims to investigate the impact of hydrocarbon revenues on economic diversification in Algeria. It seeks to determine the extent of Algeria's success in utilizing these revenues to build a diversified and sustainable economy based on various productive sectors. The study employs quantitative methods, specifically the Non-linear Autoregressive Distributed Lag (NARDL) model, covering the period from 1970 to 2024.

The results indicate that the Algerian economy suffers from symptoms of the "Dutch Disease" and the "Resource Curse," as rising hydrocarbon revenues negatively affect economic diversification in the long run. This reflects a decline in the competitiveness of productive sectors during periods of financial abundance. Finally, the study proposes a set of recommendations to achieve economic diversification, such as investing in human capital, improving the business climate, and reinvesting oil revenues into productive sectors.

Keywords: Hydrocarbon Revenues, Economic Diversification, NARDL Model.

JEL Classification: C52, O41, Q41.

1. Introduction:

The fact that many countries possess abundant natural resources has led them to rely on these materials as a primary source for achieving their goals and growing their economies. This has made the economies of these countries dependent on these revenues, especially given the depletion of these resources and the fluctuations that occur in their markets (the resource curse).[1]Hydrocarbons are among the most prominent of these resources, which many countries rely on to generate their revenues. This has made the stability of these countries' economies dependent on the fluctuations that occur in their markets (the Dutch disease).This [2] is the case if these countries fail to find alternatives by transitioning their economies from those based on limited and depletable resources to diversified economies based on the

participation of various productive sectors. Therefore, economic diversification has become an imperative policy pursued by these countries, utilizing hydrocarbon revenues to develop other sectors, expand the productive base, and achieve a stable and sustainable economy, protected from external shocks in global markets. Algeria is among these countries that rely on hydrocarbons to finance their revenues. It has made numerous attempts to diversify its economy by seeking to utilize these resources during periods of economic boom to build a diversified economy based on all economic sectors and protected from the shocks resulting from fluctuations in global hydrocarbon prices.

1.1. The Problem Statement: Studying Algeria's exploitation of hydrocarbon resources to develop non-oil sectors and build a diversified economy, protected from shocks in global energy markets, requires a thorough understanding of the study's aspects and the development of a measurement model that reflects the reality of this phenomenon. This model measures economic diversification (the productive sectors that can be relied upon) and demonstrates the extent to which economic growth is affected by shocks in hydrocarbon revenues.

Based on the aforementioned premise, the research problem can be formulated in the following question:

Has Algeria been able to utilize hydrocarbon revenues to develop economic sectors and build a diversified economy protected from oil shocks?

1.2 Sub-Questions: To answer the main problem, we have posed the following sub-questions:

- Does the Algerian economy suffer from symptoms of the Dutch Disease?

- Is there a symmetrical effect of positive and negative hydrocarbon revenue shocks on GDP growth outside the hydrocarbon sector? - What are the most important sectors that can be relied upon for the success of the economic diversification policy in Algeria, and what are the most important reforms that must be undertaken?

1.3 Hypotheses: The main hypotheses we formulated to address this research are:

- Algeria has benefited from hydrocarbon revenues to develop productive sectors;

- Algeria possesses many assets that enable it to build a diversified economy based on multiple pillars, allowing it to eliminate its dependence on the hydrocarbon sector.

1.4Study Objectives: This study is based on achieving a number of objectives, which can be summarized as follows:

- Presenting the most successful models for achieving economic diversification based on limited resources.

- Formulating a standard model to study the impact of hydrocarbon revenues on economic diversification in Algeria.

- Proposing a strategy that includes the available alternatives for diversifying the economy outside of hydrocarbons in Algeria.

1.5 The importance of the study: The study's significance lies in exploring available alternatives for the national economy outside the hydrocarbon sector. These alternatives can contribute to building a stable, diversified, and sustainable economy based on the participation of all economic sectors (agriculture, industry, and services), leveraging Algeria's existing potential.

1.6 Research Methodology: To address the research question and test the validity of the proposed hypotheses, quantitative methods will be employed through an analytical econometric study of the impact of hydrocarbon revenues on economic growth outside the hydrocarbon sector.

1.7 Motivations and Reasons for Choosing the Topic: Our reasons for choosing this topic are numerous, but the most prominent include:

- This topic is one of the most frequently discussed and debated among economic researchers in Algeria.

- The desire to contribute to finding solutions that promote the economy outside the hydrocarbon sector.

- The scarcity of university theses and research papers that have addressed this topic using standard methods and tools, allowing for accurate results.

2. Previous Studies:

2.1 A study entitled “The Impact of Economic Diversification on Economic Growth in Non-Oil Sectors – A Standard Study on a Sample of Some Arab Oil-Producing Countries”, by “Ben Haddou Amna”, concluded that there is a long-term cointegration relationship between non-oil economic growth and the determinants of economic diversification outside the hydrocarbon sector. The results also showed a direct relationship between the growth rate of non-oil GDP and foreign direct investment, fixed capital, non-oil exports, and trade openness, and an inverse relationship with both non-oil revenues and the political stability index.[3]

2.2. A study entitled "Sustainable Development and Economic Diversification in Arab Oil-Producing Countries," by Bahi Moussa, aimed to evaluate efforts toward economic diversification in Arab oil-producing and exporting countries and how diversification can contribute to driving sustainable development and the transition from hydrocarbon-based economies to knowledge-based economies. The study concluded that despite persistent attempts using various methods to address the problem of excessive dependence on oil, the results were largely insufficient due to several factors, most notably the inadequacy and ineffectiveness of macroeconomic policies, the non-economic role of states in controlling the distribution of oil wealth, and the limited role of the private sector. [4]

2.3 A study entitled "The Strategy for Diversifying the Algerian Economy in Light of Contemporary Economic Changes," by Ben Mouffok Zerrouk, concluded that the economic diversification strategy in Algeria is linked to all the conditions surrounding development, the size of available investment resources, the state of key sectors, and their focus on leading activities and industries. Furthermore, the shortcomings of alternative economic sectors to oil

in Algeria are not primarily due to a scarcity of resources or capabilities in general, but rather to the inefficient use of available resources resulting from inadequate policies aimed at developing these sectors[5] .

2.4 A study by Farah Elias El-hannani entitled “Oil Volatility, Economic Growth and Diversification – Alternative Explanation of The Oil Curse In Algeria” aimed to demonstrate the impact of oil price volatility on economic diversification in Algeria. The study used portfolio theory and the two-stage least squares method to analyze the reality of economic diversification and its relationship with oil volatility and economic and institutional variables. The study concluded that there is a positive relationship between oil price volatility and economic diversification in Algeria. In contrast, no role was found for other variables due to the weak foundation prepared for this diversification. The most important recommendation presented by the researcher is to focus on long-term development plans rather than circumstantial changes.[6]

2.5 A study by Farah Elias El-hannani, entitled "Economic Growth and Diversification – Alternative Explanation of the Oil Curse in Algeria," addressed economic diversification in Gabon, given that its economy is based on oil revenues, which represent more than 80% of exports and nearly 60% of budget revenues. This makes the Gabonese economy vulnerable to external economic shocks.

In light of this, the researcher discussed the importance of economic diversification as a strategy for developing the Gabonese economy to overcome its dependence on oil revenues. The study included an econometric analysis of eight variables: development, public investment, foreign direct investment, inflation and exchange rate, public financial management, trade openness, and entrepreneurship, using the Herfindahl-Hirschman Indices. The ordinary least squares method was also employed. The study concluded that the country's economic diversification was affected by trade openness, exchange rate, and inflation.[7]

2.6 A study entitled: “The Impact of Economic Diversification on Growth in the Saudi Non-Oil Sector”, by Mamdouh Awad Al-Khatib, concluded that economic diversification has a positive impact on growth in the non-oil sector. Although the Saudi economy has been able to raise the degree of economic diversification and achieve growth in the non-oil sector, some statistical indicators still reflect the continued dependence of the Saudi economy on oil, including the high percentage of government revenues from the oil sector, and the high percentage of oil exports out of total merchandise exports. This requires more efforts to achieve diversification in government revenues and merchandise exports, in addition to diversification in production structures.[8]

3. Econometric Study:

Based on economic theories and previous studies, this section of the study will measure the impact of oil revenues on economic diversification (economic growth outside the hydrocarbon sector) by constructing an econometric model. The stages of developing the econometric model were as follows:

3.1 Model Formulation:

To understand the nature of the relationship between oil revenues and their impact on the diversification of the Algerian economy, data covering the period 1970-2024 was used. This data was sourced from the World Bank database and the OPEC website. The dependent variable was GDP outside the hydrocarbon sector, while the independent variables were hydrocarbon revenues and the contributions of the economic sectors, divided into three categories: agriculture, industry, and services. As for the adopted method, there are many studies that have addressed the topic of diversification and its impact on economic growth. Each study relied on a specific model or method. In our study, we adopted an expanded model that includes the aforementioned variables. Due to their significant variability, a logarithm was applied to the study variables. The model equation is as follows:

3.2 Studying the Stationability of Time Series: Studying and testing the stationability of time series is among the most important conditions for constructing econometric models. Applying the unit root to ensure the stationarity of time series and determining their integral is crucial for obtaining a sound model free from econometric problems.Fuller -The extended Dickey[9] test is among the most important tests for studying the stationarity of time series. The following table shows the results of the unit root test for all study variables using this test. [10]

Table (01): Results of the unit root test using (ADF)

1st diff			Level			
None	C	T and C	None	C	T and C	
-4.3893*	-6.1220*	6.2674-*	3.8746	-2.4998	-2.9862	LGDP-HYD
5.3853*	6.4201*	6,4722*	3.5422	- 1.8265	2.4151	LAGR
- 4.5284*	- 5.8297*	- 5,9930*	4.2389	- 2.2339	- 2.0261	LSER
- 7.9728*	- 8.4188*	8.8348 - *	1.6035	-2.5602	-2.3959	LIND-HYD
-6.2527*	6.6443*	.6.8120-*	1.9099	-2.7658	-3.1947	Lhyd
Critical values at level one			Critical values at the original level			
None	C	T and C	None	C	T and C	
-2.6083	-3.6500	-4.1408	-2.6084	.35574-	4.1484	1%
-1.9471	-2.9176	-3.4969	-1.9469	.29165	-3.5004	5%
1.61248	-2.5966	-3.1775	-1.6129	2.5961	-3.1796	10%

Source: Prepared by the researcher using Eviews 09 software.

Based on the table above and the calculated (t-statistic) values compared to the critical values at significance levels (1%, 5%, 10%), we observe that all calculated values for the five series (whether with a constant, a constant and a trend, or without) are greater than the tabulated values. Therefore, all series are unstable at their original level. After taking the first difference for the series, we observe a radical shift, as all calculated values become smaller than the tabulated values. This indicates that all series become stable after the first difference

and are therefore first-order integrals (I(1)), which allows us to use the NARDL approach in estimating the model**:**[11] .

3.3. Model Estimation Using the Nonlinear Distributed Lag Period Autoregression (NARDL) Approach

This section aims to construct an econometric model that demonstrates the impact of oil revenues on economic diversification (non-hydrocarbon economic growth). This is achieved by examining the impact of value added in productive sectors (agriculture, non-hydrocarbon industry, and services) and shocks to hydrocarbon revenues as independent variables, and the impact of these variables on non-hydrocarbon economic growth as the dependent variable. The model can be written as follows:

The above model can be written using the NARDL approach as follows:

$$\Delta Ln(GDP-HYD_t)=c+\alpha_1 Ln(GDP-HYD_{t-1})+\alpha_2 Ln(AGR_{t-1})+\alpha_3 Ln(SER_{t-1})+\alpha_4 Ln(IND-HYD_{t-1})$$
$$+\alpha_6 Ln(HYD\_POS_{t-1})+\alpha_7 Ln(HYD\_NEG_{t-1})+\sum_{i=1}^{p}\phi_j \Delta Ln(GDP-HYD_{t-i})$$
$$+\sum_{j=0}^{p_1}\varphi_j \Delta Ln(AGR_{t-j})+\sum_{j=0}^{p_2}\gamma_j \Delta Ln(SER_{t-j})+\sum_{j=0}^{p_3}\lambda_j \Delta Ln(IND-HYD_{t-j})+$$
$$+\sum_{j=0}^{p_5}\varpi_j \Delta Ln(HYD\_POS_{t-j})+\sum_{j=0}^{p_6}\vartheta_j \Delta Ln(HYD\_NEG_{t-j})+\varepsilon_t$$

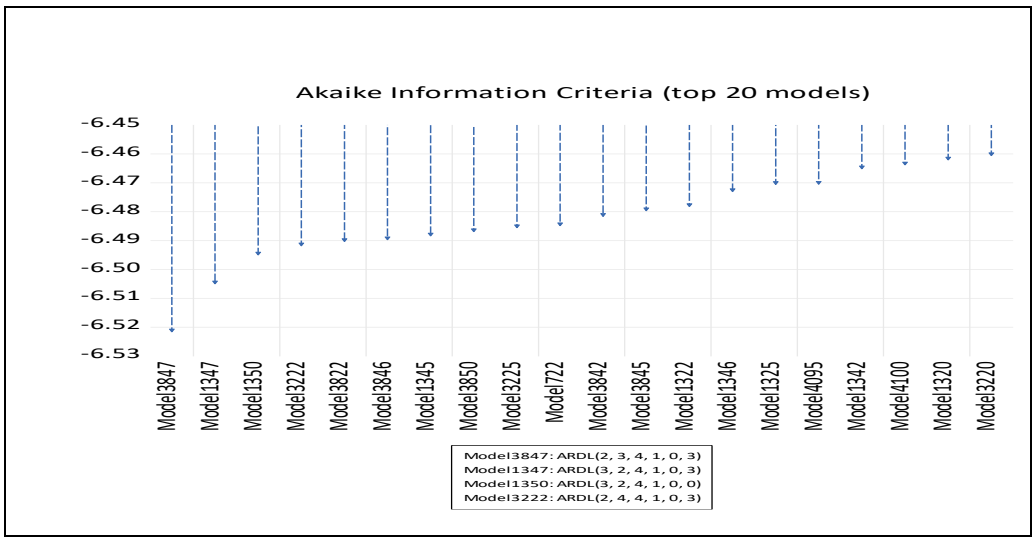
Where (Δ) represents the first difference, (Ɛ) represents the error limit, and the coefficients represent the long-term relationship. It represents the short-term kinetics or dynamics of the model. Positive shocks to hydrocarbon revenues are calculated using the following formula:

$$Ln(HYD\_POS_t)=\sum_{j=1}^{t}\Delta Ln(HYD\_POS_t)=\sum_{j=1}^{t}\max\left(\Delta Ln(HYD_j),0\right)$$

Negative shocks to fuel revenues are calculated $\left(HYD\_NEG_t\right)$ Based on the formula:

$$Ln(HYD\_NEG_t)=\sum_{j=1}^{t}\Delta Ln(HYD\_NEG_t)=\sum_{j=1}^{t}\min\left(\Delta Ln(HYD_j),0\right)$$

3.4 Determining the number of gaps and lag periods: Studies rely on taking a sufficient number of lag periods to obtain the best data set, which will be determined using the AIC criterion. The test results are shown in the following figure: Figure (01): Results of the lag period test.



Source: Prepared by the researcher based on outputs from Eviews 12.

By selecting the lowest value for the (AIC) criterion, the optimal lag times for the NARDL model are NARDL(2.3.4.1.0.3), resulting in the following model:

$$\Delta Ln(GDP-HYD_t)=c+\alpha_1 Ln(GDP-HYD_t)+\alpha_2 Ln(SER_{t-1})$$
$$+\alpha_3 Ln(IND-HYD_{t-1})+\alpha_4 Ln(AGR_{t-1})+\alpha_5 Ln(HYD\_POS_{t-1})+\alpha_6 Ln(HYD\_NEG_{t-1})$$
$$+\phi_j\sum_{j}^{2}\partial_j\Delta Ln(GDP-HYD_{t-1})+\sum_{j=0}^{3}\gamma_{\ j}\ \Delta Ln(SER_{t-1})+\sum_{j}^{4}\lambda_j\Delta Ln(IND-HYD_{t-j})$$
$$+\sum_{j=0}^{1}\ \varphi_j\Delta Ln(AGR_{t-j})+\sum_{j=0}^{3}\vartheta_j\Delta Ln(HYD\_NEG_{t-j})+\varepsilon_t$$

3.5 Cointegration Test: In order to confirm the existence of a long-term relationship, the results of the Bounds test are shown in the following table:

Table No. (02): Limit Test Results

Morale level	minimum	ceiling	F-statistic
%10	2.08	3.00	6.2210
%5	2.39	3.38	
%2.5	2.70	373	
%1	3.06	4.15	

Source: Prepared by the researcher using Eviews 09 software.

From the results in the table above, we observe that Fisher's F-statistic is 6.2210, which is greater than the upper limit critical values at all significance levels. Therefore, we reject the null hypothesis and accept the alternative hypothesis, which states that there is a cointegrating relationship between the study variables in the long run. This means that the study variables converge and combine to determine the long-term trajectory of GDP.

3.6 Estimating the Long-Run Relationship: After confirming the existence of a cointegrating relationship between the variables, it became possible to estimate the long-run relationship. The results are shown in the following table:

Table (3): Results of Estimating the Long-Run Relationship for the NARDL Model (2.3.4.1.0.3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNSER	0.7344	0.0291	25.2626	0.0000
LNIND_HYD	0.1900	0.0142	13.3958	0.0000
LNAGR	0.1169	0.0252	4.6300	0.0001
LNHYD_POS	-0.0348	0.0062	-5.5765	0.0000
LNHYD_NEG	-0.0098	0.0064	-1.5218	0.1379
C	0.0676	0.1670	0.4047	0.6884

Source: Prepared by the researcher using Eviews 09 software.

The preceding results indicate a stable long-term equilibrium relationship between the variables, as demonstrated by the F-Bounds Test. The long-term model results also showed a significant and differentiated impact of the variables on non-hydrocarbon GDP. Furthermore, oil revenue shocks have an asymmetric effect and different dynamics, with the contractionary effect (LNHYD_NEG) being greater than the expansionary effect (LNHYD_POS), thus confirming the asymmetric hypothesis.

The services, industry, and agriculture sectors emerged as key drivers of long-term growth. A 1% increase in services leads to a 0.73% increase in non-hydrocarbon GDP in the long term, confirming that services are the backbone of the Algerian economy outside the energy sector. The industry and agriculture sectors followed with strong impacts of 0.19% and 0.11%, respectively, reflecting their role in driving the non-hydrocarbon economy. The impact of hydrocarbon revenue shocks was shown to be significant in the long term. The long-term increase in these revenues, with a coefficient of 0.034 and a significance level of 0.0000, negatively impacts the growth of the economy outside the hydrocarbon sector. This is a strong indication of the Dutch Disease phenomenon in the Algerian economy, as these financial surpluses lead to a decline in the competitiveness of other sectors or the diversion of these resources to other sectors. Conversely, negative shocks, with a coefficient of 0.045 and a significance level of 0.1379, do not necessarily affect output outside the hydrocarbon sector.

Regarding the asymmetric effect of positive shocks (LNHYD_POS) and negative shocks (LNHYD_NEG), we find that the "decline" effect is greater than the "increase" effect. This means that the economy is negatively affected more deeply by positive shocks compared to negative shocks.

3.7 Estimating the short-term relationship: The results of the boundary test confirmed the existence of a cointegration relationship between the variables. Therefore, we can estimate the short-term relationship, and the results are shown in the following table:

Table (04) - Results of estimating the short-term relationship for the NARDL model (2.3.4.1.0.3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP1(-1))	0.21014	0.10279	2.04440	0.04920
D(LNSER)	0.65271	0.02181	29.92114	0.00000
D(LNSER(-1))	-0.15863	0.08194	-1.93589	0.06180
D(LNSER(-2))	-0.03781	0.01635	-2.31204	0.02740
D(LNIND_HYD)	0.19743	0.00589	33.51885	0.00000
D(LNIND_HYD(-1))	-0.03347	0.02179	-1.53634	0.13430
D(LNIND_HYD(-2))	0.00049	0.00540	0.08980	0.92900
D(LNIND_HYD(-3))	0.00885	0.00483	1.83231	0.07620
D(LNAGR)	0.13612	0.01627	8.36382	0.00000
D(LNHYD_POS)	-0.03011	0.00664	-4.53558	0.00010
D(LNHYD_NEG)	0.00640	0.01089	0.58773	0.56080
D(LNHYD_NEG(-1))	0.00215	0.01505	0.14266	0.88750
D(LNHYD_NEG(-2))	0.01188	0.01050	1.13088	0.26650
CointEq(-1)	-0.86453	0.13460	-6.42285	0.00000

Source: Prepared by the researcher using Eviews 09 software.

The Error Correction Regression mechanism illustrates what happens in the short term and the speed of return to equilibrium. The Error Correction Coefficient (-0.8645) is negative and statistically significant, confirming the existence of a cointegration relationship. This value (0.8645) means that the Algerian economy corrects 89.45% of short-term deviations and returns to long-term equilibrium within a short period. In other words, any imbalance in GDP outside the hydrocarbon sector is corrected in approximately 18 months.

We also observe that changes in agriculture (LNAGR), services (LNSER), and industry have immediate, significant, and positive effects on economic growth outside the hydrocarbon sector. Positive shocks have a direct negative impact, which highlights the neglect of non-oil sectors during periods of high hydrocarbon prices. Furthermore, negative shocks to oil revenues cannot be addressed in the short term. These findings are consistent with the reality of the Algerian economy, which faces considerable difficulty in achieving equilibrium during oil crises.

3.8 Diagnostic tests: To determine if this model is acceptable and reliable for sound economic diagnosis and analysis, we will perform some diagnostic tests, as shown in the following table:

Table (05): Diagnostic test results for the model

possibility	Value	Test type
0.1213	F-statistic: 1.5954	Heteroskedasticity Test: Breusch-Pagan-Godfrey
0.5932	F-statistic: 0.2892	Heteroskedasticity Test: ARCH
0.1609	F-statistic: 1.9427	Breusch-Godfrey Serial Correlation LM Test:
01138	F-statistic: 2.6481	Stability Diagnostics Ramsey RESET Test
0.8167	J.B : 0.4048	JARQUE-BERE

.Source: Prepared by the researcher using Eviews 09 software

Both the Breusch-Pagan-Godfrey test and the ARCH test show inconsistency in the variance. The probability value corresponding to Fisher's statistic is greater than the 5% significance level. Therefore, we accept the null hypothesis stating that the residuals have homoskedasticity. Consequently, the model does not suffer from the error variance problem, and the coefficient estimates are accurate and unbiased. The Breusch-Godfrey Serial Correlation LM test also shows the absence of autocorrelation in the model because the probability value corresponding to the F-statistic is greater than 5%, indicating that the residuals are independent of each other and there is no autocorrelation. The Ramsey RESET test confirms the validity of the model. Since the probability value corresponding to the F-statistic is greater than 5%, we accept the null hypothesis stating that the model is correctly defined (K). This means that the model has not overlooked any important variables, and the mathematical formula of the model (logarithmic) is correct. For example, it is very suitable for describing the relationship between economic sectors and non-hydrocarbon output.

The Jarque-Bera test, with a probability value much greater than 5%, confirms the normality of the distribution. This allows us to accept the null hypothesis that the residues are normally distributed, meaning that the statistical tests (t-test and F-test) used to determine the significance of the variables are valid and accurate.

8.3. Long-Run and Short-Run Asymmetry Test (WALD TEST): These tests show that the effects of positive and negative oil shocks on the dependent variable are similar in the short and long run:

- Long-Run Asymmetry Test: The results of the test are shown in the following table:

Table No. (06): Results of the long-term asymmetry test

Test Statistic	Value	DF	Probability
t-statistic	-.56632	32	0.0000
F-statistic	32.0729	(1, 32)	0.0000
Chi-square	32.0729	1	0.0000

.Source: Prepared by the researcher using Eviews 09 software

Based on the results of the WALD test and the corresponding Chi-squared value, which is significantly less than 5%, we reject the null hypothesis of symmetry and accept the alternative hypothesis stating that there is long-run asymmetry between the impact of positive and negative shocks to hydrocarbon revenues on non-hydrocarbon GDP. These results confirm the interpretation of the long-run model coefficients we previously discussed, which indicates an asymmetry in the strength of the Algerian economy's response to increases in hydrocarbon prices/revenues compared to its response to decreases (confirming the "Dutch Disease"). Specifically, oil price booms (positive shocks) lead to a "brake" on non-hydrocarbon growth, while negative shocks do not have the same strong adverse effect.

Short-run asymmetry test: The test results are shown in the following table:

Table (07): Results of the short-term asymmetry test

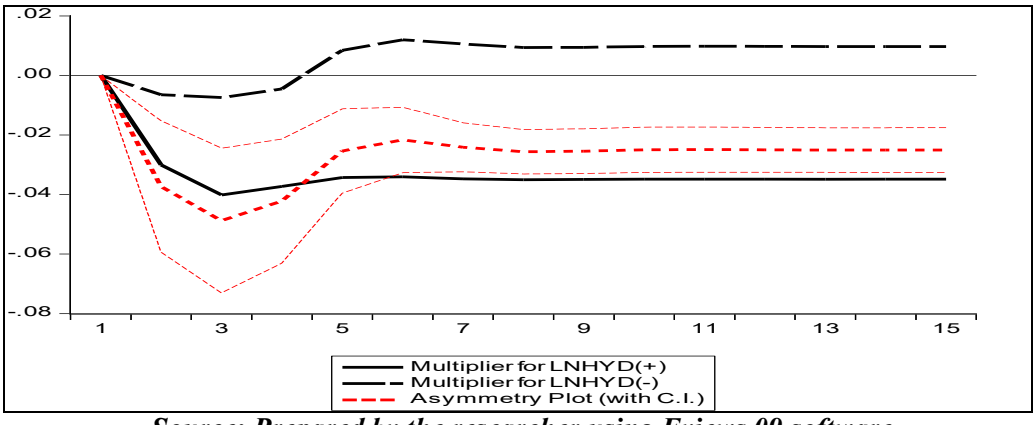
Test Statistic	Value	DF	Probability
t-statistic	1.5316	32	01354
F-statistic	2.3458	(1, 32)	0.1354
Chi-square	2.4358	1	01256

.Source: Prepared by the researcher using Eviews 09 software

From the table results, we observe that the probability value for the Chi-square statistic is greater than 5%. Therefore, we accept the null hypothesis and reject the alternative hypothesis, meaning there is insufficient evidence for short-term asymmetry. This indicates that asymmetry in the Algerian economy is a long-term structural phenomenon, not merely a rapid, momentary reaction. This suggests that the imbalances resulting from oil dependency accumulate and their effects become more apparent over the long-term equilibrium path, rather than in the short term.

3.9 Dynamic Cumulative Effect Multiplier Test: The test results are shown in the following figure:

Figure (03): Results of the asymmetric dynamic cumulative effect multiplier test



.Source: Prepared by the researcher using Eviews 09 software

– Unlike short-term multipliers, which show the immediate impact, the dynamic multiplier illustrates how this impact develops and accumulates over time. The results of this test, which uses a 15-year dynamic cumulative impact multiplier, reveal a significant effect of positive oil revenue shocks on non-oil GDP, in contrast to the response to negative shocks. The following observations can be made:

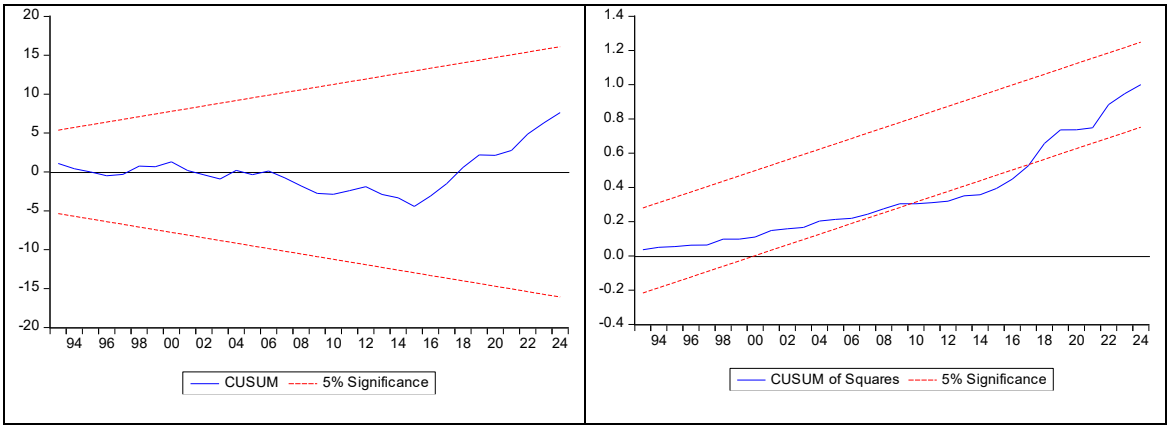
– Positive Shock Effect (Solid Dark Black Line): The curve dips below the zero line and stabilizes in the negative zone. This confirms the cumulative effect of Dutch disease. As oil revenues increase, non-oil GDP growth declines cumulatively, reaching its maximum negative impact approximately 3 to 5 years after the shock.

-Negative Shock Effect (Dash Black Line): The curve rises above the zero line and then stabilizes. A decrease in oil revenues may (cumulatively) stimulate growth in other sectors, or at least not harm them as much as a surplus does, perhaps due to the government adopting austerity policies that encourage domestic production.

- Cumulative difference (dotted red line): The movement of this line away from zero and its subsequent stabilization in negative values is evidence of the asymmetry confirmed by the Wald test. The gap between the impact of the increase and the impact of the decrease in oil prices widens over time, and stabilization in the negative zone indicates that the impact of the positive shock has become a positive structural damage, not a transient effect.

3.10 Model Stability Test: To test the structural stability of the model, the cumulative sum of residuals test and the cumulative sum of squared residuals test were used. The results were as follows:

Curve No. (04): Results of the CUSUM and CUSUMQ tests

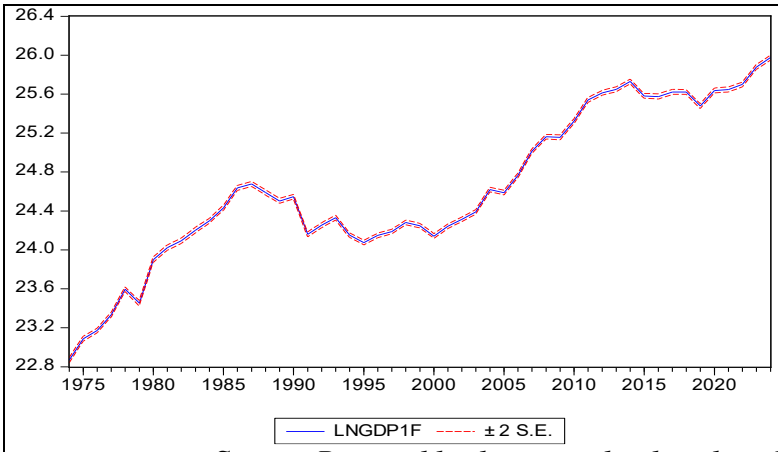


Source: Prepared by the researcher using Eviews 09 software

Through two test models (CUSUM and CUSUMQ), we observe that the curve falls within the 5% significance level. Therefore, based on these tests, it can be concluded that the model is stable between short-term and long-term results. Consequently, there is no evidence of any structural change in the model data during the study period; that is, there is no "structural break" that led to a change in the coefficients. This strengthens the estimated model parameters, as they have withstood the various historical shocks that Algeria has experienced.

3.11 Predictive Performance of the Model: The outputs of the predictive performance test of the model are shown in the following figure:

Figure No. (05): Results of the predictive performance test of the model.



Source: Prepared by the researcher based on the outputs Eviews 12

From the outputs of the predictive performance test shown in the previous figure, we note that the coefficients Variance Proportion, Theil Inequality Coefficient, and bias proportion are close to zero, and that the coefficient Covariane Proportion is close to one, which shows that the model has good predictive ability.

Conclusion:

This research paper investigated the impact of hydrocarbon revenues on economic diversification in Algeria using the NARDL approach for the period 1970-2024. The aim was to determine Algeria's success in utilizing these revenues to build a diversified and sustainable economy based on various sectors. After diagnostic tests confirmed the validity of the estimated model, we analyzed the results and compared them with the Algerian economic reality. The model outputs revealed the following:

1. The impact of structural asymmetry and "Dutch Disease": The Wald Test result, which showed long-term asymmetry, perfectly matches the Algerian reality. The Algerian economy suffers from chronic Dutch Disease, where the rise in oil revenues (positive shocks) leads to a decline in the competitiveness of other sectors such as agriculture and industry. This explains the negative cumulative trend in the Dynamic Multiplier curve.

2. Dominance of the Services Sector: The long-term results showing the services sector's leading position with a coefficient of 0.73 reflect the rentier structure of the Algerian economy. This sector thrives largely due to government spending dependent on oil revenues, but it fails to generate sustainable added value that guarantees real long-term growth.

3.The Dynamics of Cumulative Impact and Correction of Imbalances: The Dynamic Multiplier curve confirms that positive shocks cause cumulative damage that increases over time, necessitating continuous policy vigilance. However, the ECM error correction coefficient exceeding 86% indicates the economy's resilience and its ability to absorb negative

shocks and quickly return to equilibrium, opening the door to the possibility of building a more diversified and sustainable economic model. Based on the overall economic and econometric results obtained from the model, a set of structural reforms necessary to accelerate diversification and reduce oil dependency in Algeria can be proposed:

1.Reform oil revenue management: A transition to a genuine sovereign wealth fund operating under strict regulations is necessary. This fund should aim to absorb surplus oil revenues and avoid wasteful spending during periods of abundance, thus mitigating the long-term effects of "Dutch disease".

2.Stimulate economic diversification and enhance competitiveness: Investments should be directed towards real productive sectors, with tax incentives and concessional loans provided to support small and medium-sized enterprises (SMEs), thereby creating a productive economy capable of competing internationally.

3. Improve the business climate: It is essential to simplify administrative procedures, combat bureaucracy, and provide a stable legislative environment to protect both foreign and domestic investment.

4.Invest in human capital: The focus should be on technical education and specialized vocational training to meet the needs of emerging sectors and promote innovation and entrepreneurship, ensuring sustainable growth independent of oil price volatility.

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