

Asymmetric Oil Price Shocks and Fiscal Spending Procyclicality in Algeria: A Nonlinear ARDL Approach

Nadia Azzeddine

Laboratory of Environmental studies and sustainable development
Faculty of Economics, Commercial and Management Sciences
University of Tebessa (Algeria)

nadia.azzeddine@univ-tebessa.dz

Abstract :

This study investigates whether Algeria's fiscal spending reacts to shocks to the price of oil in a procyclical and asymmetrical manner between 1993 and 2024. Because hydrocarbon revenues play a major role in determining the amount of fiscal space available for public spending, the analysis uses a nonlinear ARDL framework that breaks down changes in oil prices into positive and negative components so that their unique effects on the growth of government spending can be evaluated.

The results indicate a stable long-run relationship and show that government expenditure in Algeria is both procyclical and asymmetrically affected by oil price movements. Positive oil price shocks and real GDP growth increase expenditure growth, while inflation has no significant independent effect. These findings support stronger expenditure-smoothing mechanisms and fiscal stabilization buffers.

Article info

Received

21/07/2026

Accepted

24/09/2026

Keyword:

- ✓ Oil price shocks;
- ✓ Fiscal spending;
- ✓ Procyclicality;
- ✓ Nonlinear ARDL.

1. Introduction

Challenges with fiscal policy persist for oil-exporting economies. During oil booms, public revenues rise, increasing the resources available for spending. Conversely, oil busts reduce government revenue, compelling governments to adjust by cutting spending, borrowing, drawing down reserves, and utilising stabilisation funds. If spending increases during booms and is postponed during recessions, fiscal policy becomes procyclical, potentially amplifying rather than smoothing external shocks. This policy reacts to fluctuations in oil prices.

This issue is important for Algeria, as hydrocarbons have long framed the financing of public expenditures and the state budget. Public spending has also been a key instrument to support growth, employment, transfers and subsidies and public investment. Thus oil prices can influence the economy via the external accounts and the fiscal channel. The critical question is therefore how fiscal spending responds to increases and decreases in oil prices.

The broader literature shows that fiscal policies often move procyclically in developing economies. Macroeconomic policies in many developing and emerging economies tend to be procyclical rather than countercyclical. Fiscal policy often expands during good times and contracts during bad times, especially when external financing conditions and capital inflows move with the business cycle. This evidence supports the idea that government spending may increase during favorable external conditions and weaken during downturns, which is relevant for resource-dependent economies such as Algeria (Kaminsky & al., 2005). This pattern is often linked to tax-base volatility and political pressure to spend temporary revenue gains during good times (Talvi & Végh, 2005). Political-economy mechanisms also help explain why governments may fail to save windfall revenues and instead expand spending during booms (Alesina & al., 2008). However, stronger institutions and policy credibility can reduce fiscal procyclicality (Frankel & al., 2013).

Regarding resource-dependent and oil-exporting economies, the evidence is closer to the present study. Oil prices are shown to shape fiscal policy in oil-exporting countries, as higher oil prices are associated with a larger government sector in the long run (El Anshasy & Bradley, 2012). In the same context, oil booms may weaken non-oil fiscal positions when windfall revenues are translated into higher primary spending (Villafuerte & Lopez-Murphy, 2010). Recent evidence suggests that fiscal rules and sovereign funds can help reduce fiscal procyclicality when they are well designed and effectively enforced (Coutinho & al., 2022). In the same line, institutional quality plays an important role in determining whether these mechanisms can effectively discipline public spending in oil-rich economies (Çiçekçi & Gaygisiz, 2023). Evidence from Oman also supports this line of research, showing that oil price shocks affect government revenue

and GDP, while fiscal spending depends on the transmission from oil revenues to public expenditure (Al Jabri & al., 2022)

Regarding Algeria, fiscal policy has been shown to be procyclical over 1990–2020, while the Revenue Regulation Fund played a weak stabilizing role during major downturns (Hadj Moussa, 2025). Since this evidence focuses mainly on the non-oil primary balance and oil-revenue management, the present study complements it by examining real government expenditure growth. This focus is relevant because government spending transmits oil windfalls more directly to domestic demand and is available over a longer annual series for Algeria.

The contributions of this study are threefold. First, it examines fiscal spending procyclicality in Algeria over more than three decades, which allows the analysis to cover different oil price cycles and macroeconomic conditions. Second, it decomposes oil price movements into positive and negative partial sums in order to test whether fiscal spending reacts differently to oil price increases and decreases. Third, it links the Algerian case to the broader literature on oil-exporting economies and stabilization buffers. Methodologically, the study applies the nonlinear ARDL framework to capture asymmetric effects in the fiscal response to oil price shocks (Shin & al., 2014). It also tests the long-run relationship using the bounds-testing procedure (Pesaran & al., 2001).

The remainder of this study is organized as follows. Section 2 presents the methods. Section 3 reports the empirical results. Section 4 discusses the findings and their policy implications. Section 5 concludes.

2. Methods

2.1 Data and variables

Empirical analysis is based on annual data for Algeria for the period 1993–2024. Table 1 presents a summary of the variables, their definitions and measurement, and data sources.

Table 1. Variable definitions and data sources

Symbol	Variable	Measurement	Source
RGEG	Real government expenditure growth	Annual growth of real government final consumption expenditure	World Bank/WDI
POPS	Positive oil price shocks	Cumulative positive changes in log Brent oil price	FRED/IMF and authors' calculations
NOPS	Negative oil price shocks	Cumulative negative changes in log Brent oil price	FRED/IMF and authors' calculations
RGDPG	Real GDP growth	Annual growth rate of real GDP	World Bank/WDI
INF	Inflation	Annual CPI inflation rate	World Bank/WDI

Source: Author's compilation based on the data sources listed in the table.

The dependent variable is the annual percentage change in real government final consumption expenditure, which we call real government expenditure growth (RGEG). The international oil price proxied by Brent crude oil price is the main explanatory variable. Brent crude was selected because it provides an available consistent long term time series and it is widely used in empirical research on oil exporting economies.

The oil price series was transformed into natural logarithms and decomposed into cumulative positive and negative changes. Real GDP growth captures the domestic activity cycles. Inflation controls for price pressures that could impact real spending dynamics. This compact specification is applicable to an annual sample and helps avoid overfitting.

2.2 Nonlinear ARDL specification

To capture asymmetric fiscal responses to oil price movements, the oil price series is decomposed into positive and negative partial sums. Let LOIL denote the natural logarithm of the oil price, and let DLOIL represent its annual change. Positive oil price changes are computed as $\max(\text{DLOIL}, 0)$, whereas negative changes are computed as $\min(\text{DLOIL}, 0)$. The cumulative sums of these two series define POPS and NOPS, respectively. This construction allows fiscal spending to respond differently to oil price increases and decreases.

The Schwarz information criterion identifies ARDL(1, 0, 1, 0, 0) as the baseline specification. In this model, RGEG enters with one lag, POPS enters contemporaneously, and NOPS enters with both current and lagged values. RGDPG and INF are included contemporaneously. The estimated equation is specified as follows:

$$\text{RGEG}_t = \alpha_0 + \alpha_1 \text{RGEG}_{t-1} + \beta_1 \text{POPS}_t + \beta_2 \text{NOPS}_t + \beta_3 \text{NOPS}_{t-1} + \beta_4 \text{RGDPG}_t + \beta_5 \text{INF}_t + \varepsilon_t.$$

This equation was estimated using the ARDL bounds-testing framework. The existence of a levels relationship was assessed using the F-bounds and t-bounds tests. Once this relationship was confirmed, the error-correction representation was used to recover the long-run coefficients. Fiscal asymmetry was then tested by imposing the Wald restriction:

$$C(2) = C(3) + C(4),$$

which compares the positive oil price effect with the cumulative negative oil price effect. Rejecting this restriction indicates that fiscal spending responds asymmetrically to oil price upturns and downturns.

3. Results

3.1 Descriptive evidence

Before proceeding to the econometric analysis, it is useful to examine the main statistical characteristics of the variables included in the model. Table 2 reports the descriptive statistics for the study variables over the period 1993–2024. Real government expenditure growth averaged 3.27%, compared with an average real GDP growth rate of 2.83%. Inflation exhibited a higher

mean and considerably greater variability, averaging 6.95% and reaching a maximum of 29.8%. This elevated maximum is consistent with the substantial inflationary pressures and broader macroeconomic instability experienced by Algeria during the mid-1990s.

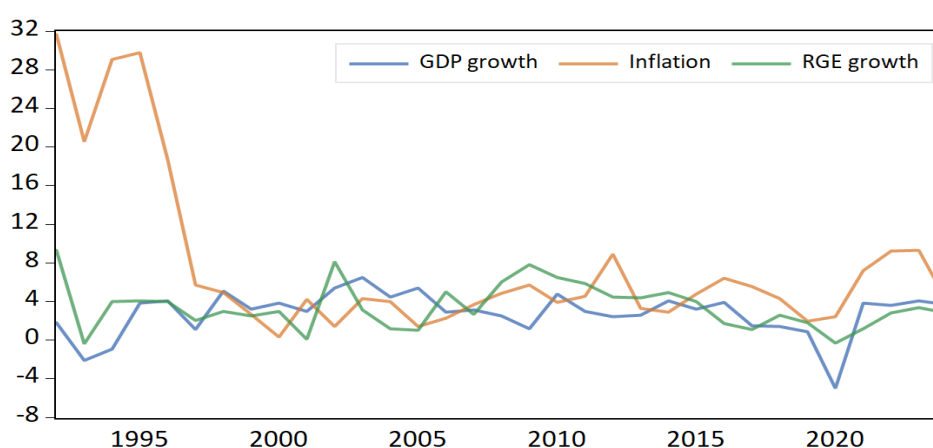
Table 2. Descriptive Statistics of the Study Variables, 1993-2024

Variable	Mean	Median	Maximum	Minimum	Std. dev.
RGEG	3.2658	3.0026	8.1000	-0.4000	2.1426
POPS	2.1740	2.4234	4.3106	0.0000	1.3965
NOPS	-1.3052	-1.0373	-0.1249	-2.8928	0.8760
RGDPG	2.8313	3.2000	6.5000	-5.0000	2.2869
INF	6.9477	4.3971	29.7796	0.3392	7.2968

Source: Author's calculations using EViews.

A comparative graph of real growth in government spending, real growth in GDP and inflation in Algeria over the period 1993–2024 is presented in Figure 1. Real growth in government expenditure was positive during a majority of the sample period but showed large year-to-year variations. Periods of significant slowdown and contraction were more likely to coincide with periods of weaker economic activity or greater macroeconomic instability. The figure also reveals that inflation was much more volatile than fiscal spending growth and real GDP growth, especially in the mid-1990s. Overall, the graphical evidence suggests that the dynamics of government spending are sensitive to changes in the domestic macroeconomy.

Fig.1. Real government expenditure growth, real GDP growth, and inflation in Algeria

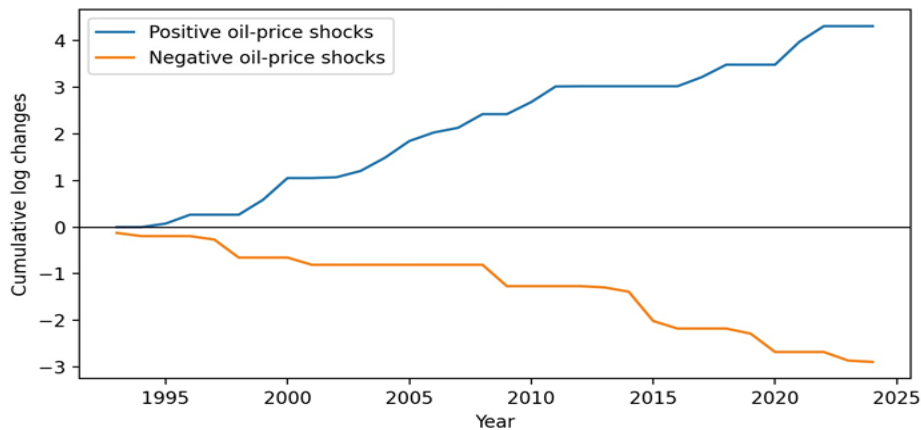


Source: Author's elaboration using EViews.

Figure 2 shows the cumulative positive and negative components of oil price changes used in the nonlinear ARDL specification. The two components present quite different paths, suggesting that the evolution of oil price increases and decreases has been uneven over the sample period.

Positive oil price shocks were associated with long periods of rising oil prices, whereas negative shocks were clustered around periods of sharp declines in the international oil market. This graphical divergence is an early signal that positive and negative oil price movements might have asymmetric effects on the government expenditure growth. Of course visual evidence cannot prove asymmetry in a statistical sense, but it does motivate a nonlinear specification rather than the use of one linear variable to characterize oil price changes.

Fig.2. Cumulative positive and negative oil price shock components



Source: Author's elaboration using EViews.

3.2 Unit-root tests

The time-series properties of the variables must be examined before estimating the nonlinear ARDL model in order to determine their orders of integration and ensure that none is integrated of order two, $I(2)$. This requirement is especially important as the critical bounds that we develop for the ARDL framework are not valid when there are $I(2)$ variables. Thus, the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests were performed with the corresponding deterministic specifications (for example, an intercept, and an intercept and linear trend if necessary). Results of the tests for the integration order decisions are summarized in Table 3.

Table 3. Unit-root test decisions

Variable	ADF decision	PP decision	Final decision
RGEG	I(0)	I(0)	Stationary at level
POPS	I(1)	I(1)	Stationary after first difference
NOPS	I(1)	I(1)	Stationary after first difference
RGDPG	I(0)	I(0)	Stationary at level
INF	I(0), mixed with trend	I(0)	No evidence of I(2)

Source: Author's calculations using EViews.

The results in Table 3 show that the variables are mixed order of integration. The results of both the ADF and PP tests are quite similar and suggest that the real government expenditure growth (RGEG) and real GDP growth (RGDPG) are stationary in levels and both variables are integrated

of order zero, i.e. $I(0)$. On the other hand, the positive and negative partial-sum components of oil price changes, POPS and NOPS, are non-stationary in levels but become stationary after first differencing and are thus classified as $I(1)$.

The PP test suggests that inflation is level stationary, but the ADF results are somewhat sensitive to the inclusion of a deterministic trend. But the evidence taken together does not suggest that inflation is integrated of order two. This sensitivity stresses the importance of considering the deterministic specification in the interpretation of the results of unit-root tests, rather than mechanically relying on a single test equation.

The overall results indicate the presence of a mixture of $I(0)$ and $I(1)$ variables in the model and the absence of any $I(2)$ series. Thus, the mixed integration structure allows applying the NARDL framework to analyze short-run and long-run asymmetric relations. However, the bound test for cointegration has to establish a stable long-run relationship and the relevant model diagnostic and stability tests have to be performed as well.

3.3 Baseline estimates

Following the examination of the integration properties of the variables, a baseline ARDL model was estimated to assess the dynamic relationship between real government expenditure growth, positive and negative oil price movements, real economic activity, and inflation. Based on the adopted lag-selection criterion, the $ARDL(1, 0, 1, 0, 0)$ specification includes one lag of the dependent variable and one lag of the negative oil price component, while the remaining explanatory variables enter contemporaneously. Table 4 reports the estimated coefficients, standard errors, individual significance tests, and overall goodness-of-fit statistics.

Table 4. Baseline ARDL(1, 0, 1, 0, 0) estimates

Variable	Coefficient	Std. error	t-statistic	Prob.
RGEG(-1)	-0.127977	0.153896	-0.831578	0.4135
POPS	2.512276	0.737410	3.406891	0.0022
NOPS	-0.741398	2.206797	-0.335961	0.7397
NOPS(-1)	4.894714	2.450644	1.997317	0.0568
RGDPG	0.341050	0.157453	2.166039	0.0400
INF	0.062182	0.053018	1.172855	0.2519
C	1.828776	1.207720	1.514238	0.1425
F-statistic	3.023893	/	/	0.023106
R-squared	0.420537			
Adjusted R-squared	0.281465			
Durbin-Watson	1.881712			

Source: Author's calculations using EViews.

These results imply that the estimated model is jointly statistically significant, as evidenced by the conventional overall F-statistic of 3.024 and its associated probability value of 0.023. The regressors therefore have joint explanatory power for changes in real government expenditure

growth. The model explains approximately 42.1% of the observed variation in RGEG, while the modified coefficient of determination decreases to 28.1% after accounting for the number of estimated factors. Given the relatively low annual sample, the results should accordingly be regarded with due caution.

The coefficient on the positive oil price component, POPS, is positive and statistically significant at the 1% level. Its estimated coefficient of 2.512 suggests that favorable oil price fluctuations are connected with an increase in real government expenditure growth, leaving the other variables constant. This conclusion is consistent with a procyclical fiscal reaction to positive oil-market conditions, whereby higher oil revenues enlarge the fiscal resources available to the government and permit more expenditure growth. Nevertheless, this coefficient should first be viewed as the contemporaneous influence within the projected dynamic definition rather than as a long-run multiplier.

The contemporaneous coefficient on NOPS is negative but statistically insignificant, whereas its initial lag is positive and significant at about the 10% level. This pattern shows that the budgetary response to negative oil price changes may be delayed rather than immediate. However, the sign and magnitude of the individual NOPS coefficients are insufficient to establish the total effect of negative oil price shocks. The joint effect of the contemporaneous and lagged NOPS factors must be examined using an appropriate Wald test. Similarly, the apparent difference between the POPS and NOPS coefficients does not, by itself, give formal evidence of asymmetry; short-run and long-run symmetry limitations must be verified explicitly.

Real GDP growth has a positive coefficient of 0.341 and is statistically significant at the 5% level. This conclusion demonstrates that government expenditure growth tends to increase during periods of increased domestic economic activity, offering additional evidence of fiscal procyclicality. However, the coefficient records a conditional correlation inside the model and should not automatically be taken as proving a causal relationship.

Inflation enters with a positive but statistically insignificant coefficient. Thus, after controlling for oil price changes and real GDP growth, there is no sufficiently significant statistical evidence that inflation independently affects real government expenditure growth across the study period. The lagged dependent variable is likewise statistically insignificant, demonstrating minimal persistence in yearly expenditure growth after the explanatory variables are taken into account.

Finally, the Durbin–Watson statistic of 1.882 is close to two and does not provide an instant indicator of substantial first-order residual autocorrelation. Nevertheless, the Durbin–Watson statistic is not an adequate diagnostic criterion for a dynamic ARDL model incorporating a lagged dependent variable. Residual serial correlation should therefore be examined formally using the Breusch–Godfrey LM test, coupled with additional diagnostic tests for heteroskedasticity,

functional-form misspecification, residual normality, and parameter stability.

3.4 Bounds test and long-run results

After proving that none of the variables is integrated of order two, the ARDL bounds-testing approach was employed to investigate whether a stable levels connection existed among real government expenditure growth, the positive and negative oil price components, real GDP growth, and inflation. The test tests the null hypothesis that the coefficients of the lagged level variables are jointly equal to zero. Both the F-bounds statistic, which examines the combined significance of the level terms, and the complimentary t-bounds statistic on the lagged dependent variable were evaluated. Table 5 presents the test statistics and the accompanying judgments based on the applicable critical boundaries.

Table 5. ARDL bounds-test results

Statistic	Value	Critical comparison	Decision
F-statistic	11.68038	Above the 1% upper bound	Levels relationship supported
t-statistic	-7.329461	More negative than the 1% I(1) bound	Levels relationship supported

Source: Author's calculations using EViews.

The results given in Table 5 provide significant support against the null hypothesis of no levels association. The estimated F-statistic of 11.68038 exceeds the upper-bound critical value at the 1% significance level. The statistic also remains above the appropriate finite-sample upper bound, demonstrating that the finding is robust to the relatively small number of annual observations. Accordingly, the null hypothesis that the coefficients of the lagged level variables are jointly equal to zero is rejected.

The t-bounds statistic leads to the same result. Its result of -7.329461 is more negative than the corresponding I(1) critical bound at the 1% level, providing complementary evidence that the adjustment coefficient associated with the lagged dependent variable is statistically distinct from zero. The consistency of the F-bounds and t-bounds decisions reinforces the evidence in favour of a stable levels relationship among the variables included in the model.

Taken together, these findings suggest the presence of a long-run relationship relating real government expenditure growth to positive and negative oil price fluctuations, real economic activity, and inflation for the period 1993–2024. The rejection of the null hypothesis also permits the model to be expressed in an error-correction form, via which short-run dynamics and the pace of adjustment toward equilibrium can be investigated. The computed long-run coefficients may thereafter be evaluated, assuming that the error-correction factor is negative and statistically significant and that the model fulfills the required residual diagnostic and parameter-stability tests.

It should also be stressed that the limits test demonstrates the presence of a levels connection but does not, by itself, demonstrate that positive and negative oil price shocks have statistically different effects. Long-run and short-run asymmetry must therefore be tested independently using the relevant Wald symmetry tests.

Following the detection of a statistically significant levels relationship, the long-run coefficients and the associated error-correction term were estimated from the selected ARDL specification. The long-run coefficients measure the equilibrium association between real government expenditure growth and each explanatory variable after accounting for the dynamic structure of the model. The error-correction coefficient, in turn, captures the speed at which short-run deviations from the long-run equilibrium are corrected. Table 6 reports the estimated long-run coefficients and the error-correction term.

Table 6. Long-run estimates and error-correction term

Variable	Coefficient	Std. error	t-statistic	Prob.
POPS	2.227241	0.610291	3.649473	0.0012
NOPS	3.682095	0.953348	3.862278	0.0007
RGDPG	0.302355	0.143577	2.105878	0.0454
INF	0.055127	0.046731	1.179656	0.2492
EC term	-1.127977	0.153896	-7.329461	0.0000

Source: Author's calculations using EViews.

These results demonstrate that both positive and negative oil price components are statistically significant in the long-run equation. The long-run coefficient on POPS is positive and significant at the 1% level. Its estimated value of 2.227 suggests that a one-unit rise in the cumulative positive oil price component is related with an approximately 2.23-unit increase in real government expenditure growth, holding the other variables constant. This outcome is consistent with a procyclical fiscal response to oil price hikes, since favourable oil-market circumstances raise hydrocarbon income and the fiscal space available for government expenditure.

The long-run coefficient on NOPS is also positive and statistically significant at the 1% level. Because the negative partial-sum component is derived from cumulative negative changes in oil prices and hence travels downward when bad oil price shocks occur, the positive coefficient must be evaluated cautiously. A fall in NOPS coupled with a negative oil price shock suggests a reduction in real government expenditure growth. Thus, the conclusion shows that persistent oil price drops restrain fiscal expenditure growth in the long run. The size of the NOPS coefficient is bigger than that of POPS, indicating a possibly stronger fiscal response to oil price drops than to increases. However, the difference between the two coefficients does not by itself prove long-run asymmetry; the null hypothesis of coefficient equality must be evaluated explicitly using a Wald test.

Real GDP growth has a positive long-run coefficient of 0.302 and is statistically significant at the 5% level. This conclusion demonstrates that better domestic economic activity is related with higher real government expenditure growth in the long run, strengthening the evidence of procyclical fiscal behaviour. Nevertheless, the estimate shows a conditional long-run correlation and should not be regarded automatically as a causal influence.

The long-run coefficient on inflation is positive but statistically negligible. Consequently, once oil price changes and real economic activity are adjusted for, the results do not provide adequate evidence that inflation has an independent long-run influence on real government expenditure growth over the time under consideration.

The estimated error-correction coefficient is negative and highly statistically significant, with a value of (-1.127977). Its sign indicates that deviations from the long-run equilibrium are corrected over time, while its statistical significance supports the validity of the error-correction specification. The coefficient suggests that approximately 112.8% of the previous year's disequilibrium is corrected within one year. Since its absolute value exceeds unity, the adjustment process involves temporary overshooting rather than smooth monotonic convergence. More specifically, a coefficient between (-1) and (-2) implies oscillatory convergence, whereby the system may cross the equilibrium path following a shock while the magnitude of the disequilibrium gradually diminishes. The estimated coefficient therefore remains consistent with dynamic stability, as also supported by the diagnostic and parameter-stability tests.

A Wald test was conducted to assess whether the cumulative effects of positive and negative oil price movements are equal. The null hypothesis of long-run symmetry is specified as $(C(2)=C(3)+C(4))$, with the results reported in Table 7.

Table 7. Wald test for asymmetric fiscal response

Item	Value
Restriction	$C(2) = C(3) + C(4)$
F-statistic	8.387301
Probability	0.0077
Chi-square	8.387301
Normalized restriction	$C(2) - C(3) - C(4) = -1.641041$
Decision	Reject symmetry at the 1% level

Source: Author's calculations using EViews.

These results reject the null hypothesis of long-run symmetry. The Wald F-statistic is 8.3873, with an associated probability value of 0.0077, showing rejection of the equality restriction at the 1% significance level. The chi-square variant of the test leads to the same conclusion. The equality between the cumulative coefficients associated with positive and negative oil price

fluctuations is therefore not confirmed by the data.

The normalized restriction, $(C(2)-C(3)-C(4)=-1.641041)$, reveals that the cumulative coefficient associated with negative oil price fluctuations is bigger than that associated with positive movements. This result is consistent with the long-run predictions presented in Table 6, where the coefficient on NOPS exceeds that on POPS. Given that NOPS accumulates negative oil price changes, its greater positive coefficient means that oil price decreases provide a stronger contractionary effect on real government expenditure growth than the expansionary effect produced by oil price increases of a comparable magnitude.

The Wald test consequently provides formal evidence that fiscal spending responds asymmetrically to positive and negative oil price fluctuations in the long run. Combined with the positive and considerable influence of POPS, the result shows that Algerian fiscal spending is both procyclical with respect to favourable oil-market conditions and more firmly limited during poor oil price episodes. This asymmetry is economically plausible in an oil-dependent fiscal system, where declining hydrocarbon revenues may impose immediate financing constraints, whereas part of the additional revenue generated during oil booms may be saved, absorbed by institutional rigidities, or transmitted to expenditure only gradually.

However, the rejection of this restriction establishes long-run asymmetry solely. A separate Wald limit on the relevant short-run coefficients would be required before establishing that the short-run fiscal response is similarly asymmetric.

3.5 Diagnostics and robustness checks

Following the estimation of the long-run and error-correction specifications, a comprehensive set of residual diagnostic and parameter-stability tests was conducted to evaluate the adequacy, reliability, and robustness of the selected model. These tests examine whether the residuals are affected by serial correlation, heteroskedasticity, autoregressive conditional heteroskedasticity, non-normality, or functional-form misspecification. In addition, the stability of the estimated coefficients over the sample period was assessed using the CUSUM and CUSUM of squares tests. Taken together, these procedures provide important evidence on whether the estimated relationships are statistically well specified and sufficiently stable for meaningful inference. Table 8 summarizes the results of the diagnostic and stability tests.

Table 8. Diagnostic and stability tests

Test	Statistic	Interpretation
Breusch-Godfrey LM	$F = 0.2312$; $p = 0.7954$	No serial correlation
Breusch-Pagan-Godfrey	$F = 1.1400$; $p = 0.3688$	No heteroskedasticity
ARCH	$F = 0.6231$; $p = 0.4363$	No ARCH effects
Jarque-Bera normality	$JB = 6.9762$; $p = 0.0306$	Residual normality rejected at 5%
Ramsey RESET	$F = 0.0628$; $p = 0.8043$	No functional-form problem
CUSUM	Within 5% bounds	Stable
CUSUMSQ	Within 5% bounds	Stable

Source: Author's calculations using EViews.

These results show that the estimated model meets most diagnostic criteria with satisfactory performance. The Breusch-Godfrey LM test has a probability value of 0.7954 and an F-statistic of 0.2312. Therefore, it is impossible to reject the null hypothesis that there is no residual serial correlation. Because residual autocorrelation may render the reported standard errors and significance tests incorrect, this result is especially crucial in a dynamic ARDL model.

With a probability value of 0.3688, the Breusch–Pagan–Godfrey test likewise fails to reject the homoskedastic residuals null hypothesis. Similarly, there is no indication of autoregressive conditional heteroskedasticity when the ARCH test produces a probability value of 0.4363. When combined, these results imply that systematic volatility clustering has no effect on the model and that the residual variance is rather stable.

With a probability value of 0.8043, the Ramsey RESET statistic is statistically negligible. Therefore, it is impossible to reject the null hypothesis of correct functional form. This result shows no evidence of significant functional-form misspecification in the estimated equation or of missing nonlinear combinations of the fitted values. However, rather than serving as conclusive proof that all potentially pertinent variables have been included, the RESET test should be seen as a generic specification check.

The only diagnostic test that rejects its null hypothesis is the Jarque-Bera test. The residuals deviate from normality at the 5% significance level, according to the statistic of 6.9762 with a probability value of 0.0306. The very short annual sample and the occurrence of exceptionally substantial macroeconomic changes, especially during the high-inflation events of the 1990s, may be the causes of this result. However, the Jarque-Bera test by itself cannot prove these explanations. Therefore, the non-normality finding is a limitation that should be recognized, and if possible, heteroskedasticity-robust or bootstrap-based standard errors may be added to the statistical inference.

Positive parameter-stability results are obtained. Throughout the sample period, both the CUSUM and CUSUM of squares statistics stay inside the 5% threshold boundaries. As a result, the

parameter stability null hypothesis is not disproved. This evidence implies that the principal results are not caused by a significant unexplained structural instability within the estimated model, and that the calculated coefficients are generally stable over time.

Overall, the diagnostic and stability tests support the adequacy of the estimated model. The residuals show no evidence of serial correlation, heteroskedasticity, ARCH effects, or functional-form misspecification, while the CUSUM and CUSUMSQ results indicate parameter stability over the sample period. Although the Jarque–Bera test reveals a departure from residual normality, this limitation should be interpreted cautiously given the relatively small annual sample and the presence of substantial macroeconomic fluctuations. Subject to this qualification, the diagnostic evidence supports the reliability of the estimated relationships.

4. Discussion

The empirical results provide evidence that government expenditure in Algeria exhibits procyclical behaviour. The positive oil price component has a positive and statistically significant effect on real government expenditure growth, both in the baseline specification and in the estimated long-run relationship. Real GDP growth is also positively and significantly associated with government expenditure growth. Taken together, these findings indicate that public spending tends to expand during periods of favourable oil-market conditions and stronger domestic economic activity rather than acting systematically as a countercyclical stabilizing instrument. This result is consistent with the broader literature showing that fiscal policy in developing and resource-dependent economies frequently moves in the same direction as the economic and commodity-price cycles.

The positive response of government expenditure to oil price increases reflects the central role of hydrocarbon revenues in Algeria's fiscal capacity. Rising oil prices increase budgetary resources and create greater scope for expanding current and capital expenditure. During oil booms, temporary revenue gains may consequently be translated into higher wage expenditure, transfers, subsidies, and public investment commitments. Because several of these expenditure categories are institutionally or politically difficult to reverse, spending increases adopted during favourable periods may generate persistent fiscal obligations after oil-market conditions deteriorate.

The results also reveal a statistically significant long-run asymmetric response to positive and negative oil price movements. The Wald test rejects the null hypothesis that the cumulative effects of the two oil price components are equal. Moreover, the estimated long-run coefficient associated with NOPS is larger in magnitude than that associated with POPS. Since NOPS is constructed as the cumulative sum of negative oil price changes, a decline in this component represents an adverse oil price shock. Its positive estimated coefficient therefore implies that oil price decreases reduce real government expenditure growth. The larger coefficient suggests that

the contractionary fiscal effect of an oil price decline is stronger than the expansionary effect of a comparable oil price increase.

This long-run asymmetry adds an important dimension to the evidence of fiscal procyclicality. Government expenditure does not respond proportionately to favourable and adverse oil-market developments. One possible explanation is that declining hydrocarbon revenues impose binding financing constraints, particularly when fiscal buffers are limited, whereas part of the additional revenue generated during oil booms may be saved, absorbed gradually, or subject to implementation constraints. At the same time, expenditure rigidities associated with public-sector wages, social transfers, subsidies, and multi-year investment projects may delay the adjustment of particular spending categories. The aggregate effect may therefore involve a combination of delayed expenditure adjustment and a relatively strong eventual reduction in expenditure growth following persistent oil price declines.

The estimated error-correction coefficient further indicates that short-run deviations from the long-run relationship are corrected relatively rapidly. Its negative and highly significant value supports the existence of an equilibrium-adjustment mechanism. Because the coefficient is slightly below -1 , the adjustment process is characterized by temporary overshooting rather than smooth monotonic convergence. In other words, government expenditure growth may initially cross its long-run equilibrium path after a disturbance before the disequilibrium gradually diminishes.

The statistical insignificance of inflation should be interpreted cautiously. It does not imply that fiscal policy has no relationship with inflation or that government expenditure cannot generate inflationary pressures. Rather, the result indicates that inflation does not have a statistically distinguishable independent effect on real government expenditure growth after controlling for oil price movements and real GDP growth. Fiscal policy may still influence inflation through other mechanisms, including subsidy policies, administered prices, import demand, monetary accommodation, liquidity conditions, and inflation expectations. The estimated equation examines the determinants of expenditure growth and is not designed to identify the effect of fiscal expenditure on inflation.

The diagnostic and stability tests generally support the adequacy of the estimated specification. The results show no evidence of serial correlation, heteroskedasticity, ARCH effects, functional-form misspecification, or parameter instability. However, the rejection of residual normality represents a qualification, particularly given the small annual sample and the presence of large macroeconomic fluctuations. The estimated significance levels should therefore be interpreted with some caution, although the overall diagnostic evidence supports the reliability of the main relationships.

The findings have important implications for fiscal management in Algeria. Since expenditure

expands during oil price upturns and responds asymmetrically to adverse oil price developments, fiscal policy should aim to reduce the dependence of annual spending decisions on current hydrocarbon revenues. A credible medium-term fiscal framework could be based on conservative reference oil prices, clearly defined expenditure paths, and transparent rules governing the accumulation and use of stabilization reserves. Temporary oil windfalls should be distinguished from permanent fiscal resources to prevent short-lived revenue increases from creating lasting expenditure commitments.

Strengthening fiscal institutions would also improve the capacity of government expenditure to contribute to macroeconomic stabilization. Greater emphasis on expenditure efficiency, multi-year budgeting, the prioritization of investment projects, and the gradual reform of rigid current expenditure could reduce the need for abrupt adjustments during oil-price downturns. Such measures would help smooth public expenditure over the oil cycle, limit procyclical fiscal behaviour, and enhance the long-term sustainability of Algeria's public finances.

5. CONCLUSION

This study investigated the procyclical behaviour of government expenditure in Algeria over the period 1993–2024. To account for the possibility that fiscal policy reacts differently to rising and falling oil prices, the analysis used a nonlinear ARDL model that separates oil price changes into positive and negative cumulative components.

The findings point to a stable long-run relationship between real government expenditure growth, oil price movements, real GDP growth, and inflation. Positive oil price shocks are associated with higher government expenditure growth, while stronger economic activity also tends to be accompanied by higher public spending. These results suggest that fiscal expenditure in Algeria generally moves with favourable oil-market and domestic economic conditions rather than acting as a countercyclical stabilizing force.

The results also show that the fiscal response to oil price changes is asymmetric in the long run. The Wald test rejects the hypothesis that positive and negative oil price movements have equal effects on government expenditure growth. More specifically, the estimated effect of negative oil price movements is larger than that of positive movements. Since the negative oil price component declines when oil prices fall, this finding implies that persistent oil price downturns reduce expenditure growth more strongly than comparable oil price increases raise it.

The error-correction coefficient is negative and highly significant, indicating that short-run deviations from the long-run relationship are corrected relatively quickly. Its magnitude suggests that the adjustment process may involve temporary overshooting before equilibrium is restored. The diagnostic and stability tests generally support the adequacy of the model, although the rejection of residual normality means that the results should be interpreted with some caution.

given the relatively small annual sample.

From a policy perspective, the findings underline the importance of reducing the dependence of public expenditure on current hydrocarbon revenues. A more credible medium-term fiscal framework, based on conservative oil price assumptions and clear expenditure rules, could help limit excessive spending during oil booms. At the same time, stronger stabilization buffers would allow the government to avoid abrupt spending adjustments when oil prices decline.

Improving the flexibility and efficiency of expenditure is equally important. Better prioritization of public investment, wider use of multi-year budgeting, and gradual reform of rigid current spending could make fiscal policy more resilient to oil price fluctuations. Such reforms would help smooth expenditure over the oil cycle and strengthen the long-term sustainability of public finances.

The study contributes to the literature by showing how asymmetric oil price movements are transmitted to government expenditure growth in Algeria. Future research could build on these findings by distinguishing between current and capital expenditure, examining individual spending categories such as wages, subsidies, transfers, and public investment, and incorporating direct measures of fiscal buffers, institutional quality, and structural breaks.

6. Bibliography List :

1. Al Jabri, S., & al. (2022). Oil prices and fiscal policy in an oil-exporter country: Empirical evidence from Oman. *Energy Economics*, 111, 106103.
2. Alesina, A., & al. (2008). Why is fiscal policy often procyclical? *Journal of the European Economic Association*, 6(5), 1006–1036.
3. Çiçekçi, C., & Gaygisiz, E. (2023). Procyclicality of fiscal policy in oil-rich countries: Roles of resource funds and institutional quality. *Resources Policy*, 85, 103675.
4. Coutinho, L., & al. (2022). Limiting fiscal procyclicality: Evidence from resource-dependent countries. *Economic Modelling*, 106, 105700.
5. El Anshasy, A. A., & Bradley, M. D. (2012). Oil prices and the fiscal policy response in oil-exporting countries. *Journal of Policy Modeling*, 34(5), 605–620.
6. Frankel, J. A., & al. (2013). On graduation from fiscal procyclicality. *Journal of Development Economics*, 100(1), 32–47.

7. Hadj Moussa, S. (2025). Challenges of oil revenue management: Procyclicality of fiscal policy in response to oil price volatility during the period 1990–2020. *Journal of Management and Economic Sciences Prospects*, 9(1), 344–358.
8. Kaminsky, G. L., & al. (2005). When it rains, it pours: Procyclical capital flows and macroeconomic policies. *NBER Macroeconomics Annual*, 19, 11–53.
9. Pesaran, M. H., & al. (2001). Bounds testing approaches to the analysis of level relationships . *Journal of Applied Econometrics*, 16(3), 289–326, 289-326.
10. Shin, Y., & al. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in honor of Peter Schmidt: Econometric methods and applications* , 281-314.
11. Talvi, E., & Végh, C. A. (2005). Tax base variability and procyclical fiscal policy in developing countries. *Journal of Development Economics*, 78(1), 156–190.
12. Villafuerte, M., & Lopez-Murphy, P. (2010). Fiscal policy in oil producing countries during the recent oil price cycle. *IMF Working Paper No. 10/28*.