The asymmetric effects of tourism spending on the development of the tourism sector in Algeria

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Abstract: The tourism sector plays a significant and multifaceted role in Algeria, and it helps build better infrastructure, protects historical and natural sites, and supports the hotel and restaurant industry. In addition, tourism improves Algeria's image and strengthens its international relationships. Therefore, by developing this sector, Algeria aims to diversify and grow the national economy beyond oil and gas, create new jobs, and reduce regional inequalities. This research employed a Non-linear ARDL model to examine the impact of tourism expenditure on the growth of the sector in Algeria, and it investigates whether positive and negative expenditures produce divergent (asymmetric) impacts on the tourism sector.

Keywords: Tourism spending, Economic growth, Algeria, NARDL model, Asymmetric effects

JEL Classification Codes :L83,L87,O4.

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1. Introduction

Many developing countries, including Algeria, consider tourism as a powerful driver for growth, economic development, and job creation. However, tourism-related expenditure does not always result in economic expansion, because the Algerian economy depends widely on oil and gas (hydrocarbons). This situation calls for a strategic diversification of the economy, although the economy benefits from oil prices, long-term development cannot be ensured by them alone.
The growth of tourism can have many positive effects on Algeria, such as creating new jobs, and supporting sustainable growth. In other words, this relationship can only exist if tourism plays a significant role, generating major expenditure and establishing links, particularly with other areas like agriculture and food processing, fishing, manufacturing, and services. Furthermore, tourism encourages the building of basic infrastructure, including roads, port and airport facilities, and other supporting services.

Problem statement

This paper aims to confirm the relationship among tourism expenditure and algeria's tourism growth. It investigates whether this relationship is symmetric or asymmetric, or in another word, do increases in spending have the same effect as decreases? The study will also explore how this relationship differs between the short term and long term, in order to provide valuable insights for formulating practical recommendations to enhance sustainable growth in this sector in Algeria, through stable and effective expenditure policies.

Study hypothesis

1. There is a long-term equilibrium relationship between tourism expenditure and tourism sector growth.
2. Tourism expenditure has an asymmetric impact on tourism sector growth in both the short and long term.
3. Tourism expenditure has a statistically significant effect on tourism sector growth in both the short and long term.

The importance of the study

Public authorities play a major role in developing the tourism sector through their intervention, infrastructure development, and flexible and stable legal regulations. However, this study focuses more specifically on how tourism spending impacts the sector, and the Non-linear ARDL (NARDL) model is used to examine these relationships because of its importance in measuring these specific links and impacts.

2. Fundamental theory and literature

Tourism is defined as the collection of productive activities that primarily serve visitors, whose refers to an individual who visits a destination beyond their regular place of living, for a period extended by one year, including for reasons such as business, holidays or other personal reasons), except for employment with an entity established in the country or place visited. (UNWTO, 2008).

2.1. The main profit of the tourism sector

Tourism is a vital sector and a major driver of the economy in many countries, and plays a multidimensional role in driving economic growth. This role is evident through its direct contribution to creating job opportunities, increasing government revenues, and stimulating other relevant economic sectors, through several approaches, the most important of which are:

Generate revenue: In 2024, the tourism sector posted a positive result, contributing $10.9 trillion in productivity gains to the global economy. These figures, which include direct and indirect impacts, highlight the enormous size and strategic weight of this vital sector ((WTTC), What is the economic impact of Travel & Tourism?, 2025)

Employment Generation through the Tourism Industry: The tourism industry is recognized as one of the leading sectors in generating employment opportunities, surpassing many other industries in its capacity to create jobs. Its contribution to employment is nearly double compared to other sectors, reflecting its significant economic impact. Furthermore, tourism activities extend across all regions of a country, including rural areas, thereby providing job opportunities for local populations beyond urban centers**.**In 2021, around 11.3 million people in the EU were engaged in tourism-related economic activities, including 6.8 million in food and beverage services, 2.1 million in accommodation, 1.8 million in transport, and 0.4 million in travel agencies and tour operations. Sectors highly dependent on tourism—namely accommodation, travel agencies and tour operators, and air transport—employed approximately 2.8 million people.(Eurostat, 2024)

Contribution to GDP:The economic contribution of tourism extends far beyond the direct revenues of hotels and airlines, establishing itself as a key driver of Gross Domestic Product (GDP) through two primary channels: the Direct Contribution and the Total Contribution.

2.2. literature review

(Mohamed & Abed , 2025) This study examines how the tourism sector contributes to economic growth in Algeria by analyzing tourism spending, employment, and investment from 2000 to 2023 using the ARDL methodology. The main results show that tourism investment spending is still insufficient and has not reached levels seen in other sectors, resulting in a negative long-term impact on growth. The study emphasizes the importance of improving tourism training, developing skills, and promoting tourism opportunities to attract greater investment and achieve desired GDP growth.

However, (Alqaralleh & Ahmad , 2025) examine the affectsof tourism on economic growth using the quantile ARDL model applied to panel data, focusing on regional differences and development levels. The main findings indicate that European countries benefit greatly from strong tourism industries, while countries in the Asia-Pacific region are actively developing tourism to strengthen their economies.

In addition, (Karimi, Huseyin , & Babak , 2024) examine the long-term and short-term causal relationship between growth and tourism development in the context of Singapore for the period from 1983:1 to 2020:4. We use an augmented distributed lag autoregressive model (Asymmetric/Non-linear ARDL (NARDL)). The overall empirical results confirm the positive implications of tourism development for long-term economic growth in Singapore, with an upward elasticity of 0.14 and a downward elasticity of 0.08. This means that tourism can be one of the important factors in Singapore’s long-term economic growth, but in the short term, its impact is negative or insignificant.

The study (Zakaria, 2025) aims to determine the relationship between the tourism sector and economic growth (GDP) in Algeria over the period 2000–2023, using the Autoregressive Distributed Lag (ARDL) model. The empirical results revealed a significant long-term impact between growth and tourism. However, the short-term results showed a weak dynamic relationship.

At the same time, using the DFE ARDL (Dynamic Fixed Effects Autoregressive Distributed Lag) model, this research estimates the short- and long-term effects of domestic and international tourism on the economic complexity of 123 economies between 1995 and 2018. Empirical analysis reveals that domestic tourism expenditure has an insignificant negative impact on economic complexity in the short term. However, in the long term, it has a significant positive effect, suggesting that domestic tourism could be a powerful driver of the long-term geography of economic activities.

On the other hand, international tourism has a positive effect in the short term, although its long-term impact is less pronounced (Phuc, Bui , & Nguyen, 2024).

While the literature has extensively explored the advantages and disadvantages of tourism, as well as attempts to establish links between growth/development and tourism, in-depth studies addressing the impact of tourism on sustainable development remain scarce. To fill this gap, our investigation focuses on understanding the link between tourism and the achievement of sustainable development goals.

Using a panel dataset covering 160 economies from 1995 to 2019, the results reveal a significant interaction between tourism and sustainable development, with the nature of this relationship varing between developed and developing economies, particularly in terms of GDP per capita (Elgin & Adem , 2024).

Furtheremore, (Oluwaseyi, 2019)measures the relationship between economic growth (GDP) and tourism revenue in North African countries between 1995 and 2016. The main findings show that tourism has the potential to stimulate economic growth both in the short term, with a coefficient of (6%), and in the long term, with a coefficient of (29%).By concentrating on Algeria and applying the Non-linear ARDL (NARDL) method to examine how positive and negative spending shocks impact the economy differently, this study aims to close this gap.

3. Data and methodology

3.1. Data The study relies on annual data from 1990 to 2023 on tourism sector growth variables, tourism expenditure, capital expenditure rate. Table 1 provides details of the variables, including their descriptions, units of measurement, and data sources. All series are transformed into natural logarithms.

Table 1. Description of study variables

Variables	Definition	Data source
Y	Tourism Sector Growth (annual growth rate of the tourism sector's contribution to GDP)	The Ministry of Tourism and Crafts Word Bank
X1	Tourism Spending (total international and domestic tourism receipts/expenditure)	
X2	Tourism Investment (rate of investment and fixed capital formation in the tourism sector)	

Source: author's computation

Assuming a linear relationship between the model variables, the regression equation can be whritten as indicated:

$$\boldsymbol{Y = f(X1, X2,)}$$

However, Ordinary Least Squares (OLS) is not an appropriate method, this is because most economic data changes over time and is non-stationary, and if we use OLS the results might be spurious. So, we change the model to Non-linear ARDL approach, which allow to see how the economy reacts differently to changes in spending

3.2. Results and the diagnostic tests

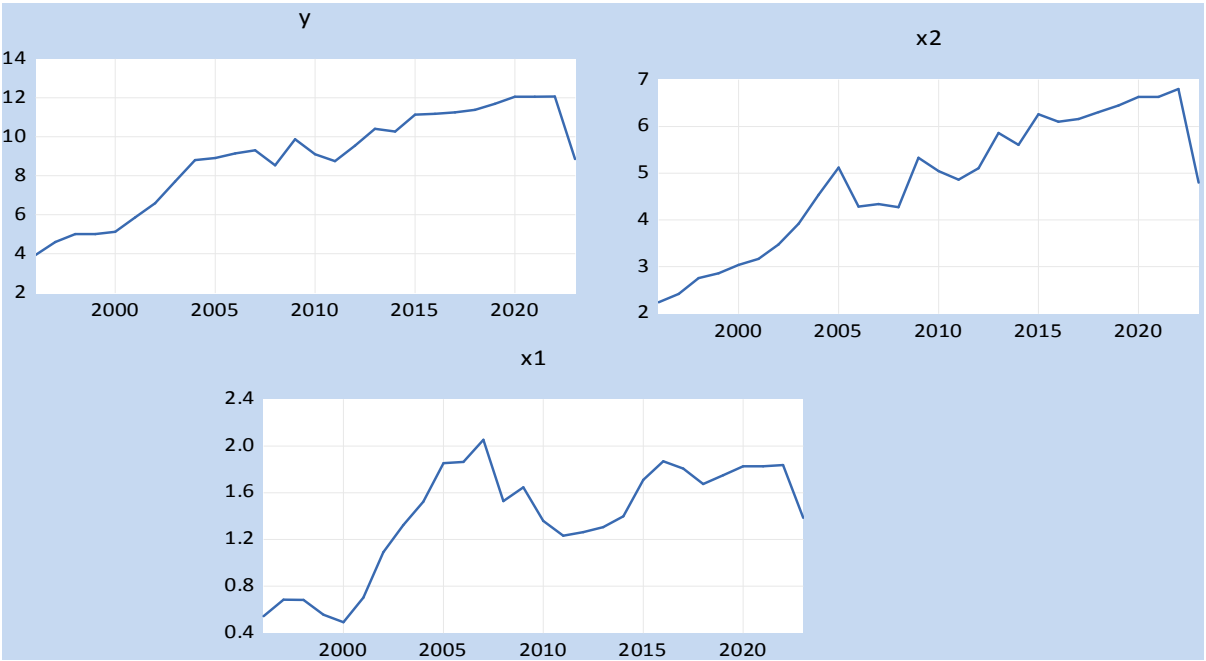
Model estimation

Most studies that rely on Ordinary Least Squares (OLS) models face problems in econometric analysis, as spurious coefficient estimation issues emerge due to the non-stationary nature of time series data. This is primarily attributed to the fact that time series contain non-random elements that affect their temporal path, which may distort the causal relationships between economic variables. Therefore, we discard the initially proposed model and instead adopt a re-specification model according to time series analysis methodology

Unit Root Test (ADF & PP) Tests

Studying the stability of time series is an essential step in detecting compounds that lead to problems in statistical estimation. Among the common analytical methodologies in this context are the enhanced Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. However, before applying these tests, a graphical representation of the data must be made to explore its initial characteristics, as the graphical representation of the time series of the study variables shows an unstable evolutionary pattern over time. Which supports the hypothesis of the instability of these chains.

Figure 01. Time Series trends of the study variables in Algeria (1990–2023)



Source: Eviews 12 output

To enssure that our variables used in the regression were stationary we can the ADF and PP tests, the main resukts presented in the following table.

Table 02. The Results of the Unit Root Test of all variables

Unit Root Test					Unit Root Tes (ADF)				
	At Level					**At Level**			
		Y	X1	X2			Y	X1	X2
With Cons...	t-Statistic	-2.1165	-1.9722	-1.9331	With Cons...	t-Statistic	-2.1165	-2.3761	-1.9280
	Prob.	***0.2401***	***0.2965***	***0.3130***		***Prob.***	***0.2401***	***0.1581***	***0.3152***
		n0	n0	n0			n0	n0	n0
With Cons...	t-Statistic	-0.2791	-1.5853	-1.3614	With Cons...	t-Statistic	-0.2791	-2.1986	-1.3614
	Prob.	***0.9871***	***0.7721***	***0.8493***		***Prob.***	***0.9871***	***0.4699***	***0.8493***
		n0	n0	n0			n0	n0	n0
Without C...	t-Statistic	0.4929	-0.0203	0.3239	Without C...	t-Statistic	0.5163	0.1170	0.3239
	Prob.	***0.8152***	***0.6671***	***0.7718***		***Prob.***	***0.8208***	***0.7114***	***0.7718***
		n0	n0	n0			n0	n0	n0
	At First Difference					**At First Difference**			
		d(Y)	d(X1)	d(X2)			d(Y)	d(X1)	d(X2)
With Cons...	t-Statistic	-2.9016	-3.8330	-4.1559	With Cons...	t-Statistic	-2.9224	-1.9970	-4.1693
	Prob.	***0.0588***	***0.0075***	***0.0035***		***Prob.***	***0.0564***	***0.2861***	***0.0034***
		*	***	***			*	n0	***
With Cons...	t-Statistic	-3.4659	-3.9542	-4.1374	With Cons...	t-Statistic	-3.4659	-3.8555	-4.5015
	Prob.	***0.0645***	***0.0239***	***0.0161***		***Prob.***	***0.0645***	***0.0294***	***0.0072***
		*	**	**			*	**	***
Without C...	t-Statistic	-2.9197	-3.8944	-4.0723	Without C...	t-Statistic	-2.9751	-3.7875	-4.0723
	Prob.	***0.0052***	***0.0004***	***0.0002***		***Prob.***	***0.0045***	***0.0005***	***0.0002***
		***	***	***			***	***	***

Notes: (*) Significant at 10%, (**) Significant at 5%, (***) Significant at 1%, and (no) Not Significant
MacKinnon (1996) one-sided p-values

The results of ADF and pp test reveal that the degree of integration of varaibles can be summarised as follows:

- Series (y) is stable at the first difference: $y_t \rightarrow I(1)$;
- Series (x_(1 t)): Stable at first difference: $x_{1\,t} \rightarrow I(1)$;
- Series (x_(2 t)): Stable at first difference i.e: $x_{2\,t} \rightarrow I(1)$؛cointegration test (cointegration analysis)

Since the time series are non-stationary of the same order, the Johansen cointegration test cannot be used. Therefore, we rely on the Bounds Testing approach. Before that, we estimate the optimal ARDL model and then the optimal non-linear NARDL model. The functional form of the model based on the study variables can be written as follows:

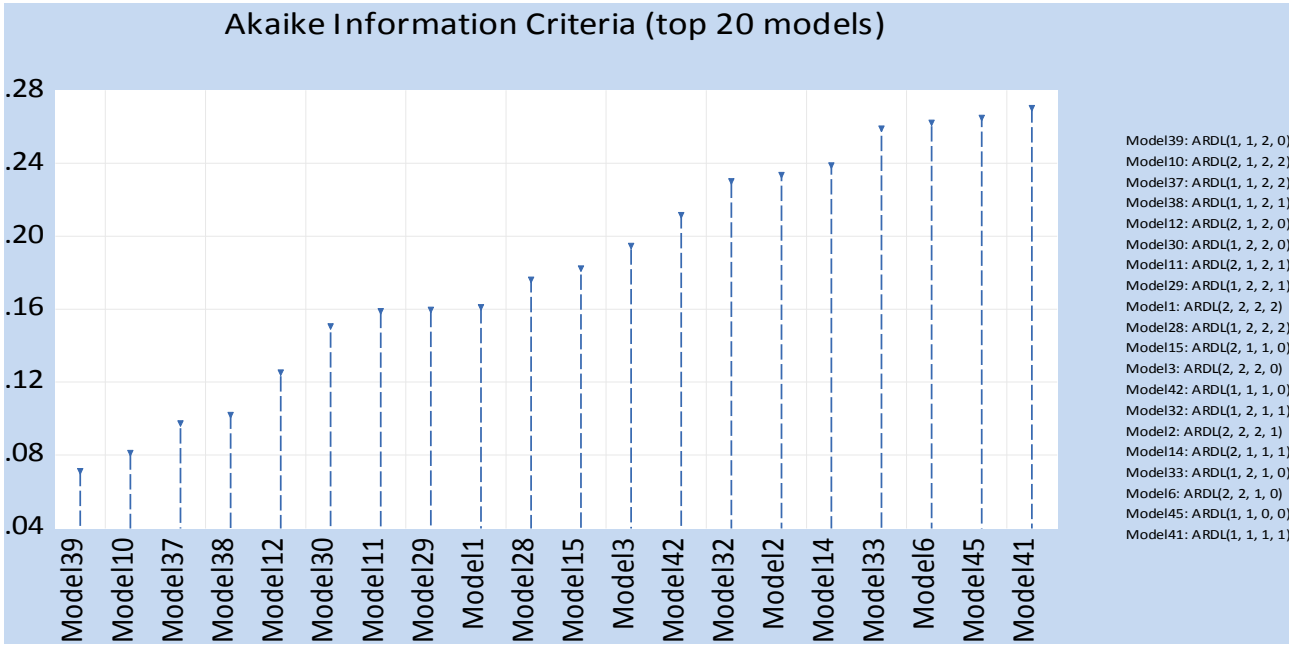
$$\Delta y_t = a_0 + \sum_{i=1}^{p-1} \beta_{1i}\Delta y_{t-i} + \sum_{i=0}^{q_1-1} \beta_{2i}\Delta x_{1\,t-i} + \sum_{i=0}^{q_2-1} \beta_{3i}\Delta x_{2\,t-i} + \emptyset_1 y_{t-1} + \emptyset_2 x_{1\,t-1} + \emptyset_3 x_{2\,t-1} + u_t$$

Based on the ARDL (p, q□, q□) model, the nonlinear formulation of this model assuming that the independent variables can be divided into two parts can be written as follows

$$\Delta y_t = a_0 + \sum_{i=1}^{p-1} \beta_{1i}\Delta y_{t-i} + \sum_{i=0}^{q_1^+-1} \beta_{2i}^+\Delta x_{1\,t-i}^+ + \sum_{i=0}^{q_1^--1} \beta_{2i}^-\Delta x_{1\,t-i}^- + \sum_{i=0}^{q_2-1} \beta_{3i}\Delta x_{2\,t-i} + \emptyset_1 y_{t-1} + \emptyset_2^+ x_{1\,t-1}^+ + \emptyset_2^- x_{1\,t-1}^- + +\emptyset_3$$

This formula refers to the NARDL (p, q□$^+$, q_1^- , q_2^+ , q_2^-) model, where this model will be estimated and the optimal deceleration scores determined using the Akaike criterion. To implement this, the statistical program EViews 12 was relied upon, which provides a summary of the best models based on the mentioned criterion by testing different deceleration scores.

Figure 02. Optimal ARDL model within 20 selected models



Source :Eviews 12 outputs

The graph shows that the lowest value of the Akaike criterion corresponds to model 39, which translates to a NARDL (1,1,2,0) model. We can therefore estimate this model to obtain the following regression results:

Table 03. Wald test results confirming the existence of a cointegration relationship

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	25.40736	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

By comparing the calculated test value with the tabulated value. The results reveal that Fisher's calculated statistical value (F-statistic=25.40) is greater than the upper-bound critical value at the 5% significance level. Therefore, the estimation results prove that a long-run cointegration relationship exists among the variables.as a consequence, we can use the NARDL approach.

Estimation results for the model parameters and confirm its validity: After confirming the existence of a long-term cointegration relationship among the variables, we estimate the model parameters, both long-term and short-term, in order to achieve an economic interpretation of the model and perform the necessary diagnostic tests to validate the proposed model.

Estimation of long-term parameters: The results of estimating the long-term parameters of the NARDL model can be summarized in the following table:

Table 04. Results of Long-Term Parameter Estimation

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1_POS	2.023822	0.176499	11.46645	0.0000
X1_NEG	0.925105	0.162011	5.710148	0.0000
X2	0.764087	0.126316	6.049010	0.0000
C	2.887243	0.339846	8.495745	0.0000
EC = Y - (2.0238*X1_POS + 0.9251*X1_NEG + 0.7641*X2 + 2.8872)				

Estimation of short-term parameters and error correction model:

The error correction model is employed to estimate the adjustment coefficient,The findings indicate the speed (Mohamed & Abed , 2025)at which the system returns to its long-run equilibrium after a short-term shock. This coefficient represents the strength of the adjustment process in the presence of short-term disequilibrium.The results of the estimation of this coefficient are presented in the table below:

Table 5. Results of Short-Term Parameter Estimation

ARDL Error Correction Regression
Dependent Variable: D(Y)
Selected Model: ARDL(1, 1, 2, 0)
Case 2: Restricted Constant and No Trend
Date: 03/04/25 Time: 23:16
Sample: 1996 2023
Included observations: 25

ECM Regression Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X1_POS)	0.989617	0.281613	3.514098	0.0027
D(X1_NEG)	2.214213	0.274213	8.074807	0.0000
D(X1_NEG(-1))	1.069195	0.393973	2.713876	0.0147
CointEq(-1)*	-1.429630	0.114123	-12.52708	0.0000

The table shows that the error correction term is negative and statistically significant, confirming that short-term imbalances are corrected and return to the long-term equilibrium. Given the coefficient value of -1.429, the adjustment occurs rapidly, specifically within a period of approximately 0.7 years (equivalent to roughly 8 months and 11 days).

4. Diagnostic tests for the estimated model

Diagnostic tests are used to ensure the robustness of the estimated NARDL model and to verify that it is free from econometric problems. There are several diagnostic tests are used to prove the model's validity. These tests are summarized as follows:

Testing for autocorrelation of errors

The problem of autocorrelation of errors is considered one of the most important economic measurement problems affecting the quality of standard models, Within the bounds testing framework, the Breusch-Godfrey test is among the most widely used methods to detect this problem.

Table 06. Results of the Autocorrelation Test

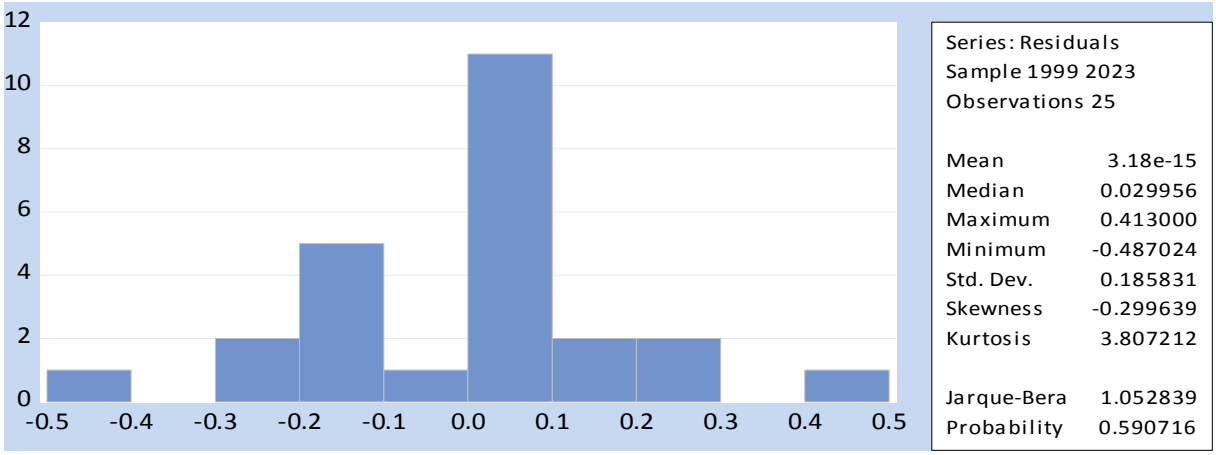
Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.417895	Prob. F(2,15)	0.6659
Obs*R-squared	1.319463	Prob. Chi-Square(2)	0.5170

The results of the estimation show that the calculated F-statistic (0.66) is below the critical value at the 5% significance level. Consequently, the null hypothesis is accepted, implying that there is no autocorrelation between the residual estimates.

Normal distribution of residuals

The Jarque-Bera test is used, where the null hypothesis indicates that the errors follow a normal distribution, and the results of this test are presented in the following figure:

Figure 03. Results of the Jarque-Bera test on residual estimates



The finding prove that the residuals are normally distributed, Furthermore, we observe that the probability of the Jarque-Bera test (0.59) is greater than 5%, and therefore we accept the null hypothesis of normality.

Variance Stability Test

Standard models require that the assumption of homoscedasticity (constant error variance) be satisfied. The ARCH test is employed to verify this assumption.

Table 07. Results of the Pagan-Godfrey Test for Error Variance Stability

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	1.628780	Prob. F(7,17)	0.1941
Obs*R-squared	10.03598	Prob. Chi-Square(7)	0.1865
Scaled explained SS	6.513627	Prob. Chi-Square(7)	0.4812

The results of the estimation indicate that the variance of the error term is constant, and given that the calculated value of the Fisher's test is below the critical value for a 5% significance level, the null hypothesis is accepted; this is explained by the fact that the variance of the error term in the estimated model is homogeneous.

Testing the functional form of the Ramsey Reset model

This test is used to determine where the model is stable over time or not, and the results of this test were as follows:

Table 08. Results of the Ramsey RESET Test

Ramsey RESET Test
Equation: NARDL
Omitted Variables: Squares of fitted values
Specification: Y Y(-1) X1_POS X1_POS(-1) X1_NEG X1_NEG(-1) X1_NEG(-2) X2 C

	Value	df	Probability
t-statistic	1.047843	16	0.3103
F-statistic	1.097974	(1, 16)	0.3103
Likelihood ratio	1.659282	1	0.1977

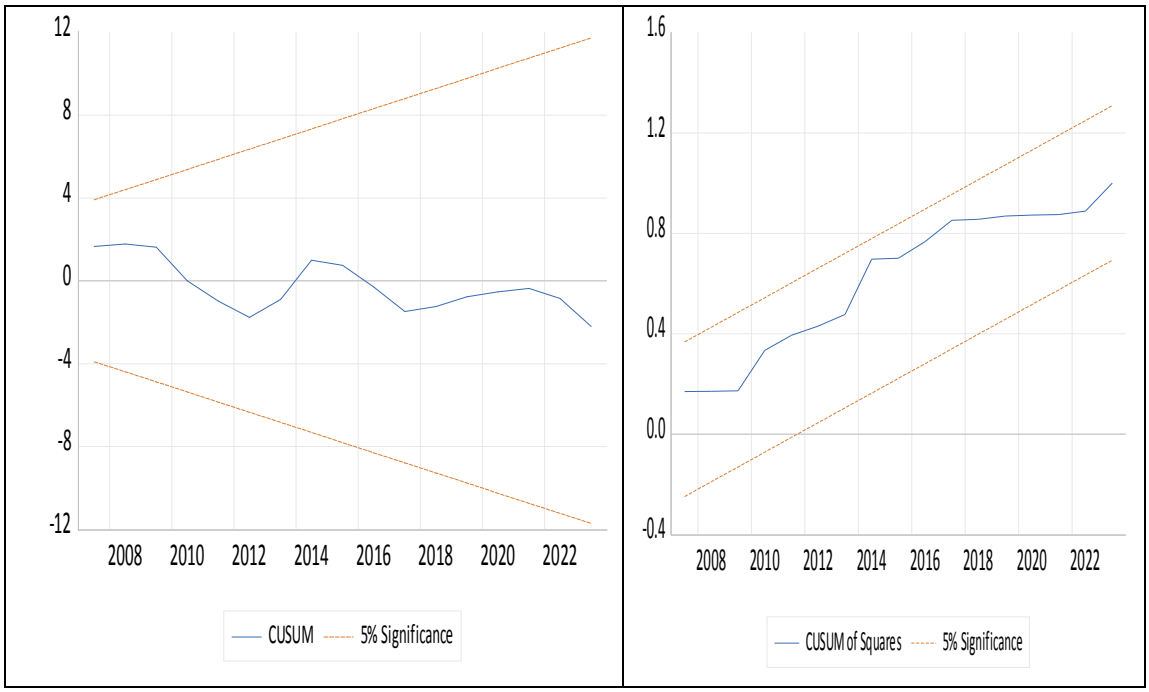
We note that the p-value from Fisher's test is greater than the 5% significance level, consequently, the results of the proposed estimation can be considered valid for describing the relationship between the economic variables under study.

Structural stability test of the estimated NARDL model

This method ensures that the data used do not exhibit any structural changes over time, to this end, two tests are used: the cumulative sum of residuals (CUSUM) test and the cumulative sum of squares of residuals (CUSUM of squares) test.

The results of the analysis show that the estimated coefficients of the NARDL model used are structurally stable over the period under study, confirming the existence of stability among the variables examined and the consistency of the model between the short- and long-term error correction results, with the graphs for both tests falling within the critical limits at the 5% significance level.

Figure 04. CUSUM and CUSUM of Squares Tests



Symmetry test for short-term and long-term parameters

The symmetry test is used to confirm the two hypotheses of symmetry between short-term and long-term parameters. In other words, using the Wald test, we prove that the negative effects of the independent variables do not differ (are similar) from the positive effects of the same variables on the dependent variable.

- For variable investment expenditure (X_1)
- Long term: Long-term parameters are tested based on the following hypothesis:
  Null hypothesis: The positive and negative effects of the independent variable x_1 have a similar effect on the dependent variable in the long term, i.e., $H_0: \emptyset_2^+ = \emptyset_2^-$،
  Alternative hypothesis: The positive and negative effects of the independent variable x_1 have an asymmetric effect on the dependent variable in the long term

$$H_1: \emptyset_2^+ \neq \emptyset_2^-$$

Table 09. Results of the Wald test for long-term symmetry (variable x1)

Wald Test:
Equation: LRFORM01

Test Statistic	Value	df	Probability
t-statistic	-5.654700	4	0.0048
F-statistic	31.97563	(1, 4)	0.0048
Chi-square	31.97563	1	0.0000

The estimation results imply that the probability value of the F-test is below the 5% level and therefore accept the alternative hypothesis This indicates the presence of asymmetry between positive and negative shocks to the investment expenditure variable in the tourism sector (X□) and their effects on the domestic tourism growth rate (Y) in the long term.

- Short term: The hypotheses for the short-term symmetry test can be formulated as follows:
  Null hypothesis: positive and negative shocks on variable x_1 have a similar effect on y in the short term.
  Alternative hypothesis: positive and negative shocks on variable x_1 have an asymmetric effect on y in the short term.

Wald Test
Equation: LRFORM01

Test Statistic	Value	df	Probability
t-statistic	5.782047	4	0.0044
F-statistic	33.43206	(1, 4)	0.0044
Chi-square	33.43206	1	0.0000

We find that the probability value of the F-test is less than 5%, and therefore we accept the alternative hypothesis This indicates the presence of asymmetry between positive and negative shocks to the capital investment variable in the tourism sector (X□) and their effects on the short-term domestic tourism growth rate (Y)

5. Conclusion

Tourism is an important sector for economic and social development. Algeria currently needs the means to diversify its national economy. The sector is poorly ranked, yet Algeria remains an almost untouched tourist destination that, unfortunately, has not yet been sufficiently exploited compared to international standards.

Algeria has enormous tourism potential that could give rise to a thriving and lucrative tourism industry. The country's natural resources, including its coastline, mountains, plains, forests, hot springs, Sahara Desert, and diverse landscapes, will enable it to become a leading destination for seaside, Saharan, cultural, and spa tourism.

Significant long-term asymmetry is confirmed by the Wald test results ($F=31.97$, $p<0.01$), which suggests that the tourism industry does not react linearly to financial infusion. For Algerian policymakers, this indicates that large-scale positive shocks to infrastructure are necessary to break the economy's reliance on hydrocarbons (cautious or incremental investment may not be sufficient to initiate the desired economic diversification).

The findings of this study imply that stable tourism spending and capital investment is key to fulfilling this potential, as the sector responds considerably to expenditure shocks.

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