P-ISSN: 2204-1990; E-ISSN: 1323-6903

Academic Translation: The Impact of Algerian Natural Gas Revenues on the Trade Balance: An Empirical Study Using the Non-linear Autoregressive Distributed Lag Model

Hadj Kouider Abdelhadi[1], Lahciene Abdelkader[2], Hacene Bouamra[3]

[1] University Ahmed Draia -Adrar, Algeria (The Spatial and Entrepreneurial Development Studies Laboratory SEDLAB), H.abdelhadi@univ-adrar.edu.dz

[2] University Ahmed Draia -Adrar, Algeria (The Spatial and Entrepreneurial Development Studies Laboratory SEDLAB), lahciene.aek@univ-adrar.edu.dz

[3] University Echahid Cheikh Larbi Tebessi -Tebessa, Algeria, Hacene.bouamra@univ-tebessa.dz

Received: 11/2023, Published: 12/2023

Abstract:

The study aimed to measure the impact of Algerian natural gas revenues on the trade balance during the period (2000-2022). The study utilized the Nonlinear Autoregressive Distributed Lag (NARDL) model to assess the effect of both positive and negative values of natural gas revenues on the trade balance over the short and long terms.

The findings indicate that an increase in natural gas revenue in Algeria leads to an increase in the trade balance in both the short and long terms. Conversely, a decrease in total revenues has a negative impact on the trade balance.

Keywords: Trade balance; Natural gas; NARDL model; Algeria.

Introduction

Global energy markets have witnessed numerous changes in recent decades, leading to an increasing importance of natural gas in the energy mix and its growing utilization worldwide. This was succinctly summarized by the International Energy Agency's (IEA) expectations in its 2011 report on natural gas, forecasting that the world would rapidly enter a golden age of gas. According to these projections, global demand for gas would reach 5.1 trillion cubic meters by 2035, increasing its share in the global energy market from 21% to 25%.

In light of these developments, the significance of Algerian natural gas in meeting the growing demand for gas is highlighted. Algeria is considered a major gas-producing country, leading in gas industry investments. It possesses comprehensive expertise and a long history in establishing gas complexes. Additionally, Algeria was the first country to put into service a gas pipeline between continents in deep waters, connecting Africa to Europe. In 1983, the first gas export pipeline to Europe was launched, making Algeria a major supplier of natural gas to European countries.

Problem Statement:

The developments in global natural gas markets have allowed Algeria to benefit from an increased volume of natural gas supplies. The importance of Algeria's natural gas exports has become more prominent amid the fluctuating oil exports. This is due to various factors,

P-ISSN: 2204-1990; E-ISSN: 1323-6903

such as the volatility of oil prices and the decline in Algerian oil production capabilities. This leads us to pose the following question: Given the production capabilities of natural gas and the increased volume of Algeria's natural gas exports, to what extent can Algerian natural gas revenues affect the trade balance in the short and long terms?

Study Objectives:

Through this study, we aim to highlight the impact of Algerian natural gas revenue, both liquefied and through pipelines, on the Algerian trade balance. This is done considering the fluctuations in Algeria's natural gas exports, which have gained importance due to various factors, including the volatility of oil prices and the decline in Algerian oil production capabilities.

Significance of the Study:

The study derives its significance from the pivotal role played by Algerian natural gas exports and their contribution to the development of the Algerian economy. Earlier, revenues from oil exports held significant importance within fuel exports. However, in recent years, amidst the fluctuations in oil prices, the importance of revenue from natural gas exports has become apparent. In 2015, revenue from natural gas exports took the top position, constituting 34% of the total revenue from fuel exports, according to statistics from the Bank of Algeria.

1. Previous Studies:

There are several studies that have addressed the Algerian natural gas topic, and some notable ones can be highlighted as follows:

- (Ktouche & Belazzouz, 2005): This study focused on the prospects of Algerian industrial development and its strategies within the challenges of the gas market. It emphasized the regional developments in the international trade of liquefied natural gas (LNG). The study concluded that the development of the gas industry, being a highly capitalistic industry relying on long-term contracts, fosters collaboration between various stakeholders, aiding in the global trade of gas. Additionally, the study found that Algeria serves as a primary energy supplier to Europe, covering approximately 12 to 15% of European demand.
- (Darbouche, 2011): This study concentrated on recent shifts in Algerian natural gas export strategy, particularly in the last few years, and the impact of amendments to hydrocarbon laws on this strategy. It examined Algeria's efforts to increase its exports rates and how this goal clashed with the structural changes in global and regional LNG trade. The study also discussed the new management's efforts in the hydrocarbon sector to mitigate risks arising from global gas trade changes and adapt to them based on available resources.
- (Ouki, 2019): This study addressed internal challenges related to the rise in domestic demand for natural gas and its expected impact on Algeria's natural gas exports. It concluded that the rapid growth of local natural gas demand significantly limits export capabilities and directly affects one of Algeria's primary revenue sources due to the nature of local gas price support.
- (Haj Gouider, 2019): This study focused on global developments in natural gas markets and their impact on Algerian gas exports, with a specific focus on the European market. Despite the crucial role played by Algerian natural gas in global markets, especially in Europe, the study found that changes in global natural gas markets negatively affected Algerian gas exports. The historical advantage of Algeria in global gas trade is no longer sufficient to secure its share in external markets.

- (Abdelrazak, 2022): This study delved into the future trends of Algerian gas exports amidst new conflicts, emerging competitors, and local consumption pressures. Considering the ongoing international developments, particularly the Russo-Ukrainian crisis, the study concluded that the European crisis could provide a demand opportunity for Algeria, estimated at around 80 billion cubic meters. However, the increasing local demand and potential production decline pose challenges to Algeria's gas exports to meet European demand.

2. The Conceptual Framework of Determinants Controlling Algerian Natural Gas Export Revenues.

2.1 Qualifications of Algerian Natural Gas: Algeria possesses significant reserves of Algerian natural gas. According to a report by British Petroleum (BP), Algeria holds around 4.5 trillion cubic meters, representing 2.1% of global reserves. Notably, the volume of Algerian natural gas reserves has remained stable since 2005, despite ongoing discoveries through efforts by Sonatrach and partnerships with foreign companies.

On the other hand, Algeria aims to enhance its production capacities, as the development of marketed natural gas production is constantly subject to changes in domestic consumption and the requirements of fulfilling contractual commitments with consumers. These conditions determine production levels. With the increasing importance of natural gas as a clean energy source, Algeria has worked to create a conducive environment for developing natural gas reserves, enabling an increase in production to reach 100.8 billion cubic meters in 2021, constituting 2.5% of global production. As of June 2022, Algeria ranks first in Africa, fourth in the Arab world, and tenth globally, according to the BP report. (Bp.2022).

Despite the rise in the volume of Algerian natural gas, it faces the challenge of increasing domestic consumption, estimated at 45.8 billion cubic meters in 2021. This could potentially have a negative impact on export capabilities if the trend continues to rise.

2.2 Paths and Methods of Algerian Natural Gas Export:

2.2.1 Pipeline Export:

Algeria is considered a leading country in the field of natural gas export through pipelines, given its extensive export networks to European countries, either through Arab countries or directly across the Mediterranean Sea (Mazouz, 2014). Algeria was the first country to commission a deep-water intercontinental gas pipeline connecting Africa to Europe. Since the inception of the first natural gas export pipeline to Europe in 1983, specifically the Enrico Mattei pipeline (also known as Transmed), and subsequent construction of new pipelines, Algeria's gas exports through pipelines have experienced significant development, constituting more than 60% of the country's gas exports.

Algeria exports gas to Southern Europe through three pipeline routes:

- Enrico Mattei Pipeline (Transmed): This pipeline connects Algeria to Italy and extends to Slovenia, passing through Tunisia. It became operational in 1983 and initially consisted of three parallel lines, each with a diameter of 20 inches and a capacity of 6 billion cubic meters per line, totaling 18 billion cubic meters. In 1995, a fourth line with similar specifications was added, increasing the pipeline's capacity to 24 billion cubic meters annually, potentially expanding to 30 billion cubic meters with additional pressure stations (Daghili & Hadi, December 22-29, 2009, p. 08).

- Pedro Duran Farell Pipeline: This pipeline, operational since 1996, extends from Algeria to Spain via Morocco, with an initial capacity of 8.5 billion cubic meters per year, increasing to 11.6 billion cubic meters annually in 2004. It supplies gas to Spain and Portugal through Morocco, with Morocco receiving around 600 million cubic meters per year as transit fees (SONATRACH, 2014). However, due to political differences, gas exports through this pipeline were suspended, and its contract, which expired in October 2021, was not renewed.
- Medgaz Pipeline: This pipeline connects Algeria to Spain through the Mediterranean Sea with an initial capacity of 8 billion cubic meters per year. It became operational in 2011, with a total length of 770 km, including 565 km with a diameter of 48 inches within Algerian territory from Hassi R'Mel to Béni Saf, and then a 200 km pipeline with a diameter of 24 inches to Almería, Spain.

There are two other pipeline projects under development to exploit new European markets for gas:

- The Galsi Gas Pipeline project, connecting Algeria to Italy via Sardinia, with a capacity of 8 billion cubic meters per year. The project involves Sonatrach (36%), Edison (18%), Eni (13.5%), Wintershall (13.5%), Hera (9%), Sfirs (5%), and Bragemsia (5%) (OPEP, 2009, p. 74). However, this project faced several challenges and was reconsidered due to the Russian-Ukrainian crisis, leading to the proposal of a new pipeline using modern technology capable of transporting hydrogen, representing a revolution in clean energy exports and the energy transition.
- The Great Desert Gas Pipeline Project to Europe: This project's capacity is estimated at 20-30 billion cubic meters per year, aiming to export natural gas from Nigeria to Europe through Algerian territory. The pipeline extends from the Warri region in Nigeria to Béni Saf or El Khala in Algeria, with a total length of approximately 4,188 km, including 2,310 km on Algerian soil, 840 km in Niger, and 1,037 km in Nigeria, with a gas pressure of up to 100 bar (OPEP, 2009, p. 75).

The implementation of these projects will enable Algeria to leverage its geographical location to capture a larger share of the European gas market amid the emergence of new competitors. However, the realization of these projects faces numerous challenges, as the launch of the Trans-Saharan Gas Pipeline project dates back to 2002, with delays in its start due to financial and security obstacles, as well as the Ukrainian-Russian crisis leading to a reconsideration of the project for the creation of a new pipeline with modern technology capable of transporting hydrogen, representing a revolution in clean energy exports and the energy transition.

2.2.2 Algerian Liquefied Natural Gas (LNG) Exports:

Until the early sixties of the last century, natural gas transportation globally was primarily done in its gaseous state through pipelines. This situation undoubtedly hindered the widespread establishment of an international market for natural gas, similar to the petroleum market. However, technological advancements in gas liquefaction contributed to Algeria taking the lead in the production and export of Liquefied Natural Gas (LNG) through the "Project El Kala." Production began in the Arzew unit in 1964, marking Algeria's entry into LNG exports to Europe in the mid-sixties and to America by the end of the mentioned decade (Ali, 2007, p. 55).

In light of developments and the entry of new players, Sonatrach increased its fleet of LNG carriers, comprising 9 vessels, with the most notable being "Lalla Fatma N'Soumer" with a capacity of 145,000 cubic meters. Sonatrach aims to reinforce its maritime fleet to keep pace with production developments, enhance LNG exports amid evolving LNG markets, and face new competitors. This necessitates Algeria to diversify its gas exports by maintaining its position in traditional markets and striving to establish a presence in new markets, especially high-demand Asian markets.

3. Empirical Study

3.1 Study variables and data source:

With the aim of comprehensively addressing all aspects of the research problem, which primarily revolves around measuring the impact of natural gas, whether liquefied or natural, revenues on the balance of trade in Algeria during the period (2000-2022), non-linear Non-Autoregressive Distributed Lag (NARDL) models were employed. These models facilitate measuring the effects of positive and negative shocks in total gas revenues and their transition to the Algerian trade balance in both the long and short terms. This represents a significant improvement over linear models that assume linearity in the relationship between macroeconomic variables in general. The reliance on non-linear models provides more efficient, reliable results and broader analytical possibilities. The procedural definitions for study variables, their units, and data sources are presented below:

Table No (01): Study Variables and Data Source

Variable	Type	Description	Source
Trade Balance (BC)	Dependent	The difference between the total exports of goods and services and total imports, calculated in billion US dollars	Bank of Algeria
Total Gas Revenues (TGR)	Main Independent	Algeria's total revenues from natural gas and liquefied gas, calculated in billion US dollars	Bank of Algeria

Source: Compiled by researchers based on Bank of Algeria

It is noteworthy that the data was transformed from its annual format (23 observations) to quarterly data (92 observations) using statistical methods to ensure the preservation of all statistical properties. This can be observed through a comparison between the original and transformed data (Appendix 01). Additionally, the natural logarithm was applied to model variables for several reasons, including ensuring the linearity of the relationship between variables and reducing variance, leading to higher quality estimation results. Moreover, elasticities were measured more accurately to facilitate the economic analysis process.

3.1.1 Study Model Description:

The study model was described based on previous applied literature addressing the same topic, taking into consideration the characteristics of the Algerian economy and the objectives outlined in this paper. The general mathematical formulation of the study model can be written as follows:

$$\boldsymbol{BC} = f(TGR)$$

With the introduction of natural logarithm:

$$\boldsymbol{LNBC} = f(LNTGR)$$

P-ISSN: 2204-1990; E-ISSN: 1323-6903

$$\mathbf{d}(LNBC_t) = \alpha + \rho LNBC_{t-1} + \left(\beta_1^{+} TGR^{+}{}_{t-1} + \beta_2^{+} TGR^{-}{}_{t-1}\right) + \sum_{j=0}^{q-1} (\gamma_n * \Delta LNBC_{t-J}) + \sum_{j=0}^{r-1} (\pi^{+}{}_{n} * \Delta TGR^{+}{}_{t-J}) + \sum_{j=0}^{r-1} (\pi^{-}{}_{n} * \Delta TGR^{-}{}_{t-J}) + \mu_t$$

Where: (α) represents the intercept or estimation constant., (ρ) the error correction coefficient and each $\left(\beta_1^{+} TGR^{+}{}_{t-1} + \beta_2^{+} TGR^{-}{}_{t-1}\right)$ Long-term positive and negative shocks to natural gas and LCG revenues while both represent $\sum_{j=0}^{r-1} (\pi^{+}{}_{n} * \Delta TGR^{+}{}_{t-J}) + \sum_{j=0}^{r-1} (\pi^{-}{}_{n} * \Delta TGR^{-}{}_{t-J})$ Positive and negative short-term shocks to natural and liquefied gas revenues and (j; 1........ n) represents the lag order of the model. and (t: 1......T) represents time, and μ_t represents the random error term, which is wight noise.

3.1.2 Descriptive Statistics for Study Variables:

To provide an initial understanding of the statistical characteristics of the time series related to study variables, a set of statistics for central tendency was calculated, as shown in the following table:

Table No (2): Descriptive Statistics for Study Variables

	TGR	BC
Mean	13.61461	9.394348
Median	12.654	9.410000
Maximum	27	40.25000
Minimum	5.74	-20.12000
Std. Dev.	5.934917	17.67815
Skewness	0.600526	-0.049101
Kurtosis	2.433869	2.009539
Jarque-Bera	1.689571	0.949379
Probability	0.42965	0.622078
Sum	313.136	699.07
Sum Sq. Dev.	774.9114	6875.376
Observations	23	23

Source: Eviews 12 outputs.

From the above table, it is evident that the mean for the trade balance variable (BC) is $30.39 billion, reflecting a somewhat positive and high surplus in the trade balance. This is attributed to the economic recovery in Algeria during periods of this study, stabilizing oil prices at high levels. The Algerian exports mainly consist of hydrocarbons, especially crude oil. Meanwhile, the mean for the total gas revenue variable (TGR) is $13.61 billion.

The highest recorded value for Algeria's total gas revenues was $27 billion in 2022, setting a record for gas exports, driven primarily by increased gas exports to European countries (due to the Russo-Ukrainian crisis) and confirmed energy discoveries in the same year. The lowest value was $5.74 billion in 2002.

On the other hand, the highest value in Algeria's trade balance was $40.25 billion in 2008, influenced by the global financial crisis, which negatively impacted global demand for goods and services, resulting in lower prices and, consequently, a reduction in the import bill. Simultaneously, the relative increase in oil prices, constituting over 60% of Algeria's GDP, contributed to the surplus. The lowest value in the trade balance was -$20.12 billion in 2016, following the late 2014 crisis and the significant decline in global oil prices.

Regarding the standard deviation values recorded in the study variables, they are considered high for both variables. Therefore, these variables have experienced noticeable volatility over the study period

3.2 Diagnostic Tests for the Model:

Among the main assumptions that regression models, particularly non-linear autoregressive distributed lag (NARDL) models, rely on is the stability of time series for the variables included in the model at levels and/or first differences. This methodology also assumes achieving long-term equilibrium between explanatory or independent variables and the dependent variable.

These basic assumptions are essential for modeling according to this methodology, contributing to building the foundation for understanding relationships between variables in the long term. Moreover, this methodology requires verifying other classic assumptions in the rest of the model and its structural stability. Therefore, the diagnostic side is considered a fundamental basis for the modeling process according to the NARDL methodology.

3.2.1 Results of Stationarity Study:

Time series are considered stable if they do not contain a unit root. Among the prominent tests adopted to detect the presence of a unit root in the applied literature are the Phillips and Perron (Pp) tests. These tests are applied in three models (with a constant, with a constant and a general trend, without a constant and a general trend). The test is based on the following hypotheses:

The series is not stationary (presence of unit root)..................................... H_0

The series is stationary (no single root)... H_1

Table No (02): Pp test for stable study variables at level and 1st difference[1]

UNIT ROOT TEST TABLE (PP)

MODEL	At Level		
		LNTGR	LNBC
With Constant	t-Statistic	-1.3113	-1.8808
	Prob.	0.6216	0.3399
		n0	n0
With Constant & Trend	t-Statistic	-1.5648	-1.7973
	Prob.	0.7992	0.6981
		n0	n0
Without Constant & Trend	t-Statistic	0.8155	-0.469
	Prob.	0.8863	0.5097
		n0	n0
MODEL	At First Difference		
		d(LNTGR)	d(LNBC)
With Constant	t-Statistic	-3.9815	-4.3522
	Prob.	0.0023	0.0007
		***	***
With Constant & Trend	t-Statistic	-4.006	-4.3713
	Prob.	0.0118	0.0039
		**	***
Without Constant & Trend	t-Statistic	-3.8811	-4.3729
	Prob.	0.0002	0
		***	***

[1]: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

P-ISSN: 2204-1990; E-ISSN: 1323-6903

Source: Eviews 12 outputs

Looking at the table above, it is evident that the time series for the total gas revenue variable is not stable at the level in the second model (With Constant). The statistical value for the (P-p) test is -1.31, which is significantly lower than the absolute value of the critical value at a 5% significance level. Considering that the associated probability value is 0.62, greater than the critical value of 0.05, we accept the null hypothesis for the test, indicating instability of this variable at the level. In the first and third models (Without Constant & Trend, With Constant & Trend), we can also accept the null hypothesis for the test, indicating non-stationarity time series for the total natural gas and liquefied gas revenue variable at the level. This is based on the fact that the probability values for the test in these models (0.79; 0.81) are both greater than the critical value (0.05). In general, the hypothesis of the non- stationarity of the gas revenue variable at the level, which shows non- stationarity with a random walk pattern of the DS type, can be accepted.

On the other hand, the null hypothesis for the (P-p) test, indicating the non-stationarity of the Economic Trade Balance variable at the level, can be accepted. This is observed in all three models tested, as all probability values are significantly greater than the critical value of 0.05 at a significance level less than 5%.

After performing the first differences for the study variables and retesting, the alternative hypothesis for the (PP) test can be accepted in all three models for the test. This is because the tabulated values for the Phillips-Perron test in all its models are less than the calculated values. This can be inferred from the probability values that do not exceed the critical value (0.05).

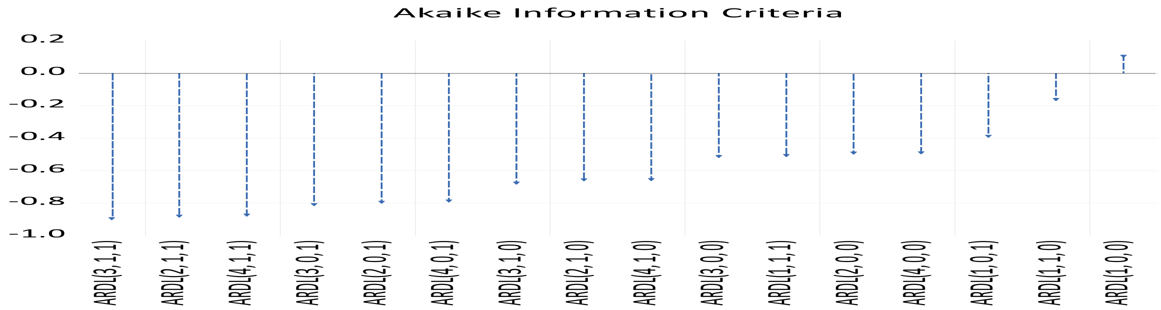
The results of the stability of time series indicate that the study variables are integrated at the first differences (I_1), allowing the possibility, according to (Pesseran and Shin 2001), of the existence of a long-term equilibrium relationship between the net total gas revenue and the economic trade balance. This is due to the integration of time series at the same degree, an indicator of the possibility of applying self-regression models for slow non-linear time gaps. The main assumption is that the time series for any model variable is stable at the level and the first difference or a mix between them.

3.2.2 Cointegration Test According to the Bounds Methodology

Through this section, the equilibrium relationship in the long term between total natural gas revenues and the trade balance will be tested. This is done by relying on the bounds test and meeting the required conditions in the error correction coefficient. Prior to that, the optimal lag order for each variable of the study will be determined. The lag order for each variable is automatically determined by modern versions of standard software, relying on minimizing the values of information criteria (AIC criterion). The results of the lag order tests are illustrated in the following figure:

Figure No (01): Optimal Lag Order Test Results

P-ISSN: 2204-1990; E-ISSN: 1323-6903



Source: Eviews 12 software outputs

The dependent variable was lagged by three time periods (*t*−3), while negative shocks in gas revenues were not lagged by any period, and positive shocks were lagged by one time period.

The subsequent table illustrates the results of estimating the cointegration equation for the study model:

Table No (04): Long-term Relationship

DEPENDENT VARIABLE: D(LNBC)

SELECTED MODEL: ARDL(3, 1, 1)				
SAMPLE: 2000Q1 2022Q4				
CONDITIONAL ERROR CORRECTION REGRESSION				
VARIABLE	Coefficient	Std. Error	t-Statistic	Prob.
C	0.277203	0.090047	3.078436	0.0028
LNBC(-1)*	-0.1729	0.026075	-6.630757	0.0065
LNTGR_POS(-1)	0.180785	0.046096	3.921924	0
LNTGR_NEG(-1)	0.152474	0.065031	2.344636	0.0091
D(LNBC(-1))	0.382806	0.089698	4.267721	0
D(LNBC(-2))	0.160735	0.040252	3.993218	0.0003
D(LNTGR_POS)	0.788794	0.265291	2.973316	0.0039
D(LNTGR_NEG)	-1.41915	0.290052	-4.892757	0
LONG RUN COEFFICIENT				
VARIABLE	Coefficient	Std. Error	t-Statistic	Prob.
LNTGR_POS	0.248	0.068678	3.611054	0.0005
LNTGR_NEG	-0.18173	0.048446	-3.751104	0.0004
C	1.802655	0.521799	7.287589	0
LONG RUN EQUATION				
EC = LNBC - (-0.2480*LNTGR_POS + 0.1817*LNTGR_NEG + 3.8027)				

Source: Prepared by researchers based on EVIEWS 12 software outputs

- **Error Correction Coefficient:**

The value of the error correction coefficient for the model was (-0.1729), thus fulfilling the necessary condition, indicating a negative sign. Moreover, this coefficient satisfies both the necessary and sufficient conditions for statistical significance, as its statistical value (T_{Stat} = -6.63) surpasses the critical value corresponding to a significance level below 5%. This inference is supported by the associated p-value, which is (0.00), significantly less than the critical value (0.05). The time unit required for the error correction coefficient to address and rectify short-term errors, leading to equilibrium in the long term, is estimated at approximately 5.78 = 1/0.1729, rounded to approximately seventeen months.

- **Bound Test:**

Table No (05): Bounds Test

F-Bounds Test

Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	14.20283		Asymptotic: n=1000	
k	2	10%	2.63	3.35
Actual Sample Size	89	5%	3.1	3.87
		2.50%	3.55	4.38
		1%	4.13	5

Source: Prepared by researchers based on EVIEWS 12 software outputs

The statistical value (F_{stat} = 14.20) is greater than the upper limit of the table value indicated above, where the upper table value is (3.87) at a significance level less than or equal to 5% for the Fisher statistic. According to Pessiran and Shin (2001), based on the above, it can be confidently asserted that there is a cointegrating relationship in the long term between the total gas revenues for the Algerian economy and the trade balance. This means that the results of estimation using the non-linear autoregressive distributed lag (NARDL) methodology can be relied upon with a high level of reliability, considering the availability of all assumptions for estimation according to this methodology.

3.3 Measurement Problems Tests:

Before utilizing the model in economic analysis, it is crucial to ensure its measurement competence by testing for the absence of various measurement problems. The following table summarizes the classical tests:

Table No (04): Summary of Classic Measurement Problems Tests

Test Type	Test	Statistical Value	Probability Value
Autocorrelation between Errors	Breusch-Godfrey Serial Correlation LM Test:	0.6907	0.740082
Heteroskedasticity	Heteroskedasticity Test: ARCH	0.2956	1.093734
Adequacy of Functional Form	Ramsey RESET Test	0.2766	1.200683

Source: Prepared by researchers based on EVIEWS 12 software outputs

The null hypotheses for the first and second tests in the above table suggest the absence of measurement problems (autocorrelation between errors and heteroskedasticity over time). Based on the statistical values for the aforementioned tests, which were lower in absolute terms than the critical values corresponding to a significance level of less than or equal to 5%, and considering that the p-values for both tests are greater than the critical value of 0.05, the null hypotheses for both tests can be accepted individually.

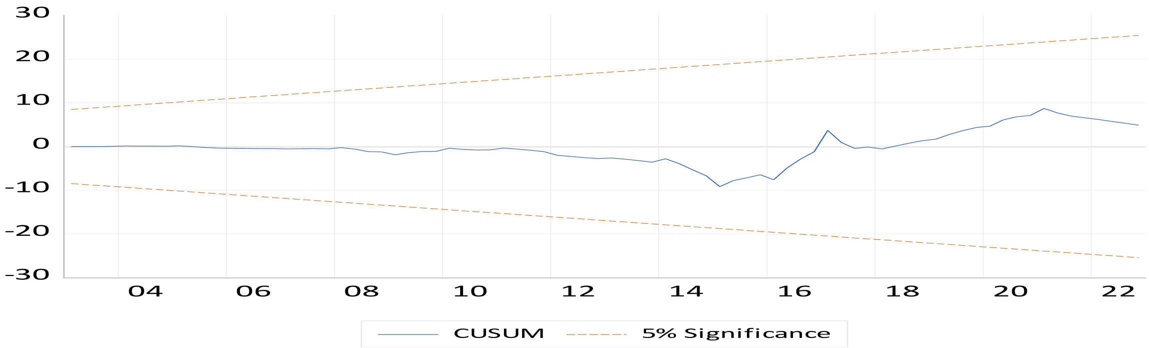
As for the last test concerning the suitability of the functional form, the null hypothesis can also be accepted. This null hypothesis asserts that the functional form of the study model is suitable. This conclusion is based on the fact that the p-value for this test (0.27) is also greater than the critical value of 0.05.

- **Structural Stability Test:**

P-ISSN: 2204-1990; E-ISSN: 1323-6903

The cumulative sum tests results is depicted in Figure 2.

Figure No (2): the result for the structural stability test.



Source: EVIEWS 12 outputs

The cumulative values (in blue) fall within the confidence intervals (in red), indicating the model's structural stability over the study period. In other words, the model exhibits a single equation throughout the study period.

As a general summary of the statistical and measurement analysis results for the study models, it appears that the model is of high quality in both statistical and measurement aspects. The adopted model possesses total significance and high explanatory power, with no indication of any measurement problems in its residuals. Additionally, the model is structurally stable based on cumulative sum tests. Therefore, the estimation results can be relied upon with high confidence.

3.4 Economic analysis of the study model:

Referring to Table (number 04) and concerning the common integration equation, the following results can be recorded:

- **in the short term:**

The negative coefficient associated with the variable representing the natural logarithm of total revenues from natural gas and liquefied gas (LNTGR_NEG) indicates a one-period lag in the adverse impact of this variable on the trade balance. The results suggest that a 1% decline in total gas revenues leads to a decrease in the trade balance by 1.41%. Since natural gas constitutes a significant portion of Algeria's export revenues, a reduction in gas revenues due to declining gas prices or export volumes could result in an overall decline in the country's revenues.

The positive coefficient associated with the variable representing the natural logarithm of total revenues from natural gas and liquefied gas (LNTGR_POS) indicates a one-period lag in the positive impact of this variable on the trade balance. The results suggest that a 1% increase in total gas revenues leads to an increase in the trade balance by 0.78%. The rise in gas revenues implies an immediate boost to the country's income, which can positively affect the trade balance in the short term. On the other hand, an increase in gas exports may be accompanied by improvements in immediate economic dynamics, positively influencing the trade balance in the short term.

- **Long-Term Impact:**

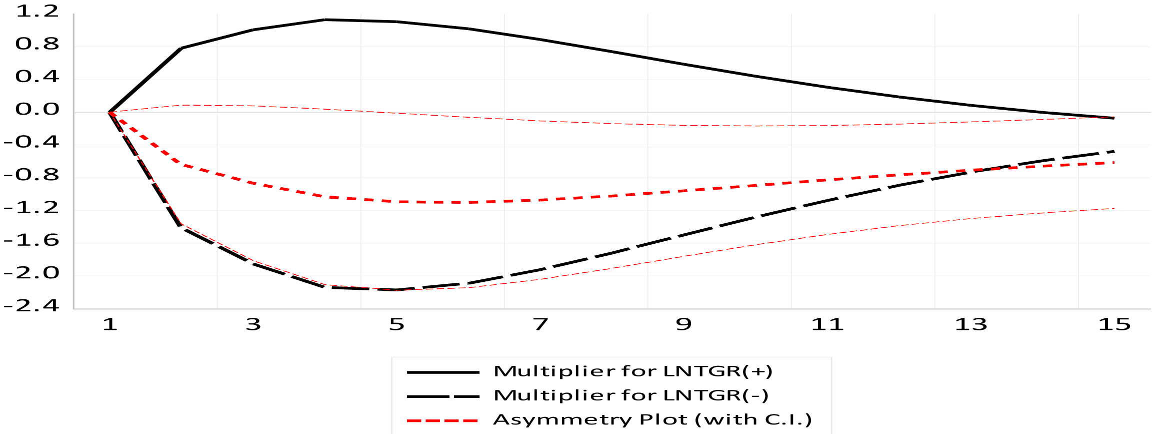
The positive sign of the coefficient associated with positive values of gas revenues in the long term indicates a positive effect on Algeria's trade balance. A 1% increase in gas revenues leads to a trade balance increase exceeding 0.24%. This growth in gas revenues not only enhances the trade balance but also contributes to overall economic growth, positively influencing the trade balance in the long term.

On the other hand, the negative values in the independent variable have a negative impact on the long-term trade balance. A 1% decline in gas revenues results in a long-term trade balance decrease exceeding 0.18%.

3.5 Asymmetric Impact Analysis of Natural Gas Revenues on the Trade Balance:

By imposing positive and negative shocks on the explanatory variable and tracking their effects on the trade balance over the following ten years, the cumulative dynamic asymmetric effects are illustrated in Figure 3.

The figure 3: The impact of the dynamic asymmetric cumulative multiplier on the revenues of natural gas and liquefied gas and their transfer to the trade balance



Source: EVIEWS 12 outputs

By introducing a positive shock to the total revenues from gas, we observe an absence of response in the trade balance during the first year. Economic shocks typically require time to impact real economic variables in general. Starting from the second year, we notice a significant and sharp increase in the trade balance, particularly in the short term (from the second to the fifth year). This effect diminishes after the shock, beginning in the sixth year, indicating a return to normal levels over the medium and long terms.

Similarly, introducing a negative shock to the independent variable shows an absence of response in the trade balance during the first year. However, by the beginning of the second year, a more pronounced decrease is recorded compared to the positive shock, with a decline exceeding 2% during the first five years. Similar to the positive shock, the impact of the negative shock fades after the sixth year, and the trade balance moves towards normal levels over the medium and long terms.

The asymmetry in the impact of positive and negative shocks on natural gas and liquefied gas revenues on the trade balance is evident from the preceding figure

Conclusion:

In conclusion, this paper aimed to assess the impact of Algerian natural gas revenues on the trade balance for the period (2000-2021) using the nonlinear autoregressive distributed lag (NARDL) model. The results reveal a significant impact of Algerian natural gas revenues, whether increasing or decreasing, on the trade balance during the studied period. Model

P-ISSN: 2204-1990; E-ISSN: 1323-6903

results using the NARDL model indicate a nonlinear relationship between natural gas revenues and the trade balance.

The findings suggest that the impact of these revenues is not merely instantaneous but extends over long time periods, emphasizing the importance of understanding the temporal dynamics and nonlinear effects in the interaction between these two factors. An increase in gas revenue effectively contributes to boosting the trade balance, especially in the short term, with this effect persisting in the long term. Conversely, a decline in revenues will negatively impact the trade balance in both the short and long terms.

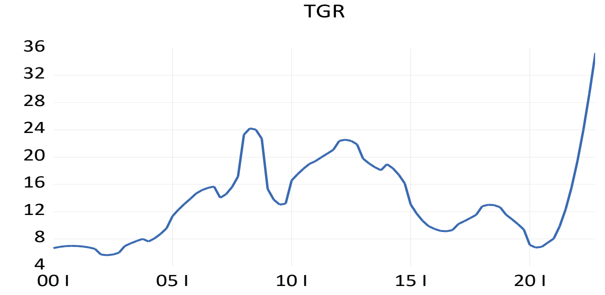
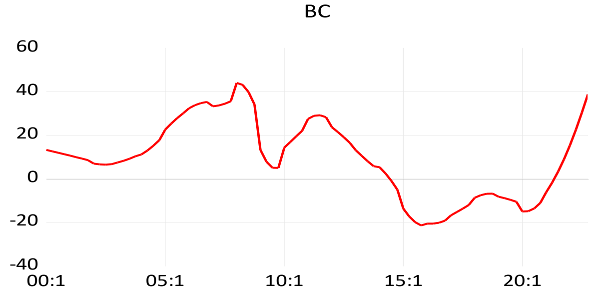
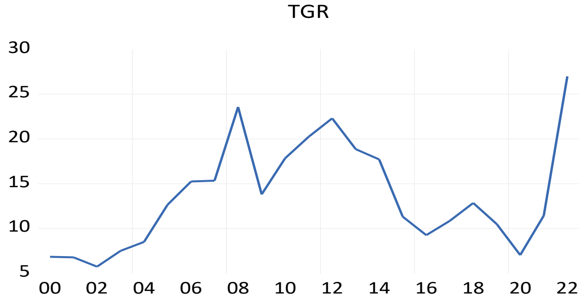
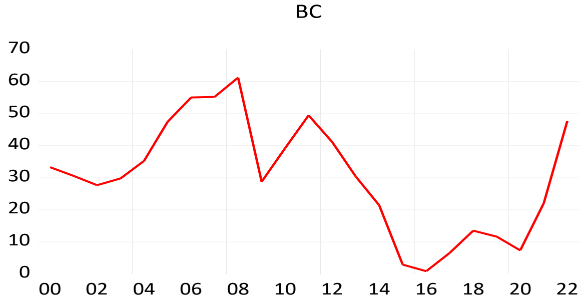
In light of these conclusions, we recommend further research to deepen our understanding of the impact of natural gas revenues on the national economy, focusing on specific factors that may have a particular influence. This enhanced understanding strengthens our ability to identify effective and sustainable policies for managing and optimizing these revenues to promote economic stability and achieve sustainable development in Algeria.

Bibliography

1) Abdelhadi Haji Gueidir. (2019). Impact of the Evolution of Global Natural Gas Markets on Algerian Gas Exports. Oran, Algeria: Unpublished Ph.D. thesis.
2) Ashour Katoush and Ben Ali Belazouz. (05, 2005). Algerian Natural Gas and Gas Market Challenges. Journal of North African Economics (02).
3) Eighth Arab Energy Conference. (2006). Qatari Paper for the People's Democratic Republic of Algeria. Eighth Arab Energy Conference. Hashemite Kingdom of Jordan, Amman.
4) Hakim Darbouche. (2011). Algeria’s shifting gas export strategy – Between policy and market constraints. Oxford: Oxford Institute for Energy.
5) Hamza Abdelrazak. (2022). Pressures of Domestic Consumption and Inverting Trends of Algerian Gas Exports Amid New Conflicts and Competitors. Economic Researcher Magazine, 01.
6) OPEC. (2009). SONATRACH: Algeria's Economic Lever. Kuwait: OPEC Bulletin Arab Petroleum Exporting Countries Organization.
7) OPEC. (2009). Technical Affairs Management, Development of Natural Gas Resources in Arab. Kuwait: Arab Petroleum Exporting Countries Organization (OPEC).
8) Ouki, M. (2019). Algerian Gas in Transition: domestic transformation and changing gas export potential. Oxford: Oxford Institute for Energy Studies.
9) Rajab Ali. (2007). Fundamentals of Gas Pricing in Global Markets. Oil and Arab Cooperation Magazine, 20.
10) Revue Sonatrach. (2007). Commercialisation Gaz & Développement a l’international. Revue Sonatrach.
11) SONATRACH. (2014). des réalisations et des engagements. BAOSEM.
12) Walid Al-Daghili and Redouane Hadi. (22-29/12/2009). The Role of Gas Networks in Supporting Sustainable Development and Integration in Arab Countries. Meeting of Experts on the Role of Energy Networks in Regional Cooperation. Beirut.

Appendices:

Appendix 01: Original and Transformed Data

Trensformed Data	Original Data
 	 

Appendix 02: Stationarity test

UNIT ROOT TEST TABLE (PP)

	At Level			
		LNTGR	LNBC	LNEXPP
With Constant	t-Statistic	-1.3113	-1.8808	-1.6819
	Prob.	***0.6216***	***0.3399***	***0.4370***
		n0	n0	n0
With Constant & Trend	t-Statistic	-1.5648	-1.7973	-1.7344
	Prob.	***0.7992***	***0.6981***	***0.7279***
		n0	n0	n0
Without Constant & Trend	t-Statistic	0.8155	-0.4690	0.5218
	Prob.	***0.8863***	***0.5097***	***0.8267***
		n0	n0	n0
	At First Difference			
		d(LNTGR)	d(LNBC)	d(LNEXPP)
With Constant	t-Statistic	-3.9815	-4.3522	-4.3719
	Prob.	***0.0023***	***0.0007***	***0.0006***
		***	***	***
With Constant & Trend	t-Statistic	-4.0060	-4.3713	-4.3481
	Prob.	***0.0118***	***0.0039***	***0.0042***
		**	***	***
Without Constant & Trend	t-Statistic	-3.8811	-4.3729	-4.3317
	Prob.	***0.0002***	***0.0000***	***0.0000***
		***	***	***

Appendix 03: Common Integration and Boundary Tests

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNBC)
Selected Model: ARDL(3, 1, 1)
Case 2: Restricted Constant and No Trend
Date: 11/29/23 Time: 17:26
Sample: 2000Q1 2022Q4
Included observations: 89

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.277203	0.090047	3.078436	0.0028
LNBC(-1)*	-0.172897	0.026075	-6.630757	0.0065
LNTGR_POS(-1)	0.180785	0.046096	3.921924	0.0000
LNTGR_NEG(-1)	0.152474	0.065031	2.344636	0.0091
D(LNBC(-1))	0.382806	0.089698	4.267721	0.0000
D(LNBC(-2))	0.160735	0.040252	3.993218	0.0003
D(LNTGR_POS)	0.788794	0.265291	2.973316	0.0039
D(LNTGR_NEG)	-1.419154	0.290052	-4.892757	0.0000

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTGR_POS	0.248000	0.068678	3.611054	0.0005
LNTGR_NEG	-0.181726	0.048446	-3.751104	0.0004
C	1.802655	0.521799	7.287589	0.0000

EC = LNBC - (-0.2480*LNTGR_POS + 0.1817*LNTGR_NEG + 3.8027)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	14.20283	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	89		Finite Sample: n=80	
		10%	2.713	3.453
		5%	3.235	4.053
		1%	4.358	5.393

Appendix 04: Measurement Issues:

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.322832	Prob. F(2,77)	0.7251
Obs*R-squared	0.740082	Prob. Chi-Square(2)	0.6907

Ramsey RESET Test
Equation: NARDL
Omitted Variables: Squares of fitted values
Specification: LNBC LNBC(-1) LNBC(-2) LNBC(-3) LNTGR_POS LNTGR_POS(-1) LNTGR_POS(-2) LNTGR_NEG LNTGR_NEG(-1) LNTGR_NEG(-2) C

	Value	df	Probability
t-statistic	1.095757	78	0.2766
F-statistic	1.200683	(1, 78)	0.2766
Likelihood ratio	1.359573	1	0.2436

Heteroskedasticity Test: ARCH

F-statistic	1.082328	Prob. F(1,86)	0.3011
Obs*R-squared	1.093734	Prob. Chi-Square(1)	0.2956