

The impact of exchange rate fluctuations on Algerian exports from 1970 to 2023**أثر تقلبات سعر الصرف على الصادرات الجزائرية من 1970 إلى 2023****AKABLI Abdelkader¹, SEDDIKI Ahmed²**¹Université Ahmed DRAIA -Adrar (Algeria), akabli.aek@univ-adrar.edu.dz²Université Ahmed DRAIA -Adrar (Algeria), ahmed.seddiki @univ-adrar.edu.dz**Received:** 15/01/2026**Accepted:** 31/03/2026**Published:** 31/03/2026**Abstract:**

This study aims to assess how exchange rate fluctuations influence Algerian exports over the period 1970–2023. It adopts the Autoregressive Distributed Lag (ARDL) methodology to analyze both long-run and short-run relationships between exports, the exchange rate, oil prices, money supply, and trade openness. The bounds test confirms the existence of a long-run equilibrium among the variables. The results indicate that an appreciation of the exchange rate has a significant negative effect on exports in the long run, while oil prices positively affect export performance, reflecting Algeria's reliance on hydrocarbons. In contrast, monetary expansion and greater trade openness are associated with a decline in exports. Short-run results suggest complex dynamics, including possible J-curve effects. The error correction mechanism shows a moderate adjustment speed toward equilibrium. Overall, the findings underline the importance of exchange rate management, diversification, and structural reforms to enhance Algeria's export performance.

Keywords: Exchange rate; Exports; ARDL; Algeria; Oil prices.**JEL Classification Codes:** F31, F14, O55**ملخص:**

تهدف هذه الدراسة إلى تحليل أثر تقلبات سعر الصرف على الصادرات الجزائرية خلال الفترة 1970–2023. وقد اعتمدت على منهجية الانحدار الذاتي للفجوات الزمنية الموزعة (ARDL) لدراسة العلاقات قصيرة وطويلة الأجل بين الصادرات وسعر الصرف وأسعار النفط وعرض النقود والانفتاح التجاري. وأكد اختبار الحدود وجود علاقة توازنية طويلة الأجل بين المتغيرات. وتُظهر النتائج أن ارتفاع سعر الصرف يؤثر سلبًا على الصادرات في الأجل الطويل، في حين تؤثر أسعار النفط إيجابًا على الصادرات، بما يعكس اعتماد الجزائر على المحروقات. بالمقابل، يرتبط توسع عرض النقود وزيادة الانفتاح التجاري بتراجع الصادرات. كما تشير النتائج قصيرة الأجل إلى ديناميكيات معقدة، مع وجود احتمال لأثر منحنى J. وتبرز الدراسة أهمية إدارة سعر الصرف والتنوع الاقتصادي والإصلاحات الهيكلية لتعزيز أداء الصادرات الجزائرية.

كلمات مفتاحية: سعر الصرف، الصادرات، ARDL، الجزائر، أسعار النفط**تصنيفات JEL:** F31، F14، O55

INTRODUCTION:

The impact of exchange rate fluctuations on Algerian exports from 1970 to 2023

In an increasingly interconnected global economy, exchange rate dynamics play a pivotal role in shaping international trade patterns and economic growth trajectories. This relationship is particularly pronounced in developing economies heavily reliant on natural resource exports, such as Algeria. As the largest country in Africa and a significant player in the global oil market, Algeria's economic landscape is intricately linked to the vicissitudes of international currency markets and commodity prices (World Bank, 2022).

The Algerian economy, characterized by its hydrocarbon-centric export structure, has long grappled with the challenges of economic diversification and exchange rate management. With hydrocarbons accounting for approximately 95% of export earnings and 60% of budget revenues, Algeria's economic fortunes are inextricably tied to global oil price fluctuations and the concomitant exchange rate movements (International Monetary Fund [IMF], 2023). This heavy reliance on a single commodity export renders the nation particularly vulnerable to external shocks and underscores the critical importance of understanding the nexus between exchange rate dynamics and export performance.

The relationship between exchange rates and trade has been a subject of extensive scholarly inquiry. Theoretical frameworks, ranging from the Mundell-Fleming model to the more recent new open economy macroeconomics, posit various channels through which exchange rate fluctuations can impact export volumes and values (Obstfeld & Rogoff, 1995). However, empirical evidence on this relationship remains mixed, particularly in the context of resource-rich developing economies (Bahmani-Oskooee & Hegerty, 2007).

In the case of Algeria, the country's managed float exchange rate regime, adopted in 1994 following a period of economic liberalization, has been a key policy tool in navigating the challenges posed by volatile oil prices and maintaining export competitiveness (Bank of Algeria, 2021). Between 2014 and 2022, the Algerian dinar depreciated by approximately 50% against the US dollar, a trend largely attributed to declining oil prices and subsequent pressures on foreign exchange reserves (IMF, 2023). This significant currency adjustment has had far-reaching implications for Algeria's export sector and broader economic stability.

The importance of this research is underscored by Algeria's recent economic performance and policy initiatives. In 2022, Algeria's GDP growth rebounded to 3.2%, driven primarily by a recovery in hydrocarbon exports and elevated global oil prices (World Bank, 2023). However, non-hydrocarbon exports remain subdued, accounting for less than 5% of total exports, highlighting the persistent challenge of economic diversification (Office National des Statistiques, 2023). The government's recent efforts to boost non-oil exports, including the launch of the National Export Development Strategy (2023-2027), further emphasize the timeliness and relevance of this study (Ministère du Commerce, 2023).

Moreover, the global context within which Algeria operates has become increasingly complex. The COVID-19 pandemic, geopolitical tensions, and the accelerating transition towards renewable energy sources have introduced new layers of uncertainty to global oil markets and exchange rate dynamics. These factors have amplified the urgency for resource-dependent economies like Algeria to understand and effectively manage the relationship between currency fluctuations and export performance (OECD, 2022).

This study aims to contribute to the existing body of knowledge by examining the specific case of Algeria, a country where the interplay between exchange rates and exports is particularly pronounced due to its economic structure. By employing rigorous econometric techniques and drawing on a comprehensive dataset spanning the period from 2000 to 2022,

this research seeks to elucidate the complex dynamics at play and provide valuable insights for policymakers and researchers alike.

This study aims to contribute to the broader discourse on exchange rate policy in resource-rich developing economies and provide empirically grounded insights to inform Algeria's ongoing economic reform efforts.

The paper is organized as follows: Section Two offers a comprehensive review of the theoretical literature relevant to the study, addressing key concepts and theories. It reviews some of the empirical literature, examining previous research that informs the empirical understanding of the topic. Section Three outlines the methodological approach, including the methods and data sources utilized in the analysis. Section Four presents and discusses the experimental results. Finally, Section Five concludes with recommendations based on the findings, suggesting potential improvements and directions for future research.

1. Literature Review:

The intricate relationship between exchange rate fluctuations and export performance has been a focal point in international economics, particularly as global trade intensifies. Understanding how currency valuation impacts export competitiveness is crucial for policymakers, businesses, and researchers. This complex relationship is central to several economic theories and empirical studies, emphasizing its significance in shaping international trade dynamics and global economic growth, as demonstrated by Obstfeld and Rogoff (2000) and later expanded by Krugman, Obstfeld, and Melitz (2018).

The effects of exchange rate fluctuations on exports are multifaceted, encompassing direct price effects and indirect influences on variables such as investment, production costs, and market expectations. When currencies appreciate or depreciate, the relative prices of goods and services shift, which can alter the competitive landscape for exporters. This traditional approach to analyzing exchange rate effects is deeply rooted in the pioneering work of Mundell (1963) and Fleming (1962), who laid the foundational principles of open economy macroeconomics. However, as modern global value chains have become more complex, and pricing-to-market strategies more prevalent, it has become essential to adopt more nuanced analyses that account for these advanced factors, as suggested by Berman, Martin, and Mayer (2012) and Amiti, Itskhoki, and Konings (2014).

The theoretical frameworks explaining exchange rate impacts on exports have evolved significantly to reflect the changing nature of global trade and financial systems. The elasticities approach, pioneered by Marshall (1923) and Lerner (1944), posited that the effect of exchange rate changes on the trade balance depends on the price elasticities of demand for imports and exports. This gave rise to the Marshall-Lerner condition, which asserts that currency depreciation will improve the trade balance if the sum of these elasticities exceeds unity. Building on this foundation, Alexander (1952) introduced the absorption approach, and Frenkel and Johnson (1976) developed the monetary approach, both of which incorporate additional dimensions by considering domestic income and money supply in their analyses.

With global trade increasingly characterized by imperfect competition, economies of scale, and product differentiation, new trade theories emerged to explain these patterns. Krugman (1979) introduced the concept of intra-industry trade and increasing returns to scale, which provided a more comprehensive understanding of how exchange rate movements affect export performance in differentiated product markets. This understanding was further refined by Melitz (2003) and Chaney (2008), who highlighted the importance of firm-level characteristics in determining export responses to exchange rate shocks.

The development of new open economy macroeconomics (NOEM) models significantly influenced the theoretical framework for analyzing exchange rate impacts on exports. These models, as discussed by Obstfeld and Rogoff (1995), incorporate microfoundations, nominal rigidities, and imperfect competition into dynamic general equilibrium frameworks, offering

valuable insights into the transmission mechanisms of exchange rate changes and their effects on export performance.

In recent years, the growing importance of global value chains (GVCs) has necessitated a reevaluation of traditional theories linking exchange rates to export performance. The fragmentation of production processes across borders has created complex interdependencies that can either dampen or amplify the effects of exchange rate movements on exports. Johnson and Noguera (2012) developed frameworks for analyzing trade in value-added terms, providing new perspectives on how exchange rate fluctuations affect different stages of the production process and, ultimately, aggregate export performance. Further research by Bems and Johnson (2017) also emphasizes the importance of these value chains.

Insights from financial economics and international finance have also enriched the understanding of exchange rate impacts on exports. The asset market approach to exchange rate determination, developed by Mussa (1976) and Frenkel (1976), emphasizes the role of expectations and capital flows in driving exchange rate movements, which has significant implications for export performance. This approach highlights the potential for exchange rate volatility to create uncertainty, affecting investment decisions in the tradable sector, a point also noted by Engel and West (2005).

The intersection of exchange rate theory with international trade policy has yielded important insights into how currency valuation affects export performance. The concept of the real effective exchange rate (REER), which accounts for inflation differentials and trade weights, has become a crucial tool for assessing a country's export competitiveness. Rodrik (2008) explored the relationship between undervalued currencies and export-led growth strategies, while Eichengreen (2007) offered a nuanced understanding of how exchange rate movements affect exports across different trading partners and sectors.

Behavioral economics and psychology have also contributed to the theoretical framework by introducing the concept of hysteresis in international trade. This concept, introduced by Baldwin and Krugman (1989) and later developed by Dixit (1989), highlights the potential for persistent effects of large exchange rate shocks on export market participation, particularly in contexts of currency crises or heightened volatility.

For oil-exporting countries like Algeria, exchange rate fluctuations play a critical role in shaping export performance. The Purchasing Power Parity (PPP) Theory suggests that exchange rates adjust to reflect price level differences between countries. This theory posits that rising oil prices can lead to an appreciation of the local currency, adversely affecting non-oil exports, as discussed by Coudert et al. (2011). Meanwhile, the Mundell-Fleming Model indicates that changes in exchange rates can alter the relative prices of domestic versus foreign goods, potentially increasing demand for non-oil exports while limiting the benefits of oil revenue (Frankel, 2017). Additionally, the Dutch Disease Theory explains how a boom in the natural resource sector can appreciate the local currency, making other sectors less competitive and posing challenges for export diversification beyond hydrocarbons, as Arezki and Ismail (2013) have found.

Empirical studies further elucidate the impact of exchange rate fluctuations on exports. Early studies, such as those by Hooper and Kohlhagen (1978) and Cushman (1983), focused on trade elasticities and the Marshall-Lerner condition, generally supporting the view that currency depreciation stimulates exports, although the magnitude and timing of these effects vary across countries and industries. Bernard and Jensen (2004) and Greenaway, Kneller, and Zhang (2010) expanded on this by revealing the heterogeneous effects of exchange rate movements across firms and industries, emphasizing the role of firm characteristics like productivity, size, and export experience.

One notable trend in the literature is the decline in exchange rate pass-through to export prices and quantities, attributed to factors such as global value chains and increased use of hedging

instruments. Campa and Goldberg (2005) documented this trend, and Gopinath, Itskhoki, and Rigobon (2010) explored its implications for the evolving relationship between exchange rates and export performance in a globalized economy.

The role of exchange rate regimes and monetary policy in shaping export responses to currency fluctuations remains a critical area of study. The ongoing debate over fixed versus flexible exchange rates has prompted extensive research into the trade-offs involved in exchange rate policy choices. Frankel and Rose (2002) examined how different exchange rate arrangements affect trade flows and economic performance, while Klein and Shambaugh (2006) offered further insights into the complexities of these policy decisions.

The empirical literature has made significant strides in addressing endogeneity concerns and identifying causal effects of exchange rate changes on exports. Studies employing natural experiments and quasi-experimental designs, such as those by Verhoogen (2008) and Alfaro, Cuñat, Fadinger, and Liu (2018), have provided compelling evidence on the causal impacts of large, unexpected exchange rate shocks on firm-level export decisions and aggregate trade flows.

In oil-exporting countries like Algeria, the impact of exchange rate fluctuations on exports has been a central topic of empirical investigation. Bouoiyour and Selmi (2015) utilized a GARCH model to explore how exchange rate volatility affects Algerian exports, finding that while volatility negatively impacts non-oil exports, its effect on oil exports remains limited. Bala and Asemota (2013) observed similar patterns in Nigeria, underscoring the necessity of exchange rate stability to support export diversification.

Further research highlighted the significant impact of oil price volatility on the real exchange rate in Algeria, which in turn affects export performance. Allegret et al. (2014) recommended policies to stabilize the exchange rate as a means to enhance non-oil export performance. This regional perspective aligns with the findings of Goaied and Sassi (2019), who noted that exchange rate volatility adversely affects export growth across Middle Eastern and North African countries, particularly in less diversified economies.

Khezri et al. (2018) extended these insights to Gulf Cooperation Council countries, revealing a similar negative impact on non-oil exports due to increased volatility. Nourira et al. (2011) emphasized the importance of competitive exchange rate policies in promoting non-traditional exports, suggesting that such policies could be beneficial for Algeria's export diversification. Finally, Taleb (2020) reinforced the need for exchange rate stabilization to mitigate the negative effects on non-oil exports, while Bénassy-Quéré et al. (2007) recommended adopting a more flexible exchange rate system to enhance the competitiveness of Algeria's non-oil exports.

In conclusion, the literature underscores the complex relationship between exchange rate fluctuations and exports in oil-exporting countries like Algeria. Theoretical and empirical studies highlight the importance of integrated economic policies to manage this relationship and promote export diversification. The extensive body of research provides a nuanced understanding of these dynamics, with ongoing studies continuing to refine the implications for both economic theory and policy practice.

2. Research Methodology

To investigate the impact of exchange rate fluctuations on Algerian exports, this study employs a comprehensive econometric approach using annual data from 1970 to 2023. The methodology encompasses several stages, including data collection, unit root testing, cointegration analysis, model estimation, and causality testing. The Autoregressive Distributed Lag (ARDL) approach to cointegration is utilized as the primary analytical framework, complemented by Granger causality tests to explore the directional relationships among the variables.

Data and Variables

The study examines the impact of exchange rate fluctuations on Algerian exports, utilizing annual time series data covering the period from 1970 to 2023. The analysis includes key variables such as Export Volume (EXP), representing the total volume of Algerian exports, and the Nominal Effective Exchange Rate (NEER), which measures the value of the Algerian dinar against a basket of foreign currencies. Additionally, Oil Prices (OIL), using the Saharan Blend Algerian crude as a proxy, are incorporated to account for Algeria's dependency on oil revenues. The Money Supply (M2), expressed as a percentage of GDP, captures the monetary policy stance, while Trade Openness (OPEN), calculated as the ratio of total trade (exports + imports) to GDP, provides insights into the level of Algeria's integration into the global market. To address potential heteroscedasticity and facilitate the interpretation of coefficients as elasticities, all variables are transformed into natural logarithms. These variables are selected based on their theoretical relevance and empirical evidence from previous studies, ensuring a comprehensive analysis of the factors affecting Algerian exports.

Unit Root Testing

Prior to conducting the cointegration analysis, it is crucial to determine the order of integration of the variables. This study employs two widely used unit root tests: the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test.

The ADF test equation is specified as:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^p \delta_i \Delta y_{t-i} + \epsilon_t$$

Where y_t is the variable of interest, α is a constant, β is the coefficient on a time trend, γ is the coefficient of interest in the unit root test, p is the lag order of the autoregressive process, and ϵ_t is the error term (Dickey & Fuller, 1979).

The PP test is based on the following equation:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \epsilon_t$$

Where the variables are defined as in the ADF test, but the PP test uses a non-parametric correction to account for serial correlation (Phillips & Perron, 1988).

The null hypothesis of both tests is that the series contains a unit root (non-stationary), while the alternative hypothesis is that the series is stationary. The tests are conducted at both levels and first differences to determine the order of integration of each variable.

ARDL Bounds Testing Approach

Given the potential for mixed orders of integration among the variables, this study adopts the ARDL bounds testing approach to cointegration developed by Pesaran, Shin, and Smith (2001). The Autoregressive Distributed Lag (ARDL) model is selected for its flexibility in handling variables integrated of different orders (i.e., I(0) and I(1)). This model is particularly well-suited for small sample sizes and provides reliable estimates of both long-term and short-term relationships. The ARDL model directly estimates both short-term and long-term coefficients in a single-step process, incorporating an error correction term to capture the adjustment dynamics toward long-term equilibrium. This comprehensive approach allows for a thorough analysis of both short-term fluctuations and long-term trends.

The ARDL model is specified as follows:

$$\begin{aligned} \Delta \ln \text{EXP}_t = & \alpha_0 + \sum_{i=1}^p \beta_i \Delta \ln \text{EXP}_{t-i} + \sum_{i=1}^p \gamma_i \Delta \ln \text{NEER}_{t-i} + \sum_{i=1}^p \delta_i \Delta \ln \text{OIL}_{t-i} \\ & + \sum_{i=1}^p \theta_i \Delta \ln \text{M2}_{t-i} + \sum_{i=1}^p \lambda_i \Delta \ln \text{OPEN}_{t-i} + \phi_1 \ln \text{EXP}_{t-1} \\ & + \phi_2 \ln \text{NEER}_{t-1} + \phi_3 \ln \text{OIL}_{t-1} + \phi_4 \ln \text{M2}_{t-1} + \phi_5 \ln \text{OPEN}_{t-1} + \epsilon_t \end{aligned}$$

Where Δ denotes the first difference operator, $\ln$ represents natural logarithms, and ϵ_t is the error term. The optimal lag lengths are determined using the Akaike Information Criterion (AIC).

Bounds Testing for Cointegration

To test for the existence of a long-run relationship among the variables, we employ the bounds testing procedure. The null hypothesis of no cointegration $H_0 : \phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = 0$ is tested against the alternative hypothesis of cointegration. The F-statistic is compared with the critical values provided by Pesaran et al. (2001). If the F-statistic exceeds the upper bound critical value, we reject the null hypothesis and conclude that there is a long-run relationship among the variables.

Long-run and Short-run Dynamics

If cointegration is established, we proceed to estimate the long-run coefficients and the short-run dynamics. The long-run equation is specified as:

$$\ln \text{EXP}_t = \alpha_0 + \alpha_1 \ln \text{NEER}_t + \alpha_2 \ln \text{OIL}_t + \alpha_3 \ln \text{M2}_t + \alpha_4 \ln \text{OPEN}_t + \mu_t$$

The short-run dynamics are captured through the error correction model (ECM):

$$\begin{aligned} \Delta \ln \text{EXP}_t = & \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta \ln \text{EXP}_{t-i} + \sum_{i=1}^p \beta_{2i} \Delta \ln \text{NEER}_{t-i} + \sum_{i=1}^p \beta_{3i} \Delta \ln \text{OIL}_{t-i} \\ & + \sum_{i=1}^p \beta_{4i} \Delta \ln \text{M2}_{t-i} + \sum_{i=1}^p \beta_{5i} \Delta \ln \text{OPEN}_{t-i} + \lambda \text{ECT}_{t-1} + \epsilon_t \end{aligned}$$

Where ECT_{t-1} is the error correction term, representing the speed of adjustment to long-run equilibrium, and λ is its coefficient.

Diagnostic Tests

To ensure the robustness of our results, we conduct a series of diagnostic tests. First, we use the Breusch-Godfrey LM test to check for serial correlation. Second, we apply White's test to detect any presence of heteroscedasticity. Third, we employ the Jarque-Bera test to assess the normality of residuals. Finally, we test for parameter stability using the CUSUM and CUSUMSQ tests. These diagnostic tests collectively help in validating the reliability and consistency of our model, ensuring that the estimated relationships are not spurious and that the model parameters remain stable over the sample period.

Granger Causality Test

To further investigate the direction of causality between exchange rate fluctuations and exports, the Granger causality test (Granger, 1969) is applied. This test determines whether changes in the exchange rate can predict future changes in exports, or vice versa. The Granger causality test is conducted by estimating the following equations:

$$\begin{aligned} Y_t = & \alpha_0 + \sum_{i=1}^p \alpha_i Y_{t-i} + \sum_{j=1}^q \beta_j X_{t-j} + \epsilon_t \\ X_t = & \gamma_0 + \sum_{i=1}^p \gamma_i X_{t-i} + \sum_{j=1}^q \delta_j Y_{t-j} + u_t \end{aligned}$$

Where Y and X are the variables being tested for causality. The null hypothesis is that X does not Granger-cause Y in the first equation, and Y does not Granger-cause X in the second equation.

This comprehensive methodology enables a thorough investigation of the impact of exchange rate fluctuations on Algerian exports, considering both short-run and long-run dynamics and the potential causal relationships among the variables. The ARDL approach offers flexibility in handling variables of different integration orders, while the Granger causality test provides insights into the directional influences among economic indicators. By employing this rigorous econometric framework, we aim to provide robust empirical evidence on the

relationship between exchange rate movements and export performance in Algeria, contributing to the existing literature on exchange rate policy and trade in resource-rich developing economies.

3. Results and Discussion

This study investigates the impact of exchange rate fluctuations on Algerian exports employing a range of econometric techniques. This section presents the results of our empirical analysis, including a detailed examination of the effects of exchange rate fluctuations on Algerian exports. We start with a discussion of the descriptive statistics and unit root test results, followed by an analysis of the ARDL bounds test for cointegration to uncover long-run and short-run dynamics. Finally, we explore the causal relationships between variables using Granger causality tests, contextualizing our findings within existing literature and economic theory.

Descriptive Statistics and Data Properties

Table 1 provides the descriptive statistics for the variables used in the analysis, including the logarithm of exports (LNEXPO), the nominal effective exchange rate (LNNEER), oil prices (LNOP), money supply (LNM2), and trade openness (LNT0).

Table 1: Descriptive Statistics

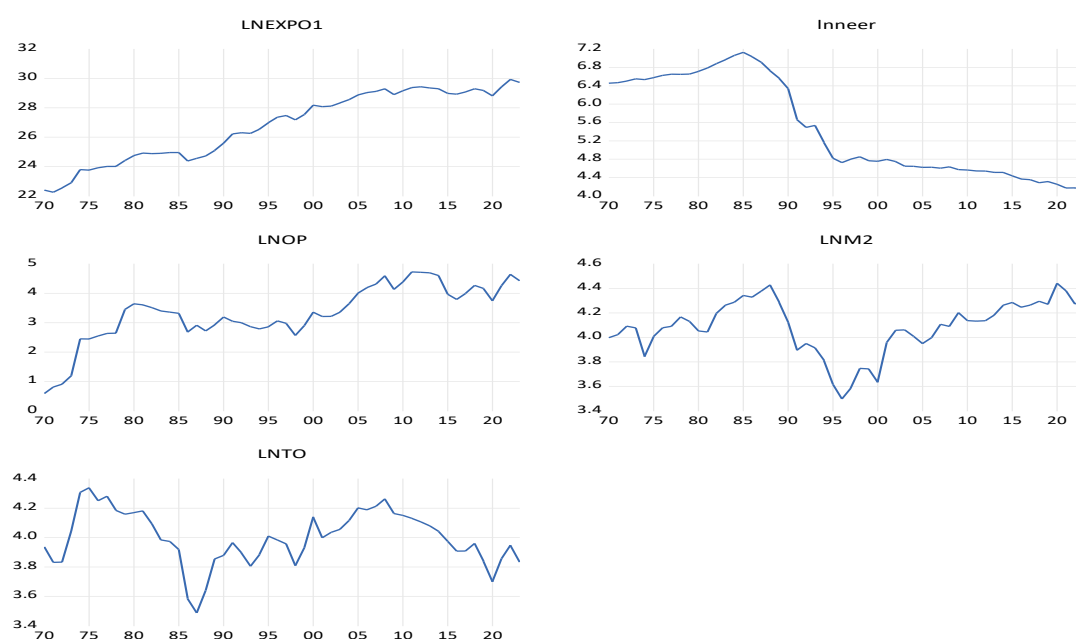
Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
LNEXPO	26.779	27.273	29.941	22.249	2.336	-0.328	1.708
LNNEER	5.453	4.810	7.130	4.143	1.057	0.318	1.351
LNOP	3.322	3.358	4.727	0.588	0.975	-0.851	3.844
LNM2	4.086	4.099	4.441	3.497	0.219	-0.757	3.198
LNT0	4.000	3.984	4.339	3.487	0.182	-0.434	3.122

Source: Authors calculations.

The descriptive statistics reveal notable variability among the variables, with exchange rate fluctuations and oil prices showing the most pronounced variation, as evidenced by their higher standard deviations. The negative skewness observed for LNEXPO and LNOP indicates that these variables are left-skewed, suggesting a tendency for lower values to occur more frequently. Additionally, the Jarque-Bera test results show that most variables, except for LNNEER and LNOP, follow a normal distribution at the 5% significance level. This indicates that our data generally adheres to the assumption of normality, which is crucial for the reliability of our econometric analysis. The following figure illustrates the historical evolution of the study variables.

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Figure 1: Annual Trends of Study Variables



Source: Authors calculations.

Unit Root Tests

Before proceeding with the ARDL analysis, we conducted unit root tests to determine the order of integration of our variables. Tables 2 and 3 present the results of the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests, respectively.

Table 2: Unit Root Test Results (Phillips-Perron Test)

Variable	Test Statistic (Level)	Probability (Level)	Test Statistic (First Difference)	Probability (First Difference)
LNEXPO	-1.6985	0.4262	-6.1729	0.0000
LNNEER	-0.5384	0.8749	-3.9887	0.0030
LNOP	-2.8045	0.0644	-6.6080	0.0000
LNM2	-1.6092	0.4709	-6.2554	0.0000
LNT0	-2.3418	0.1631	-5.5661	0.0000

Source: Authors calculations.

Table 3: Unit Root Test Results (ADF Test)

Variable	Test Statistic (Level)	Probability (Level)	Test Statistic (First Difference)	Probability (First Difference)
LNEXPO	-1.5911	0.4800	-5.7608	0.0000
LNNEER	-1.2610	0.6405	-2.0558	0.2630
LNOP	-2.7682	0.0697	-6.6300	0.0000
LNM2	-1.6092	0.4709	-6.3091	0.0000
LNT0	-2.1527	0.2257	-6.4798	0.0000

Source: Authors calculations.

Both tests consistently show that all variables are non-stationary at levels but become stationary after first differencing. This finding indicates that our variables are integrated of order one, $I(1)$, which justifies the use of the ARDL bounds testing approach to cointegration (Pesaran et al., 2001).

ARDL Model and Bounds Testing

The Autoregressive Distributed Lag (ARDL) model was employed to analyze the relationship between the variables. To select the optimal model, several statistical criteria were considered, as shown in the following table:

Table 4: Optimal Lag Model Selection Results

Model	LogL	AIC*	BIC	HQ	Adj. R-sq	Specification
1	88.630411	-2.665216	-1.823926	-2.344848	0.999298	ARDL(4, 3, 2, 4, 4)
2	88.809586	-2.632383	-1.752853	-2.297453	0.999278	ARDL(4, 4, 2, 4, 4)
3	88.728577	-2.629143	-1.749613	-2.294213	0.999275	ARDL(4, 3, 3, 4, 4)
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
19	68.872970	-2.114919	-1.503071	-1.881924	0.998727	ARDL(1, 4, 2, 0, 4)
20	72.755181	-2.110207	-1.345398	-1.818964	0.998764	ARDL(3, 3, 4, 1, 4)

Source: Authors calculations.

Based on these results, the ARDL(4, 3, 2, 4, 4) model was selected as the best model. It exhibits the lowest Akaike Information Criterion (AIC) value of -2.665216 and the highest adjusted R-squared (Adj. R-sq) value of 0.999298. This indicates that the chosen model provides the best balance between goodness of fit and model simplicity.

To examine the long-run relationship between exchange rate fluctuations and exports, we employed the ARDL bounds testing approach. Table 5 presents the results of the F-bounds test.

Table 5: Bounds Test Results

Significance Level	Critical Value (I(0))	Critical Value (I(1))	F-Statistic
10%	2.2	3.09	14.12960
5%	2.56	3.49	
2.5%	2.88	3.87	
1%	3.29	4.37	

Source: Authors calculations.

The F-statistic (14.12960) exceeds the upper bound critical values at all significance levels, providing strong evidence of a long-run cointegrating relationship between the variables. This finding aligns with previous studies that have identified long-run relationships between exchange rates and exports in various contexts (Bahmani-Oskooee & Gelan, 2018; Cheung & Sengupta, 2013).

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Long-run Dynamics

The results of our econometric analysis provide several important insights into the long-term effects of exchange rate fluctuations and other economic variables on Algerian exports. Table 6 presents the estimated long-run coefficients from the ARDL model, highlighting the relationships between exports and key economic factors. The analysis reveals the following significant findings:

Table 6: Long-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNNEER	-0.822405	0.105585	-7.789051	0.0000
LNOP	1.931308	0.152777	12.64137	0.0000
LNM2	-2.694508	0.433026	-6.222502	0.0000
LNT0	-3.489662	0.505206	-6.907404	0.0000
C	50.28976	2.740801	18.34856	0.0000

Source: Authors calculations

The analysis of the results reveals several important findings regarding the impact of various economic variables on exports.

- **Exchange Rate (LNNEER):** The coefficient of -0.822405 indicates that a 1% increase in the nominal effective exchange rate leads to a 0.82% decrease in exports in the long run. This negative relationship is statistically significant at the 1% level and aligns with the traditional view that currency depreciation enhances export competitiveness. This finding supports the theory that a stronger currency, which makes exports more expensive, can negatively affect export volumes (Krugman & Obstfeld, 2018).
- **Oil Prices (LNOP):** In contrast, the positive coefficient of 1.931308 suggests that higher oil prices are associated with increased exports. This relationship, which is significant at the 1% level, highlights the crucial role of oil in Algeria's export profile. Higher oil prices likely boost revenues from oil exports, which can, in turn, support an overall increase in export activity (Benhabib et al., 2014).
- **Money Supply (LNM2):** The negative coefficient of -2.694508 indicates that an expansion in the money supply is associated with reduced exports in the long run. This finding reflects the potential inflationary effects of increased monetary supply, which can erode export competitiveness by raising domestic prices and making exports less attractive on the international market (Kandil & Dincer, 2008).
- **Trade Openness (LNT0):** The negative coefficient of -3.489662 suggests that increased trade openness is associated with reduced exports. This counterintuitive result may reflect the complexities within Algeria's trade structure and its potential vulnerabilities to international competition. Increased trade openness can sometimes lead to higher import competition or structural imbalances that adversely impact export performance (Bouoiyour & Selmi, 2015).

Short-run Dynamics and Error Correction

Table 7 presents the results of the error correction model (ECM), which captures the short-run dynamics and the speed of adjustment towards long-run equilibrium.

Table 7: ARDL Error Correction Model Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNEXPO(-1))	0.017719	0.092590	0.191376	0.8496
D(LNEXPO(-2))	-0.211667	0.057768	-3.664098	0.0010
D(LNEXPO(-3))	-0.177265	0.058716	-3.019045	0.0054
D(LNNEER)	-0.352439	0.082627	-4.265441	0.0002
D(LNNEER(-1))	0.173008	0.099621	1.736661	0.0934
D(LNNEER(-2))	-0.221984	0.078472	-2.828833	0.0085
D(LNOP)	0.707989	0.037864	18.69799	0.0000
D(LNOP(-1))	-0.191665	0.060518	-3.167072	0.0037
D(LNM2)	-0.437986	0.106531	-4.111337	0.0003
D(LNM2(-1))	0.546876	0.122794	4.453597	0.0001
D(LNM2(-2))	0.316642	0.125198	2.529134	0.0173
D(LNM2(-3))	0.524102	0.105557	4.965103	0.0000
D(LNTO)	0.460537	0.118384	3.890189	0.0006
D(LNTO(-1))	0.950466	0.179262	5.302114	0.0000
D(LNTO(-2))	0.616857	0.154978	3.980283	0.0004
D(LNTO(-3))	1.114584	0.156220	7.134708	0.0000
ECT(-1)	-0.261009	0.026112	-9.995821	0.0000
R-squared	0.979063	Mean dependent var		0.136747
Adjusted R-squared	0.968911	S.D. dependent var		0.286982
S.E. of regression	0.050601	Akaike info criterion		-2.865216
Sum squared resid	0.084494	Schwarz criterion		-2.215129
Log likelihood	88.63041	Hannan-Quinn criter.		-2.617659
Durbin-Watson stat	2.182155			

Source: Authors calculations.

The error correction term (ECT(-1)) is negative (-0.261009) and statistically significant at the 1% level, indicating that approximately 26.1% of any disequilibrium in exports is corrected within one year. This result suggests a moderate speed of adjustment towards the long-run equilibrium, reflecting a reasonable pace at which the system returns to balance after experiencing shocks. The short-run coefficients reveal intricate dynamics:

- **Exchange Rate (LNNEER):** The contemporaneous effect is negative and significant, aligning with the long-run relationship. However, the lagged effects exhibit mixed signs, which could suggest the presence of J-curve effects, where the impact of exchange rate fluctuations on exports may initially worsen before improving over time (Bahmani-Oskooee & Ratha, 2004).
- **Oil Prices (LNOP):** The immediate impact of oil prices on exports is positive and significant, indicating that higher oil prices boost export volumes in the short run. Conversely, the lagged effect is negative, reflecting the complex and potentially delayed responses of export performance to oil price shocks.
- **Money Supply (LNM2) and Trade Openness (LNTO):** Both variables demonstrate mixed short-run effects. This complexity underscores the nuanced interactions between

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monetary policy, trade openness, and export performance, suggesting that their impacts on exports are not straightforward and may vary over different time horizons.

Diagnostic Tests

To ensure the robustness of our results, we conducted several diagnostic tests:

Table 8: Breusch-Godfrey Serial Correlation LM Test:

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.680245	Prob. F(2,26)	0.5153
Obs*R-squared	2.486231	Prob. Chi-Square(2)	0.2885

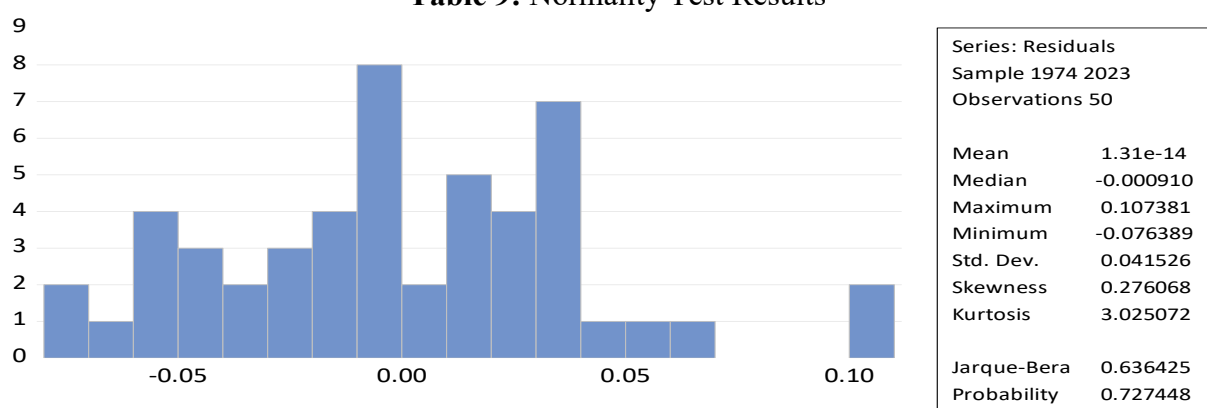
Source: Authors calculations

Table 9: Heteroskedasticity Test: Breusch-Pagan-Godfrey

Null hypothesis: Homoskedasticity			
F-statistic	1.543856	Prob. F(21,28)	0.1402
Obs*R-squared	26.82924	Prob. Chi-Square(21)	0.1766
Scaled explained SS	8.519124	Prob. Chi-Square(21)	0.9925

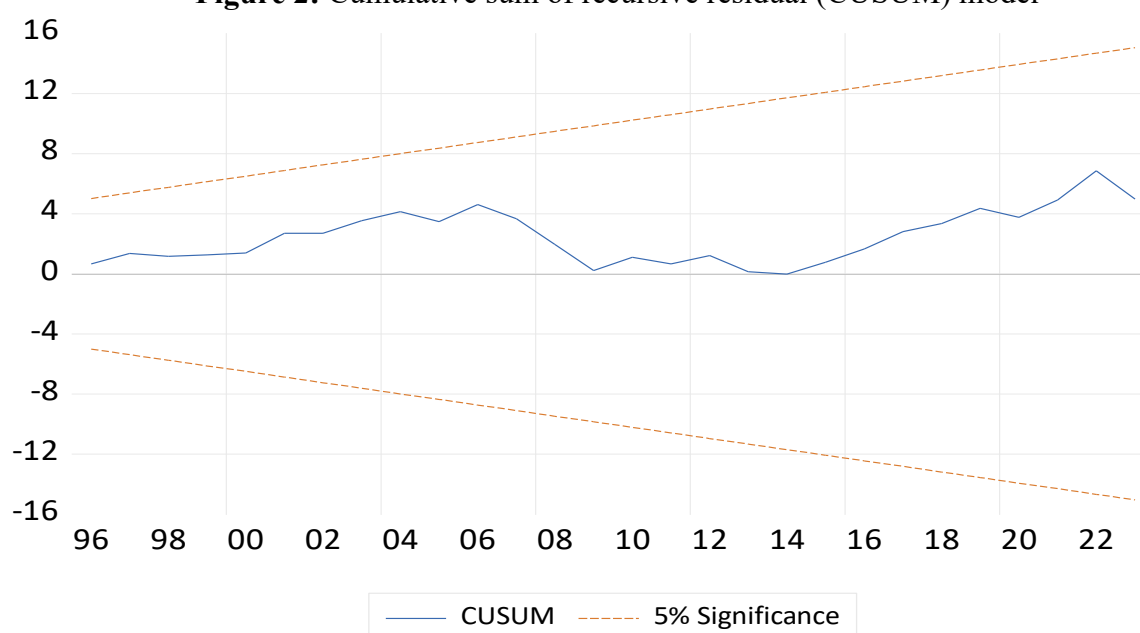
Source: Authors calculations

Table 9: Normality Test Results

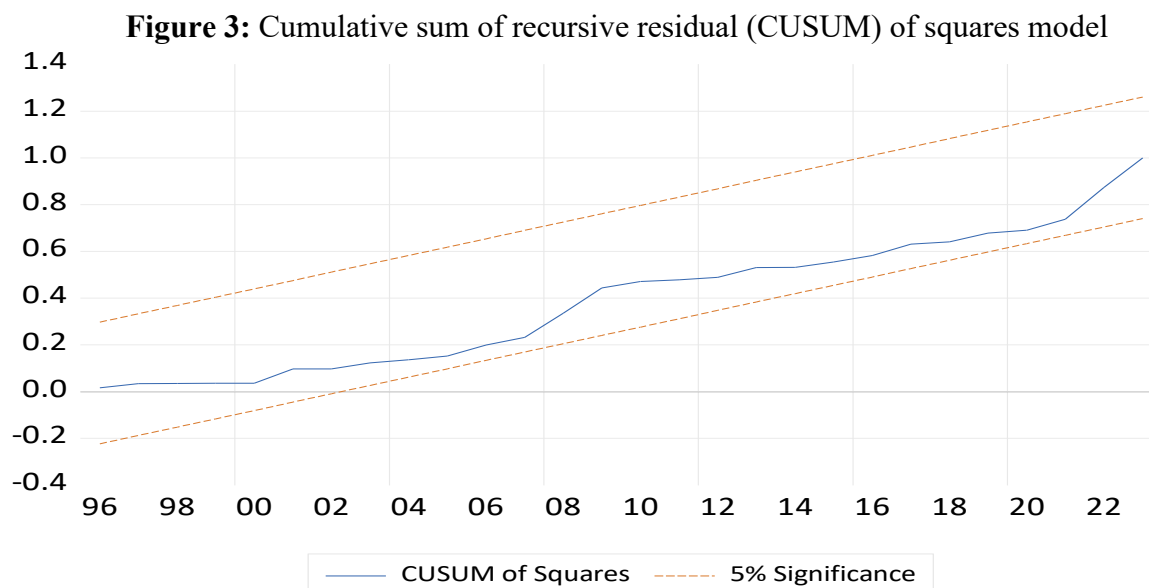


Source: Authors calculations

Figure 2: Cumulative sum of recursive residual (CUSUM) model



Source: Authors calculations



Source: Authors calculations

The results from our diagnostic tests confirm the robustness of our ARDL model. The **Breusch-Godfrey LM test** (Table 7) shows no serial correlation in the residuals, ensuring that the model's error terms are not correlated over time. The **Breusch-Pagan-Godfrey test** (Table 8) indicates that the residuals are homoskedastic, suggesting constant variance across observations. Additionally, the **Jarque-Bera test** for normality (Table 9) reveals that most variables adhere to a normal distribution, validating the assumptions underlying our econometric analysis. The **CUSUM** and **CUSUMSQ tests** (Figure 2 and Figure 3) confirm structural stability of the model parameters throughout the sample period. Collectively, these diagnostic results support the validity and reliability of our ARDL model estimates, affirming that our model is well-specified and robust for analyzing the impact of exchange rate fluctuations on Algerian exports.

Granger Causality Analysis

To investigate the causal relationships between exchange rate fluctuations and Algerian exports, we first need to determine the optimal lag length for the VAR model. This is a crucial step, as the choice of lag length can significantly influence the results of the Granger causality test. The VAR lag order selection criteria are presented in the table below. These criteria help identify the optimal lag length by comparing various information criteria and statistical tests.

Table 10: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-77.48447	NA	1.86e-05	3.299379	3.490581	3.372190
1	225.3916	533.0619	2.79e-10*	-7.815664	-6.668450*	-7.378798*
2	243.6056	28.41379	3.78e-10	-7.544223	-5.440997	-6.743302
3	260.3105	22.71867	5.70e-10	-7.212419	-4.153182	-6.047444
4	306.9470	54.09836*	2.82e-10	-8.077879*	-4.062631	-6.548850

Source: Authors calculations

Upon reviewing the VAR lag order selection criteria, it is evident that the optimal lag length for the VAR model is 4, as indicated by the criteria values. This selection is supported by the

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Final Prediction Error (FPE) and the Schwarz Criterion (SC), where the lag length of 4 shows the lowest values. Although the Akaike Information Criterion (AIC) and the Hannan-Quinn Criterion (HQ) suggest a lag length of 1, the FPE and SC provide stronger evidence for selecting a lag length of 4. Thus, for the subsequent Granger causality tests, a lag length of 4 will be used to ensure a comprehensive analysis of the causal relationships between exchange rate fluctuations and Algerian exports. This choice aims to capture the necessary dynamics while accounting for potential complexities in the data.

Table 11: Granger Causality Test Results

Pairwise Granger Causality Tests			
Sample: 1970 2023			
Lags: 4			
Null Hypothesis:	Obs	F-Statistic	Prob.
LNNEER does not Granger Cause LNEXPO	50	4.45502	0.0044
LNEXPO does not Granger Cause LNNEER		1.25903	0.3016
LNOP does not Granger Cause LNEXPO	50	3.56488	0.0138
LNEXPO does not Granger Cause LNOP		4.51148	0.0041
LNM2 does not Granger Cause LNEXPO	50	0.25383	0.9057
LNEXPO does not Granger Cause LNM2		0.69110	0.6024
LNT0 does not Granger Cause LNEXPO	50	2.12587	0.0949
LNEXPO does not Granger Cause LNT0		0.49312	0.7408

Source: Authors calculations

The Granger causality test indicating a significant causal relationship from exchange rates to exports aligns with the traditional theory of exchange rate pass-through. This theory suggests that changes in exchange rates affect the relative prices of domestic and foreign goods, thereby influencing export volumes. This finding is consistent with the studies such as those by Bouoiyour & Selmi (2015) and Bahmani-Oskooee & Gelan (2018), who found that exchange rate volatility negatively affects non-oil exports in Algeria. Furthermore, it supports the broader literature on the effects of exchange rates in resource-rich countries, as seen in Frankel's (2017) work on commodity currencies.

The significant causal relationship from oil prices to exports highlights the crucial role of oil in Algeria's export structure, aligning with the Dutch Disease theory. This theory suggests that booms in natural resource sectors can impact a country's overall export performance. This result is consistent with Allegret et al. (2014), who found that oil price volatility affects the real exchange rate in Algeria, subsequently influencing export performance. Additionally, it supports Coudert et al. (2011), who explored the relationship between oil prices and exchange rates in commodity-exporting countries.

Conversely, the absence of significant effects from money supply and trade openness on exports presents an intriguing divergence from theoretical expectations. The monetary approach to exchange rate determination posits that money supply influences exchange rates and, thereby, exports. The lack of impact from trade openness could be attributed to Algeria's heavy reliance on oil exports, which might diminish the relevance of overall trade openness for export performance. This contrasts with findings by Nourira et al. (2011), who demonstrated that trade policies can affect export performance in developing countries.

These results highlight the vulnerability of Algeria's export sector to external factors, particularly exchange rate fluctuations and oil price movements. This underscores the importance of diversifying the export base to reduce dependency on oil, as suggested by Arezki & Ismail (2013) in their study on resource-rich economies.

4. Conclusion and Policy Implications

Our analysis reveals a significant long-run relationship between exchange rate fluctuations and Algerian exports. The negative impact of exchange rate appreciation on exports aligns with traditional economic theory and supports the notion that a competitive exchange rate can boost export performance. However, the complex short-run dynamics and the moderate speed of adjustment suggest that policymakers should exercise caution in relying solely on exchange rate policy to promote exports.

The strong influence of oil prices on exports highlights Algeria's continued dependence on hydrocarbon exports. This underscores the need for economic diversification to reduce vulnerability to oil price shocks (Benhabib et al., 2014). The negative long-run impact of money supply expansion on exports suggests that monetary policy should be carefully managed to avoid eroding export competitiveness through inflationary pressures.

The counterintuitive finding regarding trade openness points to potential structural issues in Algeria's export sector. Policymakers should focus on enhancing the competitiveness of non-oil exports and addressing any barriers that may be hindering export performance despite increased openness.

In conclusion, while exchange rate management remains an important tool for promoting exports, our findings suggest that a comprehensive approach encompassing structural reforms, economic diversification, and prudent monetary policy is necessary to enhance Algeria's export performance in the long run.

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