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THE IMPACT OF INFLATIONARY PRESSURES ON THE EXCHANGE RATE IN ALGERIA UNDER THE MANAGED FLOATING EXCHANGE RATE SYSTEM DURING THE PERIOD 1985-2023: AN ECONOMETRIC STUDY USING THE ARDL MODEL

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Abstract

The study aims to assess the impact of inflationary pressures on the exchange rate in Algeria from 1985 to 2023 using the ARDL methodology. A descriptive-analytical approach was employed to review the literature and examine the evolution of the variables, along with a quantitative approach to determine the sensitivity between them.

The results showed a weak but statistically significant positive effect of the dependent variable (exchange rate) on the independent variable (inflation rate) in both the short and long term. However, in the long term, an inverse and statistically significant effect was found for all independent variables (inflation, oil prices, and money supply) on the independent variable (exchange rate). The study also demonstrated a strong response of the exchange rate to changes in the money supply.

Keywords: *General price level; Exchange rate; Inflation; Oil prices; Money supply.*
JEL Codes: *E31, E51, F31*

Introduction

Price level stability is one of the key factors of economic stability (Papadima, 2023, p. 70), which necessitates significant attention from monetary and financial authorities. It is also considered an effective tool for addressing economic imbalances. Additionally, any increase in the money supply must result from demand in the real sector to ensure the stability of the general price level, enabling money to perform its primary functions (Juhro et al., 2025, p. 324). Price stability helps preserve individuals' purchasing power and real incomes while fostering a favorable investment climate in the economy.

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The rise in the prices of essential raw materials used in the production process is the most common cause of price increases (Netseva-Porcheva, 2019, p. 131). In our analysis of price level changes, we must distinguish between changes caused by economic fluctuations and those resulting from a decline in the monetary value of the currency (Kostova-Pickett, 2017, p. 3). Additionally, a combination of social, political, institutional, and natural factors can influence price levels, whether in the short or long term, particularly in developing countries.

Inflation is defined as the increase in prices over a certain period, and it is measured using the Consumer Price Index. It reflects the purchasing power of individuals (Tasheva, 2023, p. 84). One of the main causes of inflation is the depreciation of the circulating currency, often due to "the mismatch between the amount of money circulating and the real value of economic activity." When the money supply in the economy increases faster than economic growth, it leads to a rise in prices, and thus inflation, due to the larger amount of money in the market compared to the lower quantities of goods and services available (Kostova-Pickett, 2017, p. 4). Therefore, the increase in the money supply is the primary cause of inflation. Friedman noted that "inflation is always a monetary phenomenon." Consequently, inflation targeting policy relies on monetary policy, which aims to maintain price stability (Tasheva, 2022, p. 13).

The central bank seeks to contain price fluctuations by guiding economic activity to enhance overall economic stability. In doing so, it relies on controlling the official exchange rate to mitigate the impact of domestic shocks, particularly those related to rising prices and inflation rates, which helps regulate the prices of imported goods and reduce inflationary pressures.

Since the early 1990s, the Algerian Central Bank has adopted a "managed floating exchange rate system". This system is characterized by moving away from the administrative fixation of the exchange rate while not leaving its determination entirely to international market forces. This approach enables the Algerian Central Bank to adjust the exchange rate based on structural changes and macroeconomic factors, both domestically and internationally, as well as developments in the exchange rates of major currencies in global markets (Bank Of Algeria, 2020, p. 1).

The exchange rate system in Algeria has experienced several internal shocks that have led to rising prices and, consequently, higher inflation rates in the economy. One of the most notable shocks was the significant expansion of monetary liquidity during the first half of 2018, with an average increase of approximately 57%. This was a result of the adoption of the unconventional financing policy, which began implementation at the start of the year (Bank Of Algeria, 2020, p. 5).

New banknotes (new liquidity) worth approximately $19 billion were printed in 2017, with an additional $13 billion issued by the end of November 2018 (Denden & Gueddal, 2022, p. 366). The implementation of this policy led to a record rise in the Consumer Price Index (CPI) in recent years, with World Bank data indicating that inflation rates ranged between 7% and 9% during the 2021–2023 period. Similarly, the years 2009, 2012, 2016, and 2017 witnessed high inflation rates ranging between 5.5% and 8.89%.

Based on this information, the following issue arises: What is the impact of inflationary pressures on the exchange rate in Algeria under the (managed floating) exchange rate system?

To answer this issue, we propose the following hypotheses:

- Hypothesis 1: There is a rapid, positive, and statistically significant response of the exchange rate to the inflation rate in Algeria in the short run.
- Hypothesis 2: There is a statistically significant positive impact of the inflation rate on the exchange rate in Algeria in the long run.
- Hypothesis 3: The exchange rate exhibits a strong responsiveness to inflationary pressures in Algeria.

To address the research question, the study adopted a descriptive-analytical approach by reviewing the fundamental concepts of the study variables (exchange rate and inflation) and previous studies, in addition to analyzing the data of the variables under investigation. Furthermore, the study employed a quantitative approach by modeling the relationship between the study variables using the ARDL methodology.

Literature Review

Given the role of the study variables (exchange rate and inflation rate) in regulating economic activity and their close relationship with internal and external balances, they have attracted significant attention from scholars and researchers. Econometric studies have also played a major role in addressing this topic, with some of the most notable ones being:

In a recent study focusing on Egypt, El-Kharbotly (2024) investigated the interconnected effects of fiscal and monetary policy instruments on inflation. Using advanced econometric techniques, the research identified a direct correlation between inflation and several key factors, including exchange rate fluctuations, the total budget deficit (encompassing both external and internal debt), and the growth of the money supply. On the other hand, the study uncovered an inverse relationship between interest rates and inflation, indicating that higher interest rates tend to reduce inflationary pressures.

To estimate the determinants of inflation in Algeria, researchers Senoussaoui Fatna & Bouchamat (2024) ncorporated various monetary and macroeconomic variables

(including the exchange rate). Using a VAR (Vector Autoregression) model and annual data covering the period 1990–2022, they found that the exchange rate has an inverse relationship with the inflation rate. In contrast, government expenditures, the food price index, and oil revenues exhibited a statistically significant positive relationship with inflation.

As part of the analysis of exchange rate policy in Algeria, researchers Derdouri & Lakliti (2017) examined the relationship between domestic and external prices, along with the behavior of the exchange rate in response to various variables. The study found that the exchange rate market is confined to banks and financial institutions, and that a shortage in foreign currency supply has led to the emergence of a parallel market. The researchers also indicated that the exchange rate flexibility approach, as recommended by the International Monetary Fund (IMF), had no immediate impact on exports and imports and, therefore, did not contribute to improving the trade balance. The study concluded that oil prices are not the sole determinant of the exchange rate.

The study by Kotlarz et al. (2023) analyzed the impact of the determinants of the euro-to-Swiss franc exchange rate across three periods, each characterized by a different exchange rate regime. The first period covered the pre-financial crisis era, while the second period corresponded to the post-crisis phase, during which a fixed exchange rate policy was implemented to mitigate the crisis's negative effects. The third period began with the termination of the fixed exchange rate regime.

The factors affecting exchange rates include stock indices and the fluctuations associated with them, as well as interest rate differentials, the yield curve of the local currency (Swiss franc) compared to foreign currencies (euro and US dollar), and interventions in monetary policy.

Researchers Edwards & Cabezas (2022) addressed two important aspects of the exchange rate pass-through (ERPT) issue in Iceland during the period 2003-2019: the impact of the pass-through factor related to different goods and the implications of monetary policy on it. The study relied on 12 detailed price indicators. Using the VAR model and automatic variable techniques in error correction models, the researchers concluded that the exchange rate pass-through coefficient decreased after Iceland implemented reforms in its monetary policy under an inflation targeting framework. It was also found that tradable goods were more affected by exchange rate fluctuations compared to non-tradable goods.

The research conducted by Bahmani-Oskooee et al. (2019) examined the influence of non-economic factors on the real exchange rate. Utilizing annual data spanning from 1984 to 2016 across 31 emerging and developing economies, the study employed the Panel ARDL model. The findings revealed that nations grappling with high corruption levels,

political instability, or elevated investment risks often experience a depreciation in their real exchange rate. Moreover, the study highlighted a pronounced adverse effect of widespread corruption and economic instability on the real exchange rate. In contrast, no statistically significant link was found between the real exchange rate and factors such as bureaucracy or the political system.

A review of the literature reveals that most studies have examined the impact of external fluctuations, primarily through exchange rate movements, on inflation. Additionally, previous research has highlighted the exchange rate's sensitivity to non-economic factors, such as corruption levels, political instability, and investment risks.

Several studies have confirmed that the exchange rate exerts a more significant influence on tradable goods prices, and that inflation-targeting monetary policies help mitigate the exchange rate's impact on inflation. However, existing research has not sufficiently addressed the effect of domestic fluctuations on the exchange rate within a managed floating exchange rate system, particularly through inflationary pressures.

Therefore, this study aims to examine the extent to which the exchange rate responds to price level fluctuations resulting from various factors, including declining production, the rigidity of the production system in meeting rising demand, and inflationary financing. This analysis is conducted within the framework of the Bank of Algeria's exchange rate policy, which seeks to maintain both external and internal economic balances.

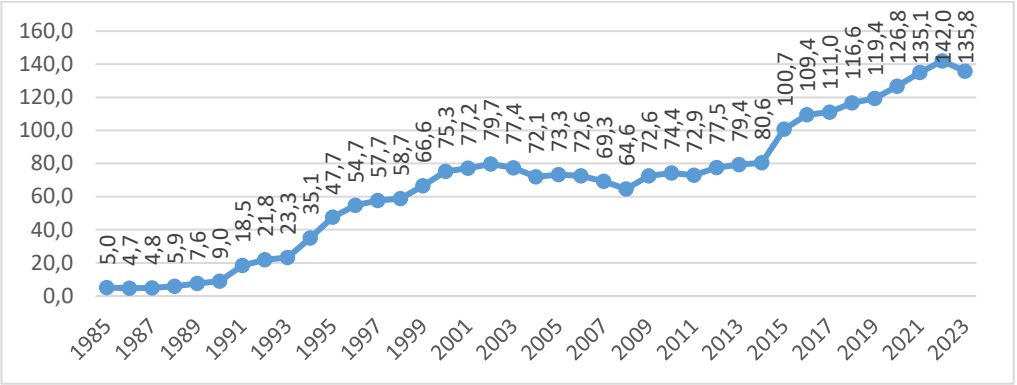
An Analytical Study (the Evolution of the Exchange Rate and Inflation)

Before modeling the relationship between the exchange rate and inflation, we must analyze the evolution of the study variables to provide a clear picture of their behavior and understand the trends and patterns in the time series, as well as the shocks they experienced during the study period and the factors influencing them. This enables us to determine the appropriate mathematical model for the study.

Analysis of the Evolution of the Exchange Rate

As outlined in the preceding analysis, the exchange rate represents the quantity of domestic currency required to purchase one unit of a foreign currency. In simpler terms, it reflects the relative value of the local currency compared to a foreign currency.

Figure no. 1. Evolution of the exchange rate in Algeria during the period 1985-2023



Source: Developed by the authors, based on *(*https://data.worldbank.org*)*

From Figure no. 1, we observe that the exchange rate experienced three main phases. The first phase extended from 1985 to 2002, during which the value of the local currency declined against foreign currencies. The exchange rate rose from approximately 5 dinars per US dollar to 79 dinars, an increase of 140%. This depreciation was primarily due to the depletion of foreign exchange reserves to record-low levels during that period. According to World Bank data, reserves fell below $1 billion between 1988 and 1990. Additionally, the balance of payments recorded deficits during most of this phase, reaching $6.3 billion in 1995. In response to this situation, the central bank adopted a managed floating exchange rate system, which combines elements of both fixed and floating exchange rate regimes, providing relative control over the exchange rate.

The second phase (2003–2013) saw an improvement in the value of the local currency due to the rise in foreign exchange reserves. According to World Bank data, these reserves reached $194 billion in 2013, the highest level recorded. This increase was driven by rising oil prices, with crude oil reaching $111 per barrel in 2012, up from $25 per barrel in 2002. Additionally, the balance of payments improved significantly, reaching approximately $37 billion in 2008, compared to $7.4 billion in 2003. As a result, the exchange rate stabilized at an average of around 73 dinars per US dollar.

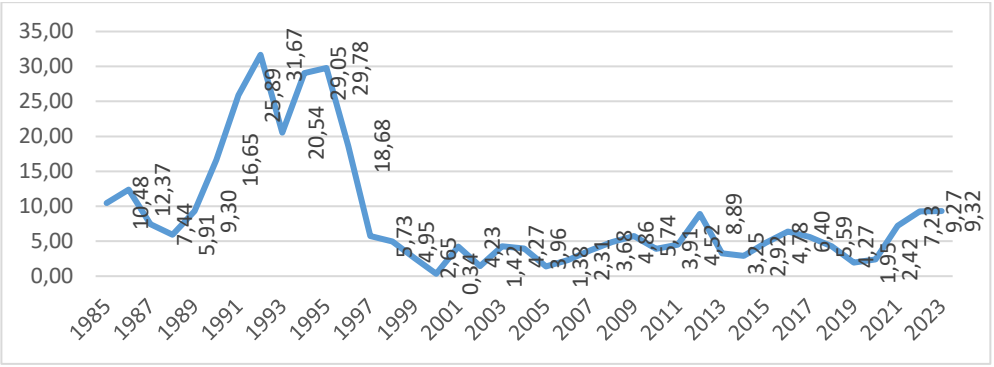
However, the exchange rate quickly increased during the third phase (2014–2023), leading to a depreciation of the local currency. The exchange rate reached approximately 142 in 2022, its highest level ever, after remaining stable at 79 in 2013. This rise was primarily due to the persistent trade balance deficit resulting from declining oil revenues. The deficit reached a record high of $26.5 billion in 2016 and continued until 2021, amounting to $4.5 billion. This was mainly driven by falling oil prices, with the average crude oil price during the 2014–2020 period standing at approximately $57 per barrel.

Overall, the average exchange rate during the study period was estimated at 67.61. The lowest value was recorded in 1986 at 4.7, while the highest value was observed in 2022, reaching 141.99.

Analysis of the evolution of inflation:

The inflation index is one of the key indicators used to measure the rate of changes in price levels, Consequently, it reflects individuals' purchasing power.

Figure no. 2. Evolution of the inflation rate in Algeria during the period 1985-2023



Source: Developed by the authors, based on *(* https://data.worldbank.org*)*

From the previous figure, we observe fluctuations in the inflation rate during the study period, with an average inflation rate of 8.66%. The highest rate was recorded in 1990 at 29.77%, while the lowest was in 2000 at 0.33%. The development of the inflation rate can be divided into two main periods. The first period extends from 1985 to 1996, during which inflation levels were particularly high, especially between 1990 and 1996, where the inflation rate rose from 9.30% in 1989 to 29.7% in 1995. This increase was driven by rising commodity prices, increased demand for goods and services, and scarcity of products, in addition to the failure of the socialist system and the transition to a market economy.

The second period, which extended from 1997 to 2023, witnessed significant fluctuations in the inflation rate between increases and decreases. The highest rate was recorded in 2023 at 9.32%, while the lowest rate was in 2000, registering 0.33%.

In our analysis of exchange rate and inflation rate trends, we found that the inflation rate consistently remained above zero throughout the study period, signaling a persistent rise in consumer prices. On the other hand, the exchange rate showed declines at certain points while stabilizing at others, implying an inverse relationship between inflation and the exchange rate. Moreover, the exchange rate appears to be influenced by oil prices, which will therefore be incorporated into the study's econometric model.

An Econometric Study (the Impact of Inflation on the Exchange Rate in Algeria During the Period 1985-2023)

To determine the relationship between the nominal exchange rate and inflation, we will use the ARDL model (Autoregressive Distributed Lag), which allows for the estimation of both short-term and long-term relationships between variables. It is considered a dynamic model capable of analyzing the evolution of variables over time, and it does not require all variables to be integrated of the first degree.

Formulation of the Model

Based on previous studies, the analysis of the development of the study variables, their trends, influencing factors, and data availability, the annual crude oil price and the ratio of money supply to GDP have been included as independent variables, in addition to the inflation rate. The dependent variable represents the exchange rate.

Our study will rely on annual data (time series) specific to Algeria, sourced from the World Bank, covering the period from 1985 to 2023, making the sample size 39 observations. The natural logarithm (ln) will be introduced into the model for the purpose of:

- Linearize the model, facilitating estimation and interpretation;
- Express the relationship between study variables using elasticities;
- Achieve data homogeneity and reduce the impact of outliers, thereby enhancing the accuracy of statistical results.

Thus, the model takes the following form:

$$LEXCRAT_t = a + \beta_1 LINF_t + \beta_2\, LOIPRICE_t + \beta_3 LBMNY_t + \varepsilon_t$$

Where:

- LEXCRAT: The natural logarithm of the official exchange rate.
- LINF: The natural logarithm of the inflation rate.
- LOIPRICE: The natural logarithm of the crude oil price per barrel (expressed in US dollars).
- LBMNY: The natural logarithm of the broad money supply (as a percentage of GDP).
- a: Represents the intercept (constant term).
- β_1, β_2, β_3: Represent the elasticities.
- ε: Represents the random error term.
- t: Refers to the time period.

Testing the Stationarity

Testing the stability of time series is a fundamental step before the modeling process, as it ensures the accuracy of estimates and prevents obtaining false or unrealistic results. One of the most prominent tests in this context is the ADF (Augmented Dickey-Fuller) test, which is used to determine whether a time series contains a unit root and to assess its level of integration.

Table no. 1. ADF Test Results

At Level					
		LEXCRAT	**LINF**	**LOIPRICE**	**LBMNY**
Intercept	t-Statistic	-3.3868	-2.6913	-1.1532	-1.4139
	Prob.	0.0179	0.0848	0.6844	0.5654
Trend and Intercept	t-Statistic	-2.2293	-2.7604	-3.0470	-2.3123
	Prob.	0.4602	0.2199	0.1335	0.4173
None	t-Statistic	1.2719	-1.2225	1.0103	-0.1754
	Prob.	0.9456	0.1993	0.9145	0.6163
At First Différence					
		d(LEXCRAT)	**d(LINF)**	**d(LOIPRICE)**	**d(LBMNY)**
Intercept	t-Statistic	-4.0479	-8.1415	-6.0946	-4.9275
	Prob.	0.0033	0.0000	0.0000	0.0003
Trend and Intercept	t-Statistic	-4.9057	-8.0913	-6.0080	-5.0350
	Prob.	0.0017	0.0000	0.0001	0.0012
None	t-Statistic	-3.2814	-8.2562	-5.9537	-4.9971
	Prob.	0.0017	0.0000	0.0000	0.0000

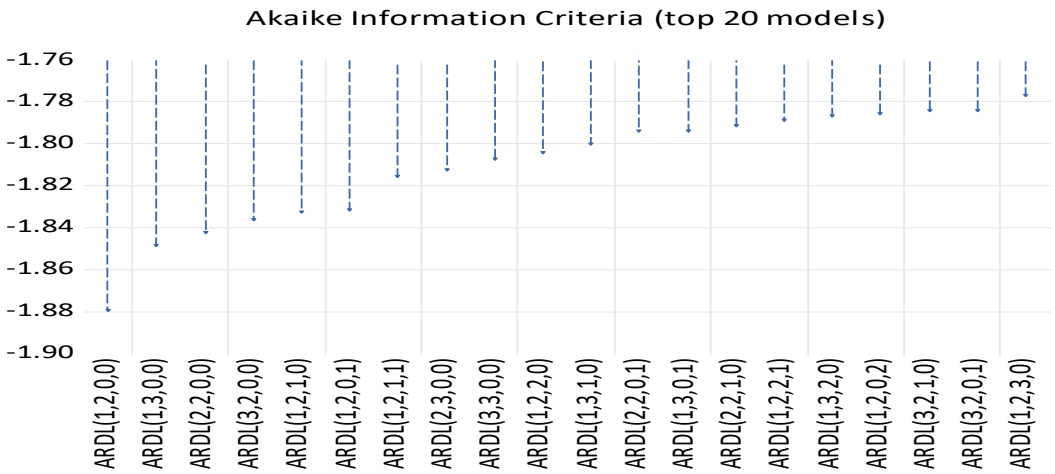
Source: Developed by the researchers based on the outputs of EViews 13.

Referring to the earlier table, the p-value for the unit root test exceeds 0.05 at the level but falls below 0.01 at the first difference. This indicates that all variables in the study achieve stationarity at the first difference, with a significant level of 1%. Consequently, the conditions are met with the ARDL methodology.

Optimal Lag Length

The following figure illustrates the optimal lag periods.

Figure no. 3. Akaike Information Criterion (AIC)



Source: Developed by the researchers based on the outputs of EViews 13.

It is observed from the previous figure that among the 20 models, the ARDL (1, 2, 0, 0) model is the most suitable compared to the other evaluated models, as it has the lowest value according to the evaluation criteria. This applies to this model.

The preliminary estimation results of the ARDL model indicate the high quality of the model, as reflected by the R-squared value, which is estimated at 0.99. This suggests that the model explains 99% of the variations in the exchange rate. Additionally, the p-value of the F-statistic is 0.000000, confirming that the explanatory variables are not spurious and that the overall model is statistically significant.

ARDL Bounds Test

"The ARDL Bounds Test reveals the existence of a long-term equilibrium relationship and cointegration in the model."

Table no. 2. ARDL Bounds Test

Null Hypothesis: No levels relationship				
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
			Asymptotic	
F-statistic	14.74856	10%	4.02	3.88
		5%	3.88	4.61
		1%	4.99	5.85

Source: Developed by the researchers based on the outputs of EViews 13

Table no. 2 shows that the value of the F-statistic is 14.74856, which is greater than the I (1) value (the upper bounds of the critical values) at all significance levels of 10%,

5%, and 1%. This confirms the presence of a cointegration and a long-term relationship within the model.

Estimation of the long-term relationship

Table no. 3. Long-term Relationship Estimation Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINF	-0.146880	0.048785	-3.010774	0.0050
LOIPRICE	-0.332982	0.092601	-3.595856	0.0010
LBMNY	-2.065000	0.151614	-13.62008	0.0000
CE = LEXCRAT(-1) - (-0.14688*LINF(-1) - 0.332982*LOIPRICE - 2.065*LBMNY				

Source: Developed by the researchers based on the outputs of EViews 13

Table no. 3 shows that all the model parameters are statistically significant, indicating the presence of a long-term equilibrium relationship.

The Error Correction Model (ECM)

Table no. 4. ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ(-1)*	-0.477161	0.052089	-9.160499	0.0000
D(LINF)	0.047595	0.018597	2.559296	0.0153
D(LINF(-1))	0.069202	0.019217	3.601094	0.0010
C	5.748726	0.750141	7.663528	0.0000

Source: Developed by the researchers based on the outputs of EViews 13

From the findings presented in Table 5, it is evident that the coefficients for (LINF) and D (LINF (-1)) are both positive and statistically significant. This suggests that the dependent variable (exchange rate) responds directly to changes in both the current and lagged values of the independent variable.

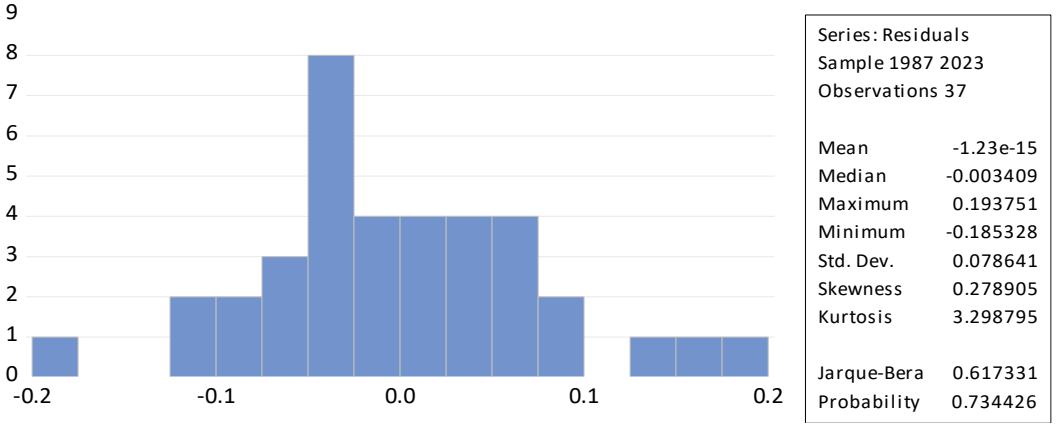
Additionally, the model analysis reveals that the error correction term, CointEq (-1), is negative and statistically significant at the 1% level, confirming the robustness of the model. This indicates that approximately 47.71% of short-term imbalances are corrected within a single period, restoring long-term equilibrium. This result confirms the model's ability to recover from shocks and reinforces the existence of a stable long-term equilibrium relationship among the variables.

Diagnostic Tests

After estimating the model, the quality of the model should be analyzed by conducting the following diagnostic tests:

Normality Test for the model's residuals: Jarque-Bera Test.

Figure no. 4. Results of the Jarque-Bera Test.



Source: EViews 13 Outputs

The test results in the previous figure indicate that the p-value of the Jarque-Bera statistic is 0.73, which is greater than the 5% significance level, confirming that the residuals follow a normal distribution.

Autocorrelation Test: LM Test.

Table no. 5. Autocorrelation Test: LM Test.

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.591568	Prob. F(2,27)	0.5605
Obs*R-squared	1.553272	Prob. Chi-Square(2)	0.4600

Source: Developed by the researchers based on the outputs of EViews 13

Table no. 5 indicates that the p-value of the F-statistic (LM Test) is 0.56, which is higher than 0.05 (the 5% significance level), confirming that there is no autocorrelation problem in the residuals.

Heteroskedasticity Test: ARCH Test.

Table no. 6. Heteroskedasticity Test: ARCH Test.

Heteroskedasticity Test: ARCH			
F-statistic	1.135687	Prob. F (1,34)	0.2941
Obs*R-squared	1.163625	Prob. Chi-Square (1)	0.2807

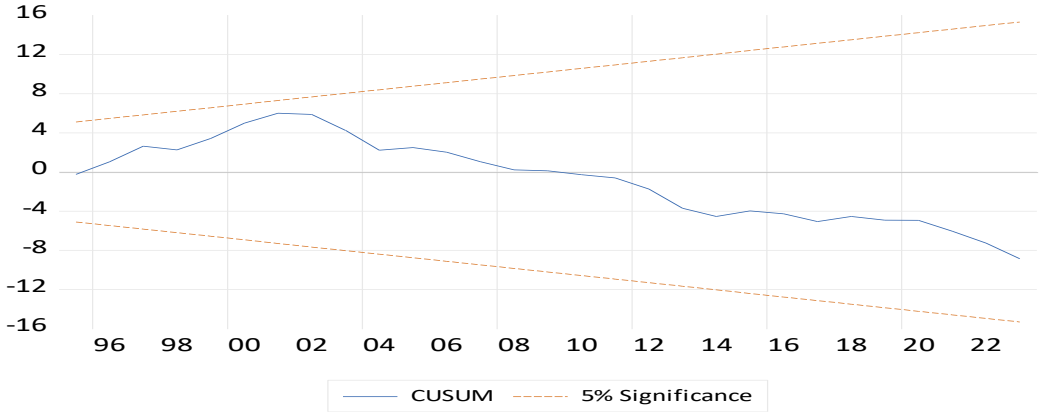
Source: Developed by the researchers based on the outputs of EViews 13

According to the results in Table no. 6, the p-value of the F-statistic (ARCH test) is 0.294, which is greater than the 5% and 10% significance levels. This reinforces the absence of a heteroscedasticity problem in the residuals.

Structural Stability Test of the Model.

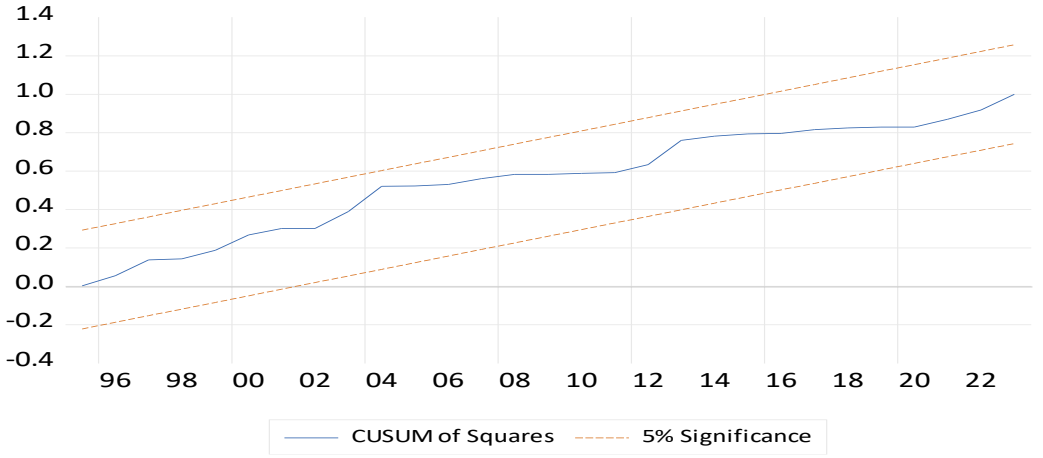
The structural stability of the model is tested through the CUSUM test and the CUSUMSQ test. The following two figures illustrate the results of these tests:

Figure no. 5. (CUSUM) Test.



Source: EViews 13 Outputs

Figure no. 6. (CUSUMSQ) Test.



Source: EViews 13 Outputs

From the previous figures, we observe that the graphs for both the CUSUM and CUSUMSQ tests lie within the 95% confidence bounds, indicating that the model exhibits structural stability.

Conclusion and Recommendations

Based on an analysis of inflationary pressures and their impact on the exchange rate in Algeria from 1985 to 2023, using the ARDL model, the study confirmed the presence of cointegration and a long-term equilibrium relationship. After validating the model through diagnostic tests and structural stability checks, the findings revealed the following:

Short-Term Findings

The study identified a statistically significant positive relationship in the short term. Specifically, a 1% increase in current and lagged inflation rates led to a 0.0047% and 0.069% rise in the exchange rate, respectively. This suggests that the exchange rate responds more strongly to past inflation rates than to current ones, though the overall impact remains minimal.

Long-Term Findings

The results demonstrated a statistically significant inverse relationship in the long term. A 1% increase in inflation caused a 0.146% decline in the exchange rate. Similarly, a 1% rise in crude oil prices and the money supply-to-GDP ratio led to a 0.33% and 2.06% decrease in the exchange rate, respectively. The exchange rate was found to be most sensitive to changes in the money supply-to-GDP ratio, followed by crude oil prices, with inflation having the least impact.

Hypotheses Validation:

- The first hypothesis, which posits a rapid, positive, and statistically significant short-term response of the exchange rate to inflation in Algeria, was accepted.
- The second hypothesis, suggesting a statistically significant positive long-term effect of inflation on the exchange rate, was rejected.
- The third hypothesis, which claims a strong exchange rate response to inflationary pressures, was also rejected.

Despite the Central Bank's efforts to manage inflationary pressures and domestic shocks through a managed floating exchange rate system—resulting in lower import prices and improved individual welfare—inflation rates remained high. This persistent rise in the general price level eroded purchasing power and adversely affected economic and social welfare.

Recommendations:

Implement an inflation-targeting policy to curb rising prices and protect purchasing power.

1. Enhance economic production flexibility to align with growing aggregate demand, ensuring that increases in money supply are matched by real economic growth to achieve price stability.
2. Promote foreign investment to boost foreign currency inflows, strengthen domestic production, and increase the aggregate supply of goods and services, thereby reducing the general price level.
3. Diversify income sources and reduce reliance on oil revenues, given their significant influence on internal and external balances, particularly the exchange rate.

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