Econometric Study of How Exchange Rate Fluctuations Affect Economic Growth in Algeria (1990-2022)

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Abstract:
This paper does an econometric analysis to investigate the relationship between changes in exchange rates and Algerian economic growth from 1990 to 2022. This paper examines previous data to determine how exchange rate swings affect Algeria's economy, emphasizing its export dependency. The research examined immediate and long-term exchange rate- Gross Domestic Product (GDP) connections using an Autoregressive Distributed Lag (ARDL) model. The model's stability and optimal time delay are assessed in the early tests. The ARDL limits testing method confirms a cointegrating connection, demonstrating a stable long-term balance between variables. An initial study shows that the exchange rate negatively impacts economic development, exposing the difficulties of imported inflation and currency instability. The study reveals no significant effects, proposing separating nominal and real aspects over more extended periods. These results help policymakers understand how exchange rate policies affect economic growth.
Keywords: Exchange Rate, Economic Development, Algeria, ARDL Model, Inflation, Cointegration.
JEL Classification: F31, O11, C22, Q43.

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Introduction

Understanding the correlation between exchange rates and economic development is crucial for countries with economies heavily reliant on international commerce and finance.

The Algerian economy, which relies significantly on the sale of hydrocarbons, has a unique opportunity to analyze the influence of exchange rate variations on economic development. Algeria faced various financial challenges and enacted policy reforms from 1990 to 2022, providing a significant period for analysis. This research investigates the relationship between the variations in currency exchange rates and economic development over this crucial historical era.

The following research questions guide the study:

What is the direct impact of fluctuations in exchange rates on Algeria's economic growth from 1990 to 2022? What is the long-term effect of the exchange rate on economic growth within a certain period?

Alternatives for this inquiry include:

H1: Exchange rate fluctuations quickly affect Algeria's economic development.

H2: The exchange rate does not statistically affect long-term economic growth, showing a difference between nominal and natural causes.

These results are analyzed by econometric methods based on the Autoregressive Distributed Lag (ARDL) model. This model is chosen because it can analyze short-term and long-term dynamics and handle different integration orders of variables. Unit root and cointegration tests assess model reliability. We then employ ARDL limits testing to demonstrate a long-term equilibrium relationship between the exchange rate and economic growth.

This study has two main objectives: The objective is to examine the immediate economic reactions to changes in exchange rates and evaluate the potential long-term consequences, including the possibility of the economy demonstrating resilience or adjusting to prolonged exchange rate patterns. This study uses the Autoregressive Distributed Lag (ARDL) methodology to examine the complexities of Algeria's economic framework and policy context. It offers vital insights into the causal processes that are now in effect.

The significance of this research is in its capacity to enlighten policymakers and economists regarding the efficacy of exchange rate adjustments as a means of economic governance in an oil-exporting nation. The research examined in this study establishes a firm basis, indicating that although the exchange rate can significantly impact the economy in the short term, its long-term consequences are influenced by underlying economic fundamentals and structural factors.

The present research commences by delineating the economic backdrop of Algeria, emphasizing the noteworthy occurrences and alterations in policies that have transpired since 1990. The text discusses the empirical methods used in the study, namely the pretests that were undertaken to confirm the reliability of the ARDL model by prioritizing the establishment of a direct correlation between theoretical frameworks and facts.

1. Literature Review:

Extensive research conducted in recent decades has focused on the relationship between exchange rates and economic performance. These studies have identified multiple processes via which variations in exchange rates might impact economic growth. The relationship between Algeria and oil exports is of great interest in Algeria because the nation heavily depends on these exports. This strong connection between the economy's well-being and international trade and finance dynamics is crucial.

Pettinger (2019) presented a fundamental viewpoint on the impact of inflation-induced devaluation of currency rates on economic activity. The study emphasized that elevated inflation rates may erode domestic products' competitiveness, reducing export demand and undermining the national currency. This occurrence has been noted in the United Kingdom. Nevertheless, it offers a valuable perspective to analyze the Algerian economy, particularly in light of Algeria's efforts to control inflation and expand its export portfolio outside hydrocarbons. (Pettinger, 2019)

Mohseni and Jouzaryan (2016) used the ARDL model to illustrate the adverse long-term effects of inflation and unemployment on economic growth, expanding upon the current discourse on this subject. (Mohseni & Jouzaryan, 2016, pp. 381-389.)

The ARDL approach, utilized in several studies conducted in the Algerian setting (Louail, 2015) and (Dekkiche, Mimouni , & Bouguetaia , 2022) offers a robust framework for evaluating macroeconomic factors' interaction over time.

Similarly, Kasidi and Mwakanemela (2013) investigated the immediate effects of inflation on Tanzania's economic development. Although this research has a narrow geographical scope, its methods and findings provide valuable insights that may be applied to Algerians. More precisely, it illuminates the process of stimulating local economic activity to reduce the effects of inflation caused by imports. This is especially noteworthy for Algeria, considering its substantial dependence on imports for consumption. (KASIDI & MWAKANEMELA, 2013, pp. 363-380.)

Clarida and Waldman (2007) examined the consequences of inflation announcements on currency exchange rates. Their findings emphasized the intricate character of the exchange rate as a financial variable, which is affected by tangible economic data, policy announcements, and expectations. The impact of monetary policy and inflation targeting on economic growth in Algeria is particularly significant, as it operates through the exchange rate channel with subtle effects. (Clarid & Waldman, 2007)

Several scholarly works on Algeria explore comparable topics consistent with these global investigations. Their study, (Zidat & Amia, 2021) found that the choice of exchange rate regime in Algeria has a considerable impact on key macroeconomic indicators such as GDP, inflation, and unemployment. They observed that managed floats, compared to more inflexible regimes, offer different advantages. (Louail, 2022) supports these findings, as they analyzed the overall influence of economic openness on GDP growth and the specific effects of tourism receipts and the real exchange rate on economic growth.

In their study, (Dekkiche, Mimouni , & Bouguetaia , 2022) examined the relationship between balance of payments and exchange rate changes, uncovering an intricate and stable equilibrium connection between these variables in the long term. Algeria's reliance on oil exports and balance of payments' susceptibility to currency rate swings make this research relevant.

Many studies on tourism and Algeria examine the complicated link between currency rates and economic performance. (Louail, 2022), monetary policy (Omolade & Ngalawa., 2016), and energy consumption (Bélaïd & Abderrahmani. , 2013). These contributions show how exchange rate development affects numerous economic sectors and policy issues.

The study "The Reflection of Financial Development and Trade Openness on The Economic Growth of North African Countries Using The Dynamic

Panel Model" examines how financial development and trade openness affected Algeria, Tunisia, and Egypt from 1990 to 2022. A dynamic panel model using the Generalised Method of Moments (GMM) showed that financial development and trade openness consistently and significantly boost economic growth. This highlights the importance of a strong finance sector in boosting economic growth from trade liberalization. (Mezenner & Saidj , 2023)

The paper "The Impact of The Exchange Rate and Inflation On The Budget Deficit In Light Of Crisis - An Econometric Study Of The Case Of Algeria Over The Period (2000-2022)" examines how exchange rate volatility and inflation affect Algeria's budget deficit during crises. The research found that the budget imbalance affects exchange rates and inflation. Due to more excellent prices and currency depreciation, the government earns more. (Benameur, 2023)

The article "Empirical Modelling of The Impact of Monetary Policy On Saudi Arabia's Economic Growth During The Period 1990-2022" examines how monetary policy affects Saudi economic growth. The study examines 1990–2022 data using Autoregressive Distributed Lag (ARDL). The primary outcome variable is GDP, considering M3 money supply, interbank interest rates, and inflation. The study shows that monetary policy affects economic growth, but its long-term implications are unclear. (Hanifa & Redif, 2023)

When analyzing the results of these several studies, it becomes clear that to comprehend Algeria's economic growth pattern from 1990 to 2022, one must consider the complex influence of the exchange rate. The current body of research provides a strong foundation for investigating this connection, with the ARDL model being a valuable instrument for understanding the intricacies of the Algerian economy's structural and policy-driven peculiarities.

This section of the literature review compiles the provided information. It is specially designed to be included in a thorough research paper investigating the impact of the exchange rate on economic development in Algeria. The study thoroughly analyzes the relevant international literature and research on Algeria, highlighting the applicability of various models and results to the Algerian context.

2- Analysing the correlation between the exchange rate and economic development in Algeria from 1990 to 2022.

We will strive to develop a suitable standard model that clarifies the long-term and short-term correlation between Algeria's exchange rate and economic development from 1990 through 2022.

2-1- Pretests

The model's general formulation, the series' stability, and the distribution of lag periods on the model variables according to the (AIC) criterion will be discussed. The preliminary examinations will entail the following:

FIRSTLY, Model Construction

First and foremost, in building the model, it is essential to recognize that the economic factors under study necessitate a timeframe for their impact to extend across both the short and long terms. Hence, we can apply the ARDL test, and the study model is articulated as follows:

$$\Delta GDP = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta GDP_{t-i} + \sum_{t=0}^{q} \beta_2 \Delta EXCH_{t-i} + \alpha_1 GDP_{t-1} + \alpha_2 EXCH_{t-1} + \varepsilon_t$$

Where:

GDP: Logarithm of Gross Domestic Product (an indicator of economic growth);

EXCH: Logarithm of the exchange rate;

Δ: Denotes first-order differences;

p,q: The model's maximum delays for both the dependent and independent variables;

β_{0-2}: Coefficients of the long-term relationship;

α_{1-2}: Coefficients of the short-term relationship (Error Correction Model).

Secondly, the Stability Analysis of Study Variables:

The presence of the stability characteristic is crucial since its lack of different variables employed might result in misleading findings. Hence, we

will use the Phillips-Perron (PP) test to assess the stability of the selected model series, which we will evaluate in their logarithmic format. The following table provides a concise overview of the outcomes obtained from this examination:

Table number(01): Time Series Stability Test (Phillips-Perron Test).

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

		GDP	EXCH
At Level			
With Constant	t-Statistic	-0.6329	-5.7440
	Prob.	0.8493	0.0000
		n0	***
With Constant & Trend	t-Statistic	-2.0661	-6.1226
	Prob.	0.5442	0.0001
		n0	***
Without Constant & Trend	t-Statistic	1.0223	1.6175
	Prob.	0.9156	0.9715
		n0	n0
At First Difference		d(GDP)	d(EXCH)
With Constant	t-Statistic	-5.9250	-6.3367
	Prob.	0.0000	0.0000
		***	***
With Constant & Trend	t-Statistic	-5.8835	-6.0801
	Prob.	0.0002	0.0001
		***	***
Without Constant & Trend	t-Statistic	-5.4105	-5.7841
	Prob.	0.0000	0.0000
		***	***

Notes:
a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant
b: Lag Length based on SIC
c: Probability based on MacKinnon (1996) one-sided p-values.

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Source: Outputs from Eviews 12.

Therefore, all variables exhibit stability when their initial differences are taken, indicating that they are integrated in the order I(1).

Thirdly, the Selection of Optimal Lag Lengths for the Model:

This is shown by Figure No. 01, which illustrates the collection of potential models obtained by adjusting the lag degrees of the variables in the model after selecting degree (1) based on the Schwarz Information Criterion (SIC). The ARDL (3,4) model is determined to be optimum based on the Akaike Information Criterion (AIC), supported by the lowest value. This is visually shown in the accompanying image.

Figure Number (01): Outcome of the Optimal Lag Lengths Test.
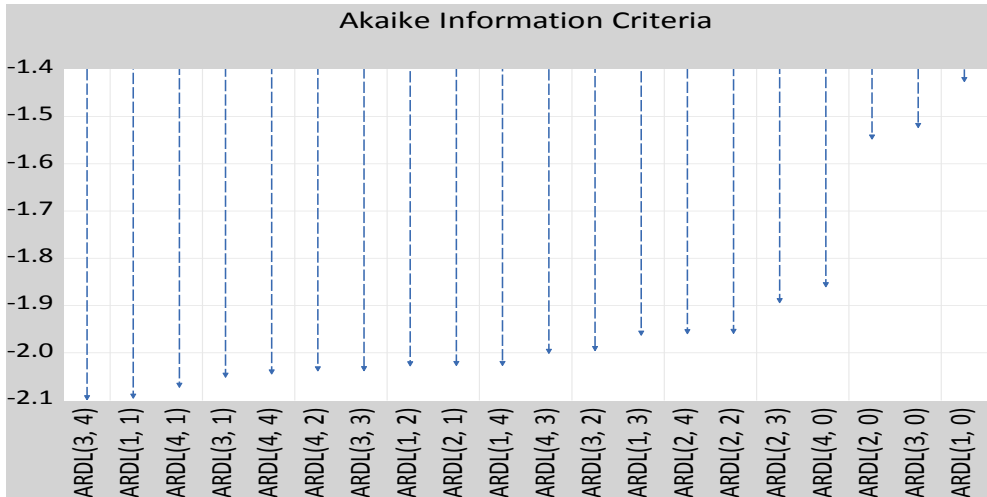
Source: Outputs from Eviews 12.

2-2- Model Residuals Diagnostics

Before using the ARDL (3,4) model for estimating the impacts in the short-term and long-term, it is crucial to evaluate the model's performance quality. The use of the following examinations accomplishes this:

Firstly, Model Quality:

In order to evaluate the model's accuracy, it is essential to compare the actual values with the predicted values, as shown in the following diagram:

**Figure Number (02): Actual Values, Estimated Values, and Residuals.**

Source: Outputs from Eviews 12.

From the figure, we observe a convergence of the estimated values to the actual values, indicating the estimated model's quality. Therefore, it can be relied upon for interpreting and analyzing results.

Secondly, Normal Distribution of Residuals:

Examining the residuals' distribution involves evaluating the premise that 'the residuals follow a normal distribution.' This is accomplished by analyzing the data, which enables the observation of residuals clustering in the center and decreasing as they go out from the center towards the outer edges or the absence of such clustering. Alternatively, this may be accomplished by comparing the Jarque-Bera statistic with the critical value from the Chi-Square distribution with 2 degrees of freedom and a significance level of 0.05, as seen in the image below:

Figure Number (03): Residuals follow a normal distribution.
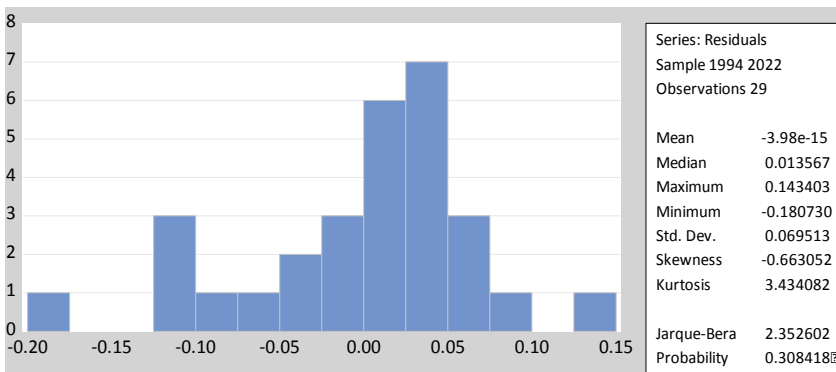
Source: Outputs from Eviews 12.

The test result was not statistically significant ($\alpha > 0.05$), as shown by a J-B value of 2.35, which is lower than the critical threshold of $\chi^2 = 5.99$. This indicates that the residuals of the model have a normal distribution.

Thirdly, The Autocorrelation Test of Errors:

Autocorrelation among residuals is assessed by testing the hypothesis that 'there is no autocorrelation among the residuals.' The comparison is made by evaluating the Lagrange statistic (R-Square) obtained from the LM test against the critical value from the Chi-Square distribution table with 2 degrees of freedom and a significance threshold of 0.05. Based on the LM test, the probability chi-square is statistically significant at a level lower than 0.05. Therefore, we confirm the null hypothesis that there is no autocorrelation. The information is shown in the following table:

Table Number (02): Results of the Autocorrelation Test of Errors.

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.005931	Prob. F(2,18)	0.9941
Obs*R-squared	0.019097	Prob. Chi-Square(2)	0.9905

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 09/09/23   Time: 23:17
Sample: 1994 2022
Included observations: 29
Presample missing value lagged residuals set to zero.

Source: Outputs from Eviews 12.

Fourthly, the Heteroscedasticity Test:

This is conducted by comparing the R-squared statistic calculated through the Breusch-Pagan-Godfrey test with the table value of the Chi-Square distribution at 2 degrees of freedom and a significance level of 0.05. According to this test, the Prob F is more significant than 0.05, meaning the F is insignificant. Therefore, we accept the alternative hypothesis that asserts the homogeneity of variance, as illustrated in the following table:

**Table Number (03): Heteroscedasticity test results.**

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.361866	Prob. F(8,20)	0.9286
Obs*R-squared	3.666881	Prob. Chi-Square(8)	0.8859
Scaled explained SS	2.383767	Prob. Chi-Square(8)	0.9669

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/09/23   Time: 23:18
Sample: 1994 2022
Included observations: 29

Source: Outputs from Eviews 12.

Fifthly, Stability Test:

In order to verify the integrity of the data and the suitability of the model for prediction, it is crucial to assess the stability of the model by conducting a graphical examination of the residuals and squared residuals. This is shown in the following diagram:

Figure Number (04): Outcome of the Model Stability Test.
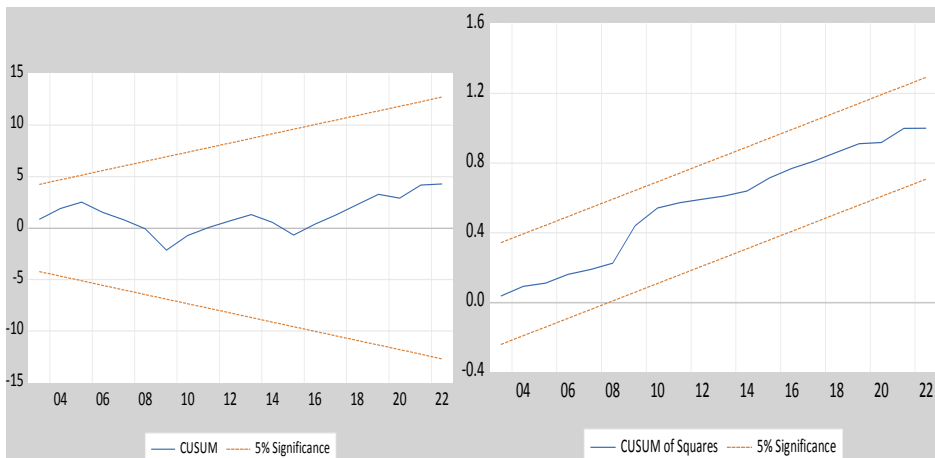
Source: Outputs from Eviews 12.

Given that the graphical representations in both the CUSUM Test and the CUSUM of Squares Test fall below the crucial boundaries at the 0.05 significance level, we conclude that the model is stable.

2-3- Model Parameter Testing Over the Short and Long Term:

In this study, we examine the potential for cointegration among the model variables and evaluate the immediate and long-term effects of the exchange rate on Algeria's economic development.

First, Testing for Cointegration Using the Bounds Test:

The following hypothesis is tested by examining the potential cointegration: Cointegration is present among the model variables. The following table presents the outcomes of the cointegration test conducted utilizing the Bounds Test methodology:

Table Number (04): Results of the Bounds Test.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	6.484995	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Actual Sample Size	29	Finite Sample: n=35		
		10%	3.223	3.757
		5%	3.957	4.53
		1%	5.763	6.48
		Finite Sample: n=30		
		10%	3.303	3.797
		5%	4.09	4.663
		1%	6.027	6.76

Source: Outputs from Eviews 12.

The findings suggest that, for most significance levels, the computed F-statistic value exceeds the critical values for the lower and upper bounds. As a result, the null hypothesis of no cointegration relationship among the variables is rejected. This finding indicates the presence of a sustained equilibrium connection between the Algerian economy and its exchange rate.

Secondly, Analysis and Interpretation of the Short-Term Relationship:

The estimation results for the short-term correlation between the exchange rate and economic growth in Algeria from 1990 to 2022 are presented in the table below.

Table Number (05): The outcomes of the error correction parameter and short-term parameter estimation.

ARDL Error Correction Regression
Dependent Variable: D(GDP)
Selected Model: ARDL(3, 4)
Case 2: Restricted Constant and No Trend
Date: 09/09/23   Time: 23:24
Sample: 1990 2022
Included observations: 29

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	0.016533	0.180782	0.091454	0.9280
D(GDP(-2))	-0.441064	0.184809	-2.386595	0.0270
D(EXCH)	-0.770505	0.228267	-3.375460	0.0030
D(EXCH(-1))	-0.270325	0.239201	-1.130120	0.2718
D(EXCH(-2))	-0.179342	0.219584	-0.816737	0.4237
D(EXCH(-3))	-0.251287	0.137049	-1.833557	0.0816
CointEq(-1)*	-0.060187	0.013010	-4.626065	0.0002

R-squared	0.674685	Mean dependent var		0.040105
Adjusted R-squared	0.585963	S.D. dependent var		0.111081
S.E. of regression	0.071476	Akaike info criterion		-2.232409
Sum squared resid	0.112394	Schwarz criterion		-1.902372
Log likelihood	39.36993	Hannan-Quinn criter.		-2.129046
Durbin-Watson stat	1.975761			

Source: Outputs from Eviews 12.

The following issues are clarified in Table Number 05:

Short-term economic growth is significantly and statistically impacted negatively by the exchange rate; for instance, an increase of 1% in the exchange rate leads to a decline of 0.77% in economic development. This is consistent with economic theory, which asserts that developing and importing countries are negatively impacted by a high exchange rate of foreign currencies, which hinders economic development. Algeria's economy, which is significantly impacted by inflation imported from abroad, affects the exchange rate of the dinar, which in turn reduces the value of the Gross Domestic Product (GDP) and economic growth rates.

There is a dynamic relationship between Algeria's exchange rate and economic development over the short term. As evidenced by the estimated error's statistically significant negative value (CointEq(-1) = -0.0601), which quantifies the portion of the dependent variable's imbalance that is correctable with time, this is the case. A negative sign between the variables indicates a long-term equilibrium relationship.

Thirdly, An Examination and Elucidation of the Prolonged Association:

The estimation results for the long-term correlation between the exchange rate and economic growth in Algeria from 1990 to 2022 are presented in the table below:

Table Number (06): Results of Estimating Long-Term Parameters.

```
ARDL Long Run Form and Bounds Test
Dependent Variable: D(GDP)
Selected Model: ARDL(3, 4)
Case 2: Restricted Constant and No Trend
Date: 09/09/23   Time: 23:23
Sample: 1990 2022
Included observations: 29
```

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.242152	0.351148	3.537404	0.0021
GDP(-1)*	-0.060187	0.037242	-1.616079	0.1217
EXCH(-1)	-0.186887	0.085560	-2.184289	0.0410
D(GDP(-1))	0.016533	0.196311	0.084220	0.9337
D(GDP(-2))	-0.441064	0.204678	-2.154912	0.0435
D(EXCH)	-0.770505	0.279574	-2.756001	0.0122
D(EXCH(-1))	-0.270325	0.251144	-1.076378	0.2946
D(EXCH(-2))	-0.179342	0.232308	-0.772002	0.4491
D(EXCH(-3))	-0.251287	0.150511	-1.669558	0.1106

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH	-3.105125	2.899472	-1.070928	0.2970
C	20.63830	14.17380	1.456088	0.1609

EC = GDP - (-3.1051*EXCH + 20.6383)

Source: Outputs from Eviews 12.

The findings presented in Table 06 indicate that the exchange rate does not have a statistically significant effect on long-term economic growth. This discovery is consistent with economic theory, which posits that the relationship between nominal and real variables is transient within classical-influenced economies.

Conclusion:

An extensive econometric analysis examined Algeria's economic growth and currency rate variations from 1990 to 2022. We employed the Autoregressive Distributed Lag (ARDL) model to determine immediate and long-term effects. Empirical research shows that exchange rate volatility hurts short-term economic growth. Specifically, a 1% rise in the exchange rate reduces GDP growth by 0.77%. Due to its import dependency and imported inflation, Algeria's economy is vulnerable to rapid currency exchange rate movements. The research shows that the exchange rate does

not affect economic growth. According to the research, the Algerian economy can adjust to exchange rate changes. Additionally, nominal factors like the currency exchange rate may not directly affect economic outcomes. According to conventional economics, nominal variables lose their significance with time.

According to the conclusions, Algerian authorities must prioritize currency rate stability to mitigate immediate economic effects. Foreign currency reserves and exports outside oil may be needed to improve the financial structure. Inflation management and local product competitiveness may also mitigate the consequences of a falling currency exchange rate. Investigating the effects of foreign exchange rate variations on unrelated enterprises, especially those outside the oil sector, might improve future research. This would allow a thorough economic reaction strategy. Studying how foreign investment and capital flows mitigate exchange rate effects may help us comprehend Algeria's economic growth patterns.

We learn about exchange rate economics by studying how it affects economic development in a country's oil export industry. The findings underline the complexity of economic responses to exchange rate variations and the importance of temporal considerations in policymaking. Long-term prosperity and financial stability need a thorough grasp of Algeria's economic drivers.

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