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Modeling Algeria's Foreign Exchange Reserves with ARIMA: Trends and Policy Implications

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Abstract:

Given the critical importance of FER in ensuring monetary stability and guiding policy decisions, accurate forecasting is essential for effective economic management. This article explores the role of Foreign Exchange Reserves (FER) in the Algerian economy by employing the ARIMA model to forecast future reserve levels. The study uses monthly in order to build and validate the ARIMA model, providing a detailed analysis of the trends and dynamics in Algeria's FER.

The forecasts generated cover the period from September 2023 to December 2023, indicating a slight downward trend in reserve levels. While the actual FER for September closely aligns with the forecasted value, with a relative error of just 1.01%, the forecast's accuracy could be affected by unforeseen economic events or policy shifts. These findings offer valuable insights for policymakers, emphasizing the need for a forward-looking approach to reserve management and monetary policy in Algeria.

Keywords: ARIMA; Foreign Exchange Reserve; Forecasting; Algeria

JEL Classification Codes: C22, F31, F37

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1. Introduction

In the post-Bretton Woods era, foreign exchange reserves have become indispensable for maintaining macroeconomic stability, particularly in the economies subject to significant fluctuations and external shocks. The debt crises that plagued many developing countries and the Asian financial crisis of the late 1990s highlighted the importance of abundant foreign exchange reserves. Consequently, many countries, especially oil exporters, have accumulated substantial foreign exchange reserves. For these countries, the level of reserves held by their central banks is a crucial determinant of macroeconomic stability during periods of low prices, often referred to as oil shocks.

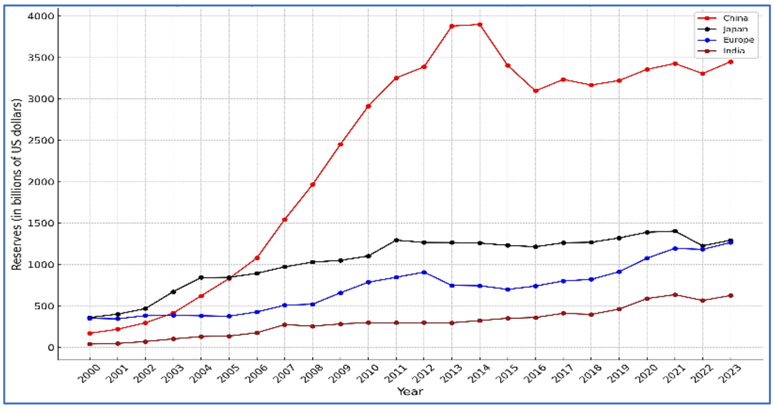
The accumulation of reserves has emerged as a widespread practice among countries seeking to preserve their economies against external vulnerabilities and promote macroeconomic resilience. Therefore, the trend of amassing foreign assets is not confined to the oil-exporting countries alone. According to the World Bank, countries exporting manufactured goods, such as China, India, South Korea, and Singapore have also significantly augmented their foreign exchange reserves (3.4 trillions, 628 Billion, 420 Billion, and 360 Billion USD respectively in 2023).

Foreign exchange reserves, also known as reserve assets in the balance of payments, are documented in the capital account (Aman, 2021). Based on the definition of the World Bank, FER includes: The total Foreign Exchange Reserves comprise holdings of monetary gold, Special Drawing Rights (SDRs), reserves of IMF member countries maintained by the IMF, and foreign exchange assets managed by monetary authorities. Central banks predominantly maintain reserves in convertible foreign currencies, with the US dollar—constituting approximately 60% of these reserves worldwide. FER plays a critical role in stabilizing domestic currencies, facilitating international trade, and supporting global commerce, investment, and finance.

Globally, China and Japan are the leaders in foreign exchange reserves, India and Europe Zone also have significant reserves. Over the last two decades, global foreign exchange reserves have grown significantly, driven by various factors such as increased trade between countries, leading to rising external surpluses and a greater need for reserves to support international transactions. The increase in reserves in India and other developing countries highlights their efforts to stabilize their economies and manage external shocks, even in the face of challenges like the 2008 global financial crisis, which affected the size and distribution of foreign exchange reserves.

Some emerging countries attempt to accumulate reserves in order to intervene in the foreign exchange market to protect their currencies (either upward or downward) due to their economies being open to indirect foreign investment flows, which cause severe fluctuations in their foreign exchange market. These fluctuations can transmit shocks to the export sector through the exchange rate channel. These economies primarily include emerging markets in Southeast Asia, which rely on an export-driven economic growth model. For instance, China makes efforts to counteract the appreciation of its exchange rate resulting from its growing trade surplus (Gómez, 2019).

Figure. 1: Foreign Exchange Reserves for (China; Japan; Europe; India)



Source: Author's calculations based on WDI data.

The graph depicts the Foreign Exchange Reserves (FER) of four major economies: China, Japan, Europe, and India, over the period from 2000 to 2023. China's FER has consistently increased over the years, far outpacing the other economies. China's rapid economic growth and trade surplus have been major drivers of its FER accumulation. Japan's FER experienced a period of growth, peaking around 2008, followed by a gradual decline. This could be attributed to the Japan's economic challenges, including deflation and trade deficits. The FER of Europe has fluctuated over the years, with periods of growth and decline. This may reflect economic and political developments, also the monetary policy may have influenced the fluctuations in its FER. India's FER has exhibited steady growth, indicating a strengthening economy and increasing foreign exchange reserves.

The forecasts provide valuable insights for shaping exchange rate policy by enabling the central bank to anticipate periods of reserve accumulation or depletion. Adopting a managed exchange rate can help ensure that reserves are utilized efficiently to maintain currency stability, while avoiding excessive interventions that could exhaust reserves. Furthermore, stable or increasing foreign exchange reserves offer an opportunity to strategically allocate a portion of the reserves towards long-term economic development, without undermining financial stability.

This article aims to highlight the significance of Foreign Exchange Reserves (FER) in the Algerian economy by applying the ARIMA model to forecast its future values, which is crucial for preparing effective monetary policy in Algeria. The subsequent sections provide an analysis of FER using monthly data from the past four years and develop an ARIMA model to forecast future reserve levels. This forecasting is essential for understanding FER trends and their implications for monetary policy.

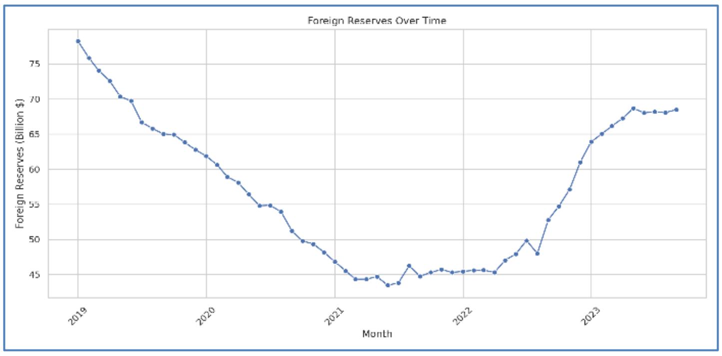
2. The role of Foreign Exchange Reserves in the Algerian economy

Algeria's small economy has been primarily driven by the growth of its hydrocarbon industry (Djoudi Mohammed Al, 2021). It is heavily reliant on oil exports, which account for a significant portion of government revenue, GDP growth, and foreign exchange earnings from its exports. This dependency makes the economy vulnerable to global oil price fluctuations. When oil prices drop, the Algerian government faces budget deficits, reduced public spending, and potential economic instability.

Foreign exchange reserves serve as a buffer to stabilize the economy during periods of low oil prices. FER allow the government to manage exchange rate fluctuations and prevent excessive depreciation of the Algerian dinar. The Bank of Algeria can utilize foreign exchange reserves to intervene in the foreign exchange market, selling dinars to influence its value and mitigate volatility. Maintaining a stable currency helps control inflation rates, which can rise sharply if the local currency depreciates significantly due to external shocks.

Algerian foreign exchange reserves data for the period 2019-2023 is plotted in **Figure 2** which illustrates the evolution of Algeria's foreign exchange reserves from January 2019 to September 2023 (monthly data) and reveals the following trends:

Figure. 2: Algeria's FER (2019/01 to 2023/09)



Source: Author's calculations based on the data of BA.

2.1 The Decline Period from 209 to 2021:

The reserves experienced a significant and continuous decrease from the beginning of 2019 until mid-2021, dropping from nearly $80 billion to around $44 billion, marking the lowest levels of reserves during this period and the whole decade. This decline can be primarily attributed to the drop in global oil prices, which were severely impacted by the COVID-19 pandemic and the subsequent reduction in global oil demand. This had a direct effect on Algeria's foreign currency revenues, given the country's heavy reliance on oil and gas exports. Additionally, other factors such as government spending also played a role.

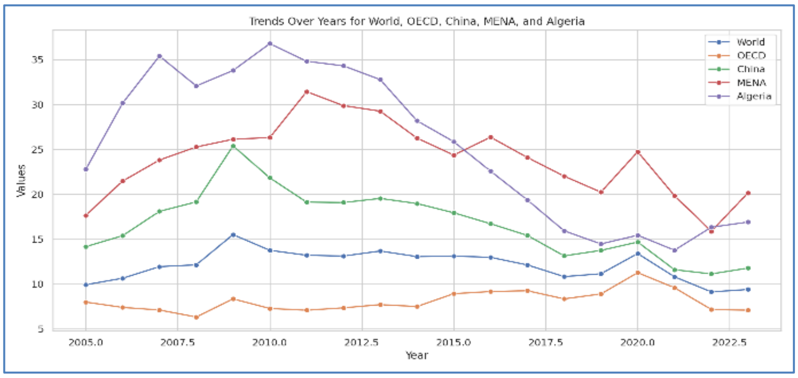
Government spending is crucial in managing reserves; increased government spending can deplete reserves, while reduced spending can help increase them. Monetary policy also contributed to this decline, with the Algerian Central Bank's limited intervention in the foreign exchange market to support the local currency, though such interventions remain quite limited in Algeria.

2.2 Recovery and Improvement Period from 2021 to 2023:

During this period, the curve shows relative stability with some minor fluctuations from mid-2021 to mid-2022, averaging around $46 billion. This is followed by a noticeable gradual increase in foreign exchange reserves starting from mid-2022 until the fall of 2023, reaching approximately $70 billion. This rise reflects the recovery and improvement in global oil prices, which was accompanied by an increase in hydrocarbon export revenues for the Algerian economy. Additionally, the Algerian government's efforts to regulate imports and rationalize public spending contributed to improving the balance of payments surplus.

The improvement in foreign exchange reserves is considered a positive indicator that enhances the stability of the Algerian economy and provides the country with greater flexibility in facing external shocks, such as fluctuations in oil prices or global financial crises.

Figure 3: Total Reserves in month of imports (World; OECD; China; MENA; Algeria)



Source: Author's calculations based on the data of WDI.

Months of Importation measure, (**Figure 3**), reflects the number of months a country can sustain its import of goods and services using its current foreign exchange reserves, assuming import levels remain steady. Algeria's foreign exchange reserves have experienced fluctuations, marked by periods of both growth and decline. Algeria's FER is generally within the range of other MENA and Arab World countries indicating a similar level of financial resilience, though it has experienced fluctuations but fluctuations suggest potential economic vulnerabilities.

Algeria's FER is typically higher than the global average, suggesting, in addition to its distinguished low level of foreign debts, a relatively strong financial position. FER of Algeria has experienced periods of growth and decline, indicating sensitivity to economic factors such as oil prices, government policies, and global events.

Algeria's FER is influenced by various factors, including oil prices, trade balance, and government policies. The fluctuation in Algeria's foreign exchange reserves reflects the challenges facing the Algerian economy, which are closely linked to the volatility of oil prices and global economic factors. These challenges are expected to continue impacting the level of reserves in the future, necessitating proactive measures from policymakers to enhance the resilience of the Algerian economy. Therefore, the curve illustrates the challenges that the Algerian economy has faced in the recent past, as well as the efforts made to address them, leading to a significant improvement in foreign exchange reserves.

3. Data description:

This study utilizes monthly data on Algeria's Foreign Exchange Reserves (FER) spanning from January 2019 to September 2023. This dataset encompasses 57 observations of the total reserves held by the Bank of Algeria (BA), which include foreign currency deposits, gold reserves, and Special Drawing Rights (SDRs).

The data is sourced from the Bank of Algeria, which periodically publishes a comprehensive statistical bulletin containing detailed datasets across various timeframes, including monthly, quarterly, semiannual, and annual data. The covered period offers an extensive overview of fluctuations in foreign exchange reserves under different economic conditions, facilitating robust forecasting and trend analysis. The data is presented in **Appendix 2**.

3.1 Variable Definition:

The data used for this study consists of monthly time series data on the Foreign Exchange Reserves (FER) of Algeria, measured in millions of US dollars.

Distribution: The distribution of FER values appears to be slightly right-skewed based on the skewness value of 0.2689. This indicates that there are a few larger values in the data that are pulling the mean to the right. This might make the Median a more reliable indicator of the central tendency of the data compared to the Mean.

Central Tendency: The Mean (56,701 billion $) and Median (54,850 billion $) are relatively close, suggesting that the data is not heavily skewed.

Dispersion: The standard deviation (10,260 billion $) is relatively large, indicating that the data points are spread out from the center. This value of FER in a relatively short period (4.5 years) indicates that it has undergone to many fluctuations and the absence of the stability.

Normality: The Jarque-Bera test statistic is 4.5883, with a p-value of 0.1008. This suggests that the data is approximately normally distributed at a 10% significance level. However, a more rigorous normality test might be needed for a definitive conclusion.

Range: The range between the maximum (78,241 billion $) and minimum (43,464 billion $$) values is relatively large, indicating variability in the data.

Overall Assessment: The descriptive statistics suggest that the FER data is moderately skewed with a relatively large spread. While the data appears approximately normally distributed based on the Jarque-Bera test, it's important to consider the skewness and kurtosis values, which are indicative of deviations from normality.

3.2 ARIMA Process:

ARIMA is a sophisticated forecasting technique that disregards independent variables and relies solely on the current and past values of the dependent variable to generate often highly accurate short-term predictions (Studenmund, 2014). The origins of ARIMA models date back to the 1970s when Box and Jenkins first introduced the methodology, although time series modeling itself had been established even earlier in the 1950s. ARIMA modeling is based on the following steps: (Porter, 2009)

Step 1: Identification. This involves determining the appropriate values for ***p***, ***d***, and ***q***.

Step 2. Estimation. It involves estimating the parameters for the autoregressive and moving average components within the model.

Step 3. Diagnostic checking. It implies whether the chosen model fits the data reasonably well, considering that another ARIMA model might also be suitable

Step 4. Forecasting. It calls for producing forecasts that are more trustworthy than the ones obtained from conventional econometric modeling

A series that becomes stationary after being differenced (D) times and can then be modeled as an ARMA(p,D,q) process is represented by the ARIMA(p,D,q) model as follow (Studenmund, 2014):

$$\Delta Dy_t = c+\phi_1\Delta Dy_{t-1} + \ldots + \phi_p\Delta Dy_{t-p}+\varepsilon_t+\theta_1\varepsilon_{t-1}+\ldots+\theta_q\varepsilon_{t-q}$$

Where ΔDy_t denotes a **D-th** differenced series, and ε_t is an uncorrelated process with mean zero.

4. Results and Discussion:

4.1 Stationarity tests:

Table.1 Table 1 presents the results of unit root tests for. These tests aim to determine whether the time series is stationary or non-stationary. The tests are based on the following hypotheses (Wooldridge, 2013):

The null hypotheses: (H0): p = 1 (or the time series is non-stationary)

The alternative hypotheses: (H1): p < 1 (or the time series is stationary).

Table. 1: Unite root tests using PP test

Time series	Level		First difference		I(d)
	Constant	Constant, Linear Trend	Constant	Constant, Linear Trend	
LFER	-1.60(0.47)	-0.58(0.98)	-5.41*(0.00)	-7.08*(0.00)	I(1)
*MacKinnon (1996) one-sided p-values * Significant at 1%					

Source: Author's Calculations using Eviews13.

LFER at the level: The table shows that the p-values for the tests assuming both a constant or a constant and linear trend are greater than the 5% significance level (or 1%, as noted in the margin). This indicates that we cannot reject the null hypothesis of a unit root, meaning the LFER time series is non-stationary at the level.

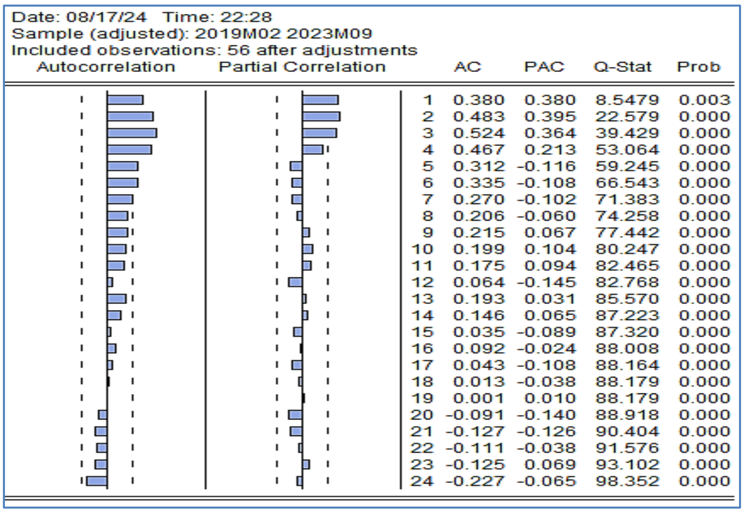
LFER after taking the first difference: The table shows that the p-values for the both tests (constant or a constant and linear trend) are significantly lower than the 5% significance level (or 1%). This suggests that we can reject the null hypothesis of a unit root after taking the first difference, meaning the LFER time series is stationary after the first difference.

Thus, the LFER time series is an integrated series of order one **(I(1)).** The presence of a unit root indicates a long-term trend in the data, possibly with temporary shocks affecting the time series.

4.2 Model Identification:

The Autocorrelation and partial autocorrelation functions graphs of the first differences of (LFER) series are shown in **figure. 4.** ACF and PACF represent the main tools to identify the potential process that fit the data.

Figure. 4: ACF and PACF graphs of the DLFER series.


Date: 08/17/24 Time: 22:28
Sample (adjusted): 2019M02 2023M09
Included observations: 56 after adjustments

Lag	AC	PAC	Q-Stat	Prob
1	0.380	0.380	8.5479	0.003
2	0.483	0.395	22.579	0.000
3	0.524	0.364	39.429	0.000
4	0.467	0.213	53.064	0.000
5	0.312	-0.116	59.245	0.000
6	0.335	-0.108	66.543	0.000
7	0.270	-0.102	71.383	0.000
8	0.206	-0.060	74.258	0.000
9	0.215	0.067	77.442	0.000
10	0.199	0.104	80.247	0.000
11	0.175	0.094	82.465	0.000
12	0.064	-0.145	82.768	0.000
13	0.193	0.031	85.570	0.000
14	0.146	0.065	87.223	0.000
15	0.035	-0.089	87.320	0.000
16	0.092	-0.024	88.008	0.000
17	0.043	-0.108	88.164	0.000
18	0.013	-0.038	88.179	0.000
19	0.001	0.010	88.179	0.000
20	-0.091	-0.140	88.918	0.000
21	-0.127	-0.126	90.404	0.000
22	-0.111	-0.038	91.576	0.000
23	-0.125	0.069	93.102	0.000
24	-0.227	-0.065	98.352	0.000

Source: Author's Calculations using Eviews13.

When choosing the right model for analysis and forecasting, the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) are essential in figuring out the structure of the times series. These two functions play a crucial role in understanding the structure of the time series and selecting the appropriate model for its analysis and forecasting.

The **ACF** values are high and statistically significant (i.e., Q-stat values with probabilities less than 0.05) up to a relatively high lag (around lag 12). This indicates a strong and long-term autocorrelation in the data.

The **PACF** values are statistically significant at lags 1, 2, and 3, then gradually decrease. This suggests that D(LFER) might have some autoregressive (AR) and moving average components. Therefore, based on the patterns sown in the ACF and PACF above we can select the following models.

4.3 Identifying Potential Models: Given the overall pattern of the ACF and PACF, the following models can be proposed and being compared according to the following criteria:

Table .2: Estimation results of thirteen potential models (p,D,q)

Suggested Models	Significant coefficients at 5%	Adj R^2	S.E. of regression	AIC	SCH
ARIMA (1,1,0)*	1 (1)	0.1154	0.02714	-4.3207	-4.2107
ARIMA (1,1,1)	2 (2)	0.2988	0.02416	-4.5273	-4.3827
ARIMA (2,1,1)	1 (1)	0.3296	0.02363	-4.5528	-4.3720
ARIMA (2,1,0)	2 (2)	0.2457	0.02506	-4.4574	-4.3127
ARIMA (3,1,1)*	0 (4)	0.3482	0.02330	-4.5621	-4.3451
ARIMA (3,1,0)	2 (3)	0.3410	0.02343	-4.5686	-4.3878
ARIMA (1,1,2)	**3 (3)**	**0.3809**	**0.02271**	**-4.6247**	**-4.4438**
ARIMA (1,1,3)	**3 (4)**	**0.3819**	**0.02267**	**-4.6100**	**-4.3930**
ARIMA (0,1,1)*	0 (1)	0.0525	0.02809	-4.2538	-4.1453
ARIMA (0,1,2)*	0 (2)	0.1080	0.02725	-4.2961	-4.1514
ARIMA (0,1,3)	1 (3)	0.2396	0.02516	-4.4272	-4.2464
ARIMA (2,1,2)	3 (4)	0.3784	0.02275	-4.6044	-4.3874
ARIMA (3,1,3)*	0 (6)	0.3613	0.02553	-4.5459	-4.2566
(p,D,q)* are excluded due to the insignificant coefficients					

Source: Author's calculations using E-views 13

Thirteen potential models have been estimated for different combinations of autoregressive models and moving average models. This allows us to compare between them based on the criteria used for evaluating the candidate models.

The table presents a comparison of various ARIMA models proposed for analyzing a specific time series. Each row represents a different ARIMA model, and the columns provide the following information:

Adj R-squared: The adjusted R-squared, which indicates the percentage of variance in the dependent variable that is explained by the model.

S.E. of Regression: The standard error of regression, a measure of the dispersion of actual values around the predicted values.

AIC: Akaike Information Criterion, used to compare models, where a lower AIC value is preferred.

SC: Schwarz Criterion (also known as BIC), similar to AIC but penalizes complex models more strongly.

Best Models: Considering the values of S.E. of Regression, AIC, and SC, the following two models show the best performance:

ARIMA (1,1,2): This model achieves the lowest S.E. of regression (0.02271), indicating that it provides more accurate forecasts compared to the other models. Additionally, it has relatively low AIC and SC values.

ARIMA (1,1,3): This model has an S.E. of regression very close to the previous model (0.02267) but with slightly more parameters. Therefore, we can depend on the model ARIMA (1,1,2) that can batter fit the dataset under consideration.

4.4 Estimation results:

The following table presents the estimation results of the chosen model ARIMA (1,1,2) as follows:

Table .3: Estimation results of the ARIMA (1,1,2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004526	0.015651	-0.289185	0.7736
AR(1)	0.882132	0.085067	10.36986	0.0000
MA(1)	-0.971846	0.128524	-7.561571	0.0000
MA(2)	0.479941	0.105282	4.558628	0.0000
SIGMASQ	0.000470	9.07E-05	5.179197	0.0000
R-squared	0.425889	**Mean dependent var**		-0.002380
Adjusted R-squared	0.380861	**S.D. dependent var**		0.028856
S.E. of regression	0.022706	**Akaike info criterion**		-4.624663
Sum squared resid	0.026293	**Schwarz criterion**		-4.443828
Log likelihood	134.4906	**Hannan-Quinn criter.**		-4.554554
F-statistic	9.458262	**Durbin-Watson stat**		1.877534
Prob(F-statistic)	0.000008			

Source: Author's calculations using E-views13

Adjusted R-squared (0.381) indicating that the model explains about 38.1% of the variation in D(LFER). This is a moderate level of fit which is slightly lower than the R-squared, suggesting that some of the model's explanatory power is due to the inclusion of additional variables. **F-statistic: 9.458,** with a p-value of 0.000008, indicating that the overall model is statistically significant.

Coefficient Estimates:

AR(1):0.882, statistically significant (p-value = 0.0000), suggesting a strong positive autocorrelation between the current value and the previous value.

MA(1):-0.972, statistically significant (p-value = 0.0000), indicating a strong negative moving average effect.

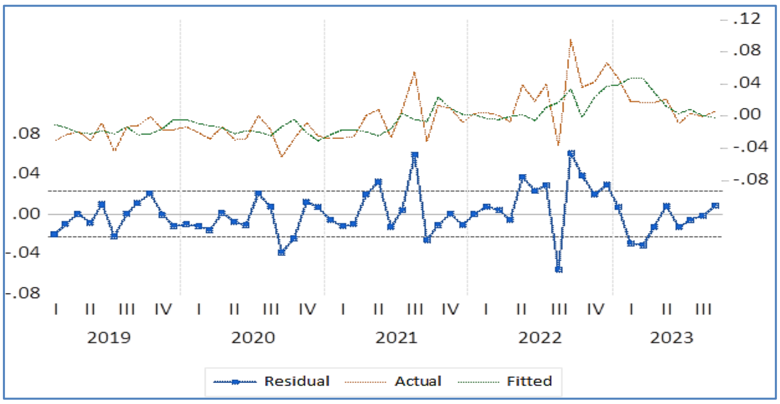
MA(2):0.480, statistically significant (p-value = 0.0000), suggesting a positive moving average effect at lag 2.

Residuals:

Durbin-Watson statistic: 1.878, which is within the acceptable range of 1.5 to 2.5, suggesting no significant autocorrelation in the residuals.

Overall Assessment: ARIMA (1,1,2) appears to be a reasonable fit for the data, with significant AR and MA. The model explains a moderate amount of the variation in the dependent variable.

Figure. 5: Actual series, fitted series and residual series of the DLFER.



Source: Author's calculations using E-views13

Figure. 5 shows three important elements Actual, Fitted, and Residuals graphs. Comparing the actual and fitted series helps to see how well the model captures the underlying pattern of the data. A well-behaved residual series should be centered around zero with no obvious patterns, indicating that the model is capturing all the systematic information in the data.

The graph shows that there seems to be a close fit between the actual and fitted values, although there are some periods where the actual values deviate more noticeably in addition to the residuals fluctuate around zero, Thus, the model seems to track the actual series reasonably well.

Figure. 6 presents the Autocorrelation (AC) and Partial Autocorrelation (PAC) functions for the residuals, accompanied by the Q-statistic and Prob values. The residuals exhibit the characteristics of white noise, meaning there is no significant autocorrelation. This is a positive indication that the model used to fit the data has accounted for most, if not all, of the systematic variations, leaving the residuals as random noise.

Figure. 6: Autocorrelation and partial autocorrelation function graphs of the residual series.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.050	0.050	0.1457	
		2	-0.114	-0.117	0.9263	
		3	0.071	0.084	1.2353	
		4	0.096	0.075	1.8093	0.179
		5	-0.078	-0.073	2.2011	0.333
		6	-0.010	0.013	2.2080	0.530
		7	-0.036	-0.068	2.2957	0.682
		8	-0.076	-0.069	2.6886	0.748
		9	0.002	0.014	2.6890	0.847
		10	0.030	0.015	2.7534	0.907
		11	-0.042	-0.024	2.8778	0.942
		12	-0.146	-0.138	4.4502	0.879
		13	0.131	0.133	5.7449	0.836
		14	0.129	0.087	7.0242	0.797
		15	-0.056	-0.026	7.2751	0.839
		16	0.040	0.073	7.4082	0.880
		17	0.056	-0.017	7.6671	0.906
		18	0.055	0.074	7.9258	0.927
		19	0.036	0.033	8.0380	0.948
		20	-0.096	-0.125	8.8649	0.944
		21	-0.100	-0.055	9.7895	0.939
		22	0.025	0.011	9.8491	0.957
		23	0.034	0.025	9.9625	0.969
		24	-0.136	-0.121	11.829	0.944

Source: Author's calculations using E-views13

4.5 Data forecasting:

The forecast spans from September 2023 to December 2023, with the projected Foreign Exchange Reserves (FER) showing a slight downward trend over this period. While the actual FER value for September has been released, the figures for October, November, and December are yet to be reported. The relative error for September stands at 1.01%, reflecting a minimal discrepancy between the forecasted and actual values. The accuracy of the ARIMA forecast hinges on the model's quality and the validity of its assumptions. However, unexpected economic events or policy changes could influence the actual FER, potentially causing deviations from the forecasted figures.

Table. 4: Algeria's FER forecast from SEP 2023 to Dec 2023.

Months	Sep	Oct	Nov	Dec
Forecasted FER (Billion USD)	67.915	67.6	67.411	67.152
Released FER (Billion USD)	68.477	-	-	-
Relative error (%)	1.01	-	-	-

4. Conclusion

Given the crucial role of FER in economic stability and policy formulation, accurate forecasting is essential for government planning, especially in the context of external shocks like fluctuations in oil prices and global economic uncertainties. The forecasted trends could offer valuable insights for policymakers in managing reserves effectively, ensuring economic resilience, and supporting strategic decision-making in areas such as monetary policy, trade, and international investment.

This study aimed to forecast Foreign Exchange Reserves (FER) for the Algerian economy using the **ARIMA** model, a widely applied technique in time-series forecasting. The model was chosen based on its ability to capture the historical dynamics of FER while accounting for both autoregressive and moving average components. Through a thorough diagnostic analysis, the model's robustness was confirmed.

The findings suggest that the ARIMA model provides reliable forecasts for Algeria's foreign exchange reserves. This implies that the model has captured the key patterns in the data, making it suitable for short- to medium-term forecasting of FER.

The forecasts suggest that Algeria's **FER** levels will remain stable in the short to medium term. However, external factors like fluctuating oil prices and global market uncertainties could put pressure on reserves. To secure economic stability, the central bank should prioritize maintaining **adequate reserve buffers** to absorb potential external shocks. The central bank also should adopt policies to ensure that reserve levels remain above the recommended threshold to mitigate risks from global uncertainties.

The Algerian economy is heavily reliant on oil and gas exports, making FER highly sensitive to fluctuations in global commodity prices. The forecasted trends highlight the importance of **diversifying sources of foreign exchange earnings** to reduce volatility in reserves. The authorities should encourage diversification of the economy by promoting non-oil exports, foreign direct investment (FDI), and tourism. This would help stabilize FER and reduce vulnerability to commodity price shocks.

The forecast results underline the importance of a prudent and forward-looking approach to monetary policy. Algeria's monetary authorities should continue to build reserves while promoting economic diversification, strategic reserve management, and flexible exchange rate policies to ensure long-term economic stability and resilience to external shocks. These measures will strengthen Algeria's capacity to withstand global uncertainties and enhance the effectiveness of its monetary policy.

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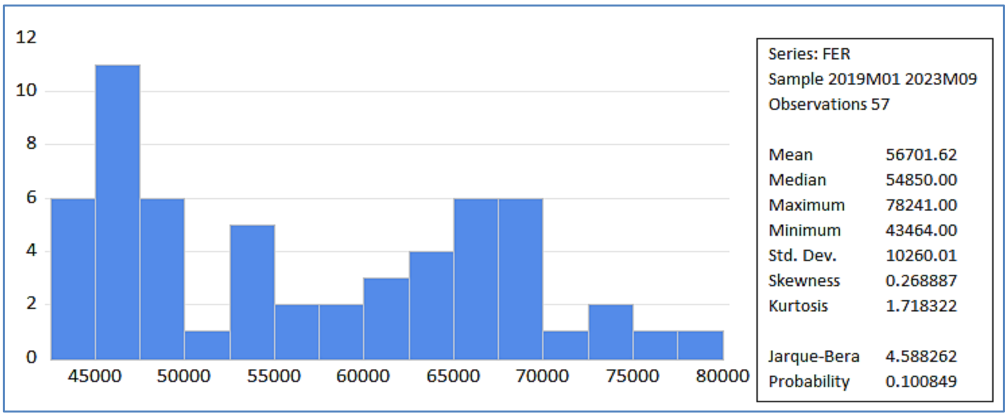
6. Appendices

Appendix. 1 Descriptive Statistics of FER



Source: Author's calculations using E-views 13

Appendix. 2: Foreign Exchange Reserves for Algeria from Jan 2019 to Sep 2023-Billion USD

Month	FER	Month	FER	Month	FER
	Million USD		Million USD		Million USD
Jan-19	78,241	**Aug-20**	53,920	**Mar-22**	45.606
Feb-19	75,842	**Sep-20**	51,216	**Apr-22**	45.280
Mar-19	74,042	**Oct-20**	49,761	**May-22**	47.034
Apr-19	72,593	**Nov-20**	49,354	**Jun-22**	47.921
May-19	70,353	**Dec-20**	48,167	**Jul-22**	49.838
Jun-19	69,732	**Jan-21**	46,817	**Aug-22**	47.994
Jul-19	66,686	**Feb-21**	45,522	**Sep-22**	52.763
Aug-19	65,789	**Mar-21**	44,323	**Oct-22**	54.715
Sep-19	65,022	**Apr-21**	44,327	**Nov-22**	57.095
Oct-19	64,924	**May-21**	44,692	**Dec-22**	60.994
Nov-19	63,820	**Jun-21**	43,464	**Jan-23**	63.903
Dec-19	62,756	**Jul-21**	43,787	**Feb-23**	65.041
Jan-20	61,883	**Aug-21**	46,225	**Mar-23**	66.140
Feb-20	60,615	**Sep-21**	44,724	**Apr-23**	67.264
Mar-20	58,925	**Oct-21**	45,290	**May-23**	68.677
Apr-20	58,101	**Nov-21**	45,692	**Jun-23**	68.028
May-20	56,406	**Dec-21**	45,296	**Jul-23**	68.184
Jun-20	54,795	**Jan-22**	45,415	**Aug-23**	68.082
Jul-20	54,850	**Feb-22**	45,588	**Sep-23**	68.477

Source: BA quarterly reports: https://www.bank-of-algeria.dz(consulted on September 13, 2024).