Modeling Inflation Dynamics and Forecasting in Cameroon

A Comparative Time-Series Analysis of Selected African Economies

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Abstract

This study models and forecasts inflation in Cameroon, treating it as a primary case study, while using Ghana, Nigeria, and Côte d'Ivoire as comparative reference economies. Annual inflation data were transformed and cleaned to construct country-specific time series. Stationarity properties were formally tested using the Augmented Dickey–Fuller procedure to determine appropriate model specifications. Autoregressive Integrated Moving Average (ARIMA) models were then estimated for each country, with model selection guided by the Akaike Information Criterion and residual diagnostics. Based on the estimated models, five-year-ahead inflation forecasts were generated to assess short- to medium-term inflation patterns. The results demonstrate considerable heterogeneity across countries, with Cameroon exhibiting relatively stable, mean-reverting inflation behaviour compared to the more volatile trends in Ghana and Nigeria. These observations underscore the importance of country-specific time-series modelling for inflation forecasting and provide an empirical basis for comparative macroeconomic analysis across African economies.

1. Introduction
1.1 Problem Description

Inflation is a central macroeconomic variable with immediate implications for economic soundness, income distribution, and prolonged growth. In Sub-Saharan Africa, inflation patterns are fundamental due to high exposure to external shocks, structural rigidities, and limited policy buffers (International Monetary Fund, 2026). Episodes of high and volatile inflation have historically constrained development outcomes and weakened confidence in economic institutions (World Bank, 2026, Sub-Saharan Africa).

Empirical studies stress that both domestic and external factors, including fiscal imbalances, exchange rate movements, commodity price shocks, and institutional capacity, determine inflation in African economies. While some countries experience relatively steady inflation paths, others undergo persistent volatility, suggesting that inflation patterns differ substantially across national contexts (United Nations, 2026).

Against this background, this study therefore asks:

How do inflation dynamics in Cameroon compare to those of Ghana, Nigeria, and Côte d'Ivoire, and what do these differences imply for inflation forecasting and policy analysis?

Cameroon serves as the primary case study, with Ghana, Nigeria, and Côte d'Ivoire functioning as reference economies for comparison.

1.2 Objectives
The objectives of this study are to:

- Model inflation patterns in Cameroon using time-series econometric techniques.
- Assess the stationarity properties of inflation across selected African economies.
- Identify appropriate ARIMA specifications for each country.
- Generate short- to medium-term inflation forecasts.
- Compare inflation persistence, volatility, and forecast behaviour throughout countries.

1.3 Relevance to Stakeholders
This research is relevant to multiple stakeholders:

- **Policy analysts and central bank researchers**, who require reliable inflation forecasts for macroeconomic planning.
- **Development economists** are interested in understanding macroeconomic stability in African economies.
- **Researchers and students**, particularly those working with applied time-series methods in African data contexts.
- **Economic planners**, who benefit from comparative insights across peer economies.

2. Data Description and Preparation

2.1 Data Sources & Collection

- Inflation, consumer prices (annual %) from the World Bank: International Financial Statistics database, International Monetary Fund (IMF)

Annual data were collected for the period **1960 – 2024** for all countries.

2.2 Data Cleaning and Processing

- The dataset was first filtered to include only observations for Cameroon, Ghana, Nigeria, and Côte d'Ivoire.
- The data were restructured into a long format to facilitate country-level sequential analysis. Year variables were converted to numeric values, and observations with missing inflation data were excluded to maintain consistency in model estimation.
- Each country's inflation series was sorted in chronological order, as ARIMA models require explicit temporal sequencing.
- Preliminary plots were generated for each country to visually inspect trends, volatility, and potential structural differences before formal modelling.

3. Methodology

3.1 Tools and Libraries

Library	Purpose in the Project
pandas	Data ingestion, cleaning, transformation, and construction of structured comparison tables across countries
numpy	Efficient numerical computations and support for statistical calculations
matplotlib	Visualization of inflation trends, ACF/PACF plots, and forecast trajectories
statsmodels	Core time-series econometric analysis, including stationarity testing, ARIMA estimation, diagnostics, and forecasting
statsmodels.tsa.stattools	Augmented Dickey–Fuller test to assess stationarity of inflation series
statsmodels.tsa.arima.model	Estimation of ARIMA models for country-specific inflation dynamics
statsmodels.graphics.tsaplots	Identification of autoregressive and moving-average structures
warnings	Suppression of non-critical convergence and statistical warnings for clean output

Table 1 Python Libraries used and their roles in the analysis

3.2 Time-Series Modelling Framework

The Autoregressive Integrated Moving Average (ARIMA) framework is used to model inflation patterns. ARIMA models represent temporal dependence through autoregressive and moving-average components and apply differencing as needed to achieve stationarity.

The general ARIMA(p, d, q) model specifies inflation as a function of its own past values and past shocks, rendering it suitable for macroeconomic time series that exhibit persistence and serial correlation.

3.3 Stationarity Testing

Before estimating the ARIMA model, the inflation series for each country were assessed for stationarity using the Augmented Dickey–Fuller (ADF) test. This test determines whether a unit root is present in the series and informs the selection of the appropriate differencing level.

The ADF test statistics are statistically significant at the 5 percent level, with p-values below 0.05. Therefore, the unit root hypothesis is rejected, indicating that the inflation series are stationary in levels and do not require differencing before model estimation.

As a result, the differencing parameter in the ARIMA specification is set to d = 0.

3.4 Model Selection and Diagnostics

For each country, multiple ARIMA specifications were estimated by varying the autoregressive (p) and moving average (q) orders. The Akaike Information Criterion (AIC) guided model selection by balancing goodness-of-fit with parsimony. After selecting the optimal model, diagnostic checks were conducted, including:

- Residual autocorrelation tests
- Normality assessment
- Heteroskedasticity evaluation

These diagnostic procedures confirm that the selected models offer an adequate statistical representation of the data.
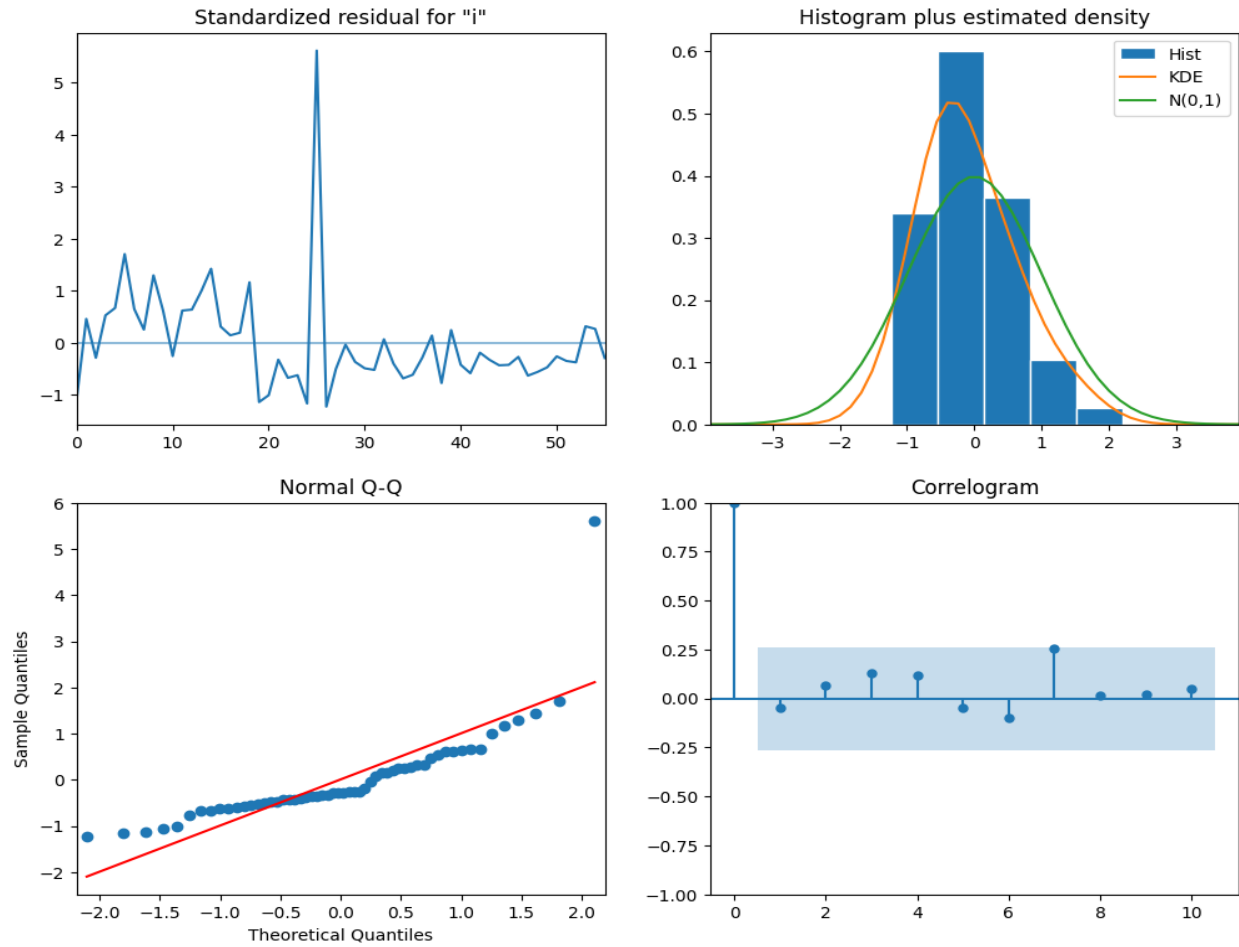
Figure 1 ARIMA Diagnostic Plots for Cameroon

3.5 Forecasting Strategy

Inflation was forecast for five years for each country using the estimated ARIMA models. Forecasts were generated dynamically and included confidence intervals to reflect forecast uncertainty.

Forecasts for Cameroon are emphasised as the primary case study, while those for the other countries facilitate cross-country analysis.
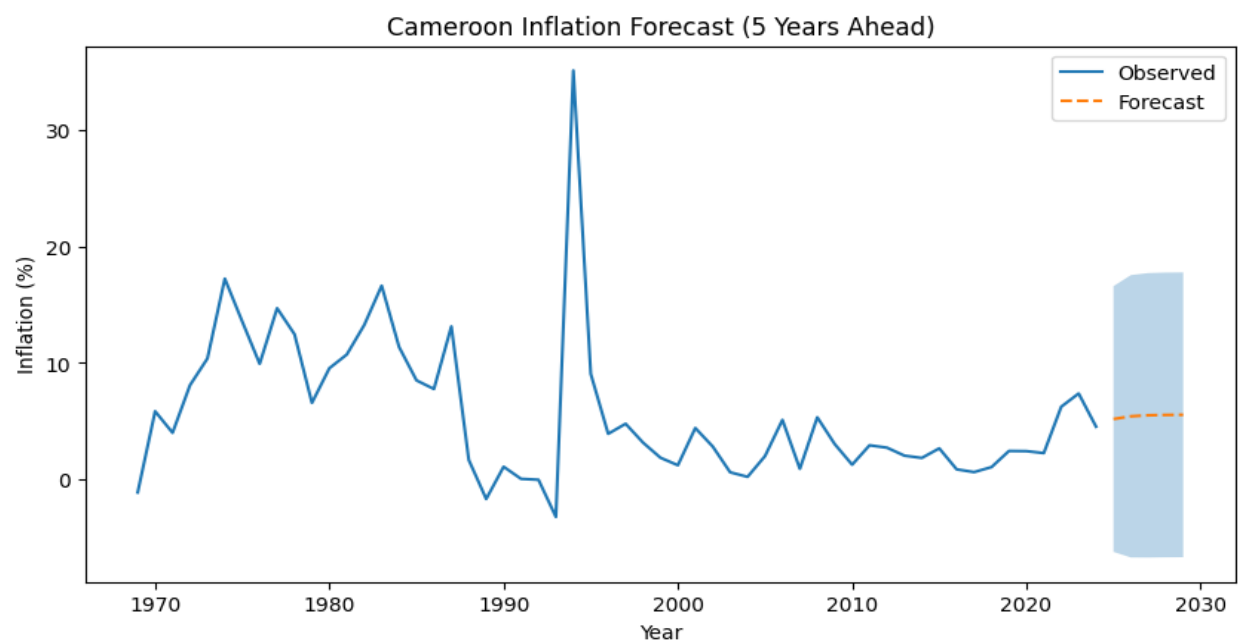
Figure 2 Cameroon Inflation Forecast (Five-Year Horizon)

4. Results
4.1 Stationarity and Model Selection

The ADF test results show heterogeneity in inflation dynamics throughout countries. Inflation in Cameroon, Nigeria, and Côte d'Ivoire is stationary, while Ghana's inflation series is non-stationary and requires differencing.

Cameroon's inflation process is appropriately modelled by an ARIMA(1,0,0) specification, indicating moderate persistence without long-term divergence. Ghana, in contrast, requires a higher-order ARIMA model with differencing, reflecting greater volatility and structural instability.

Country	ADF Statistic	ADF p-value	Stationarity	Best ARIMA	AIC
Cameroon	-5.0645	0.000017	Stationary	(1, 0, 0)	362.23
Ghana	-2.8446	0.052185	Non-stationary	(3, 1, 3)	542.66
Nigeria	-2.8981	0.045568	Stationary	(1, 0, 1)	502.68
Cote d'Ivoire	-4.4853	0.000209	Stationary	(1, 0, 0)	393.45

Table 2: ADF Test Results and Selected ARIMA Models

4.2 Historical Inflation Comparison

Comparative analysis of historical inflation indicates that Cameroon shows less volatility than Ghana and Nigeria. Inflation fluctuations in Cameroon tend to revert to a stable mean, whereas Ghana and Nigeria undergo more pronounced inflationary episodes. Côte d'Ivoire's inflation behaviour closely parallels that of Cameroon, implying similar inflation dynamics within the region.
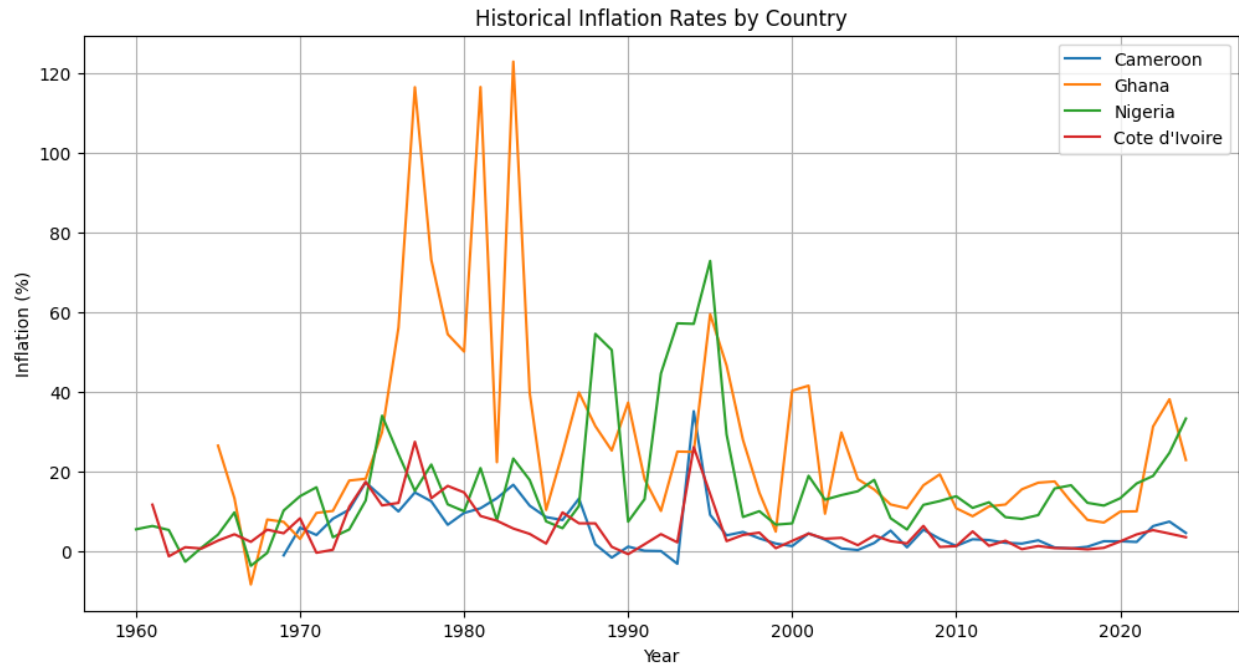

Figure 3: Comparative Historical Inflation Trends

4.3 Forecasted Inflation Dynamics

Forecast results reinforce the differences observed in historical dynamics. Cameroon's projected inflation path converges smoothly toward its long-run mean and is associated with relatively narrow confidence intervals. In contrast, Ghana's forecasts display wider uncertainty bands, indicating the complexity and volatility of its inflation process. Nigeria's forecasts suggest continuous inflationary pressure, while Côte d'Ivoire's projections closely correspond to Cameroon's stability.

Country	Forecast Year 1	Forecast Year 2	Forecast Year 3	Forecast Year 4	Forecast Year 5
Cameroon	5.19	5.43	5.51	5.54	5.56
Ghana	20.7	22.84	30.61	35.56	34.95
Nigeria	27.78	20.29	17.72	16.85	16.54
Cote d'Ivoire	4.38	4.86	5.11	5.23	5.3

Table 3: Five-Year Inflation Forecasts by Country

5. Discussion and Interpretation

The results show that Cameroon's inflation patterns are comparatively stable and predictable. The stationarity of inflation and the adequacy of a simple ARIMA specification imply that inflation shocks are predominantly transitory.

The contrast between Ghana and Nigeria illustrates the influence of structural and policy-related factors on inflation persistence. Côte d'Ivoire's similarity to Cameroon suggests the presence of regional or institutional commonalities.

From a methodological perspective, the results show the need for formal stationarity testing rather than uniformly applying differencing across countries.

6. Policy Implications

For Cameroon, the results support the incorporation of time-series forecasting models into short-term inflation monitoring frameworks. Steady inflation dynamics improve the effectiveness of policy actions and reduce uncertainty for economic agents.

The comparative evidence indicates that countries with more volatile inflation processes may require supplementary policy instruments and structural reforms to achieve price stability.

7. Recommendations

- Strengthen inflation monitoring systems using model-based forecasts.
- Maintain macroeconomic policies that reinforce inflation stability.
- Use comparative regional analysis to benchmark performance.
- Integrate short-term inflation forecasts into fiscal planning and monetary policy coordination.
- Enhance data quality and continuity to improve the reliability of inflation modeling and forecasting.
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8. Conclusion

This study modelled inflation patterns in Cameroon and compared them with those of Ghana, Nigeria, and Côte d'Ivoire using ARIMA methods. The results reveal significant cross-country heterogeneity, with Cameroon exhibiting relatively stable, mean-reverting inflation behaviour. The comparative framework provides valuable context and underscores the importance of country-specific analysis in macroeconomic modelling.

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