Economic Analysis of Nigeria (2000-2024): Productivity, Currency Devaluation, and Policy Implications

1.0 Introduction

Focusing on the relationships between money supply (M1), exchange rate, inflation rate, stock price, and their combined impact on productivity, this report analyzes the economic performance of Nigeria from 2000 to 2024 utilizing descriptive statistics, correlation analysis, and a productivity model to gain meaningful insights into economic trends and potential policy implications.

Objectives:

i.   Understanding economic performance through correlations.
ii.   Developing a productivity model

2.0 Methodology

The data for this analysis covers the period from 2000 to 2024. Four datasets were gathered from various sources such as the Central Bank of Ghana, National Bureau of Statistics and Nigerian Stock Exchange Live and spans from the year 2000 to 2024.

Data Cleaning and Preparation

- Some of the initial datasets contained daily and monthly rates, which were averaged to obtain yearly rates for consistency with other data. The Dates were formatted for uniformity (i.e., converted to a consistent date format).
- Data types were formatted (e.g., stock price converted from object to numeric).
- The four datasets were then merged using the date as the key.
- Unnecessary columns were removed, and the final data had the following columns: Stock Price, Inflation Rate, Annual Change in Inflation, Exchange Rate and Money Supply (M1). Link to the Final Cleaned Dataset.

Statistical Summary (Link to the Notebook i.e., codes)

	Date	Stock Price	Inflation Rate (%)	Annual Change Inflation	Exchange Rate	Money Supply M1
count	25	25	25	25	25	25.00
mean	12/30/2012 15:21	31,594.13	13.60	0.84	264.669	8,234,993.00
min	12/31/2000 0:00	5,886.72	5.39	-9.64	104.732	509,213.20
25%	12/31/2006 0:00	21,347.70	10.83	-0.70	131.963	2,114,935.00
50%	12/31/2012 0:00	28,859.28	12.88	0.97	158.823	6,621,233.00
75%	12/31/2018 0:00	39,258.73	16.50	2.87	306.824	10,908,950.00
max	12/31/2024 0:00	98,915.19	27.64	11.94	1371.818	32,304,930.00
std	NaN	19,103.31	5.03	4.41	264.226	7,966,423.00

The dataset covers a 25-year period, with 2012-12-30 being the midpoint.

- Descriptive statistics for each variable were calculated, revealing:

  - **Stock price:** Wide range, high standard deviation showing significant fluctuations.
  - **Inflation rate:** Varied considerably, with periods of both low and high inflation.
  - **Annual change in inflation:** Generally increasing trend, but with substantial variability.

- **Exchange rate:** Significant depreciation over the period, reflected in the high standard deviation.
- **Money supply M1:** Substantial growth, with high standard deviation showing significant variability.

Key Takeaways
- Stock prices showed considerable variability, reflecting periods of significant market gains and losses.
- Inflation rates were also variable, indicating economic instability with periods of both low and high inflation.
- Annual changes in inflation displayed fluctuations, suggesting an uncertain economic environment.
- The exchange rate showed significant depreciation, highlighting currency devaluation.
- Money supply M1 experienced substantial growth, with high variability, potentially reflecting changes in monetary policy.

Implications
- The high variability in key economic indicators suggests periods of economic instability.
- Changes in money supply and significant exchange rate variability point towards the impact of monetary and fiscal policies.
- These statistics provide a foundation for further analysis to understand the factors influencing economic performance and their impact on productivity.

## 3.0 Visualizing Individual Indicators
Plots were created for each variable, revealing trends and fluctuations:

- **Money supply M1**: General increasing trend.
- **Exchange rate:** Significant fluctuations with an increasing trend (currency depreciation).
- **Inflation rate:** Fluctuations with periods of both increase and decrease.
- **Stock price:** General increasing trend with some fluctuations.

# Analyzing Relationships Between Variables
Scatter plots were used to examine the relationships between different economic indicators
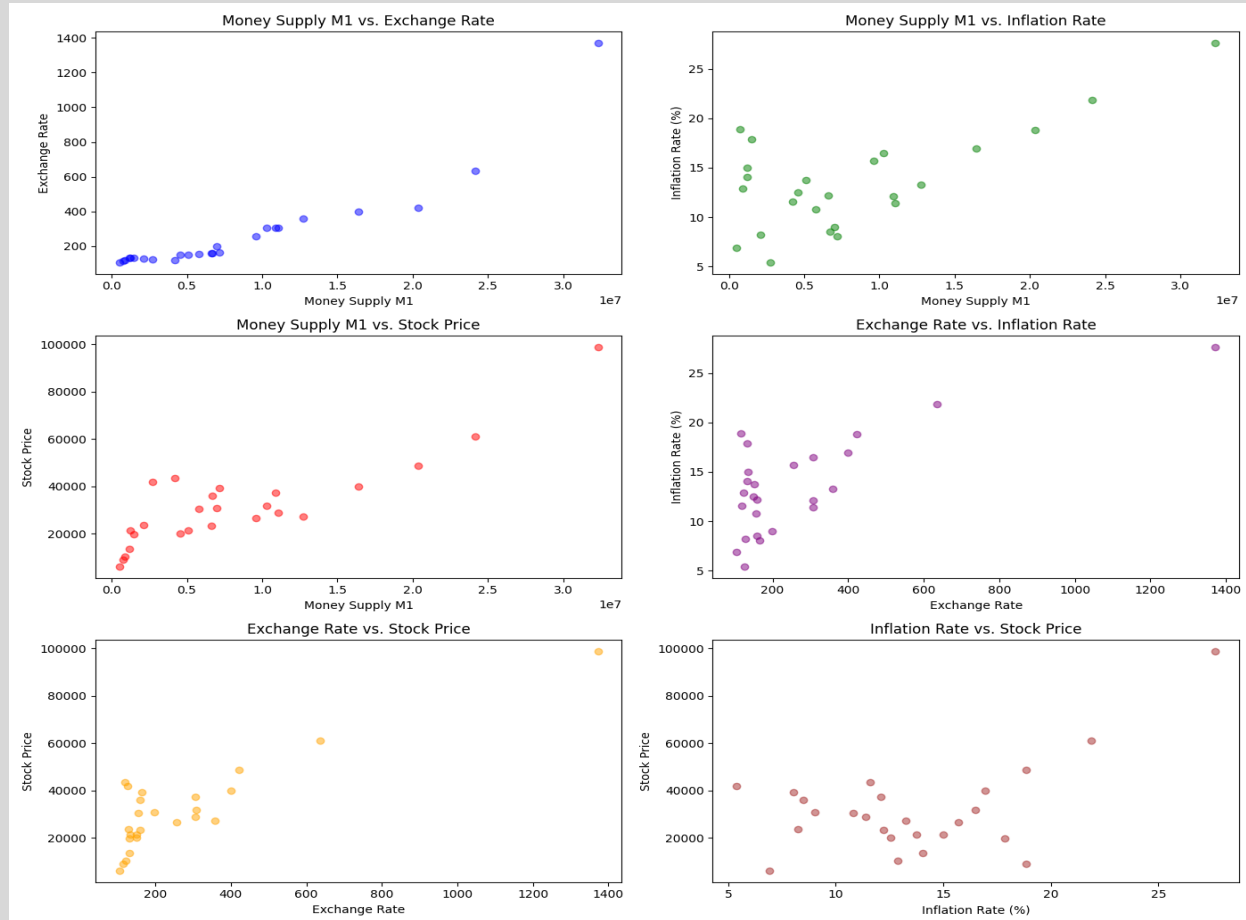
- **Money Supply M1 vs. Exchange Rate:** Positive correlation, suggesting that increased money supply is associated with currency depreciation. A positive correlation suggests that increasing money supply (M1) might lead to a depreciation of the exchange rate, potentially due to higher demand for foreign currency relative to the domestic currency.
- **Money Supply M1 vs. Inflation Rate:** Positive correlation, indicating that increased money supply is associated with higher inflation. An increase in money supply can lead to higher inflation if the additional money supply outpaces the growth of goods and services in the economy. This is because more money chasing the same amount of goods can drive up prices.
- **Money Supply M1 vs. Stock Price:** Positive correlation, implying that an increase in money supply may lead to stock market appreciation. An increase in money supply can lead to higher stock prices in some cases. This is because more money circulating in the economy can potentially increase investment in companies, driving up their stock prices. However, this relationship is not always straightforward and can depend on other factors like investor confidence and interest rates.
- **Exchange Rate vs. Stock Price:** Weak positive correlation, suggesting that higher exchange rates (currency depreciation) might have a positive impact on stock prices of export-oriented companies, but the relationship is influenced by other factors. The relationship between exchange rate and stock price can be complex. For export-oriented companies, a weaker domestic currency can make their exports cheaper on the global market, potentially boosting their profits and stock prices. However, for companies that rely heavily on imports, a weaker currency can increase their production costs, potentially affecting their profitability and stock price negatively.

- **Exchange Rate vs. Inflation Rate:** Positive correlation, suggesting that currency depreciation can lead to higher import prices, contributing to overall inflation. A depreciation in the exchange rate (meaning the domestic currency weakens) can lead to higher import prices. Since many goods are imported, this can contribute to overall inflation.
- **Inflation Rate vs. Stock Price:** Less clear but somewhat positive correlation, implying that higher inflation rates might be associated with higher stock prices, but the relationship is not very strong. The relationship between inflation and stock price can also be complex. In some cases, moderate inflation can be seen as a sign of a growing economy, which might be positive for stock prices. However, high and persistent inflation can create uncertainty and erode investor confidence, potentially leading to stock price declines.

Limitation: Scatter plots were used to examine the relationships between different economic indicators. While scatter plots are helpful for visualizing potential correlations, it's important to note that they may not capture the full picture for time-series data. For instance, scatter plots do not inherently account for lagged effects, where a change in one variable might impact another variable with a time delay.

Correlation Matrix Analysis

Correlation Matrix of Economic Variables
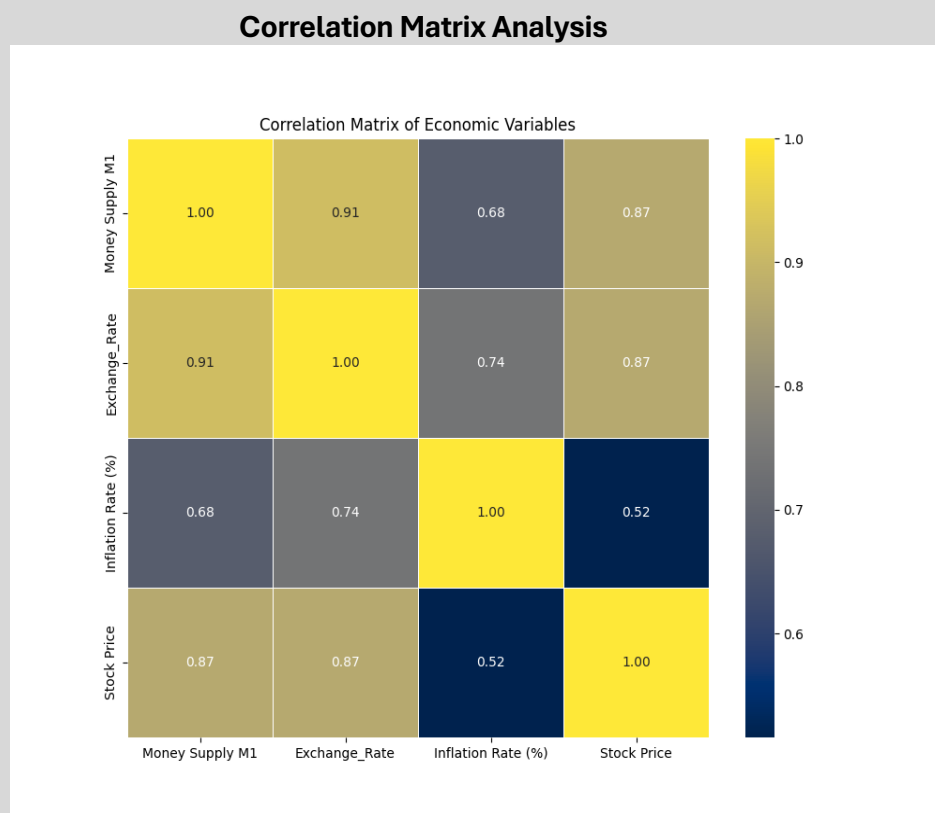
The correlation matrix confirmed the observed relationships:

- **Money supply M1**: Positively correlated with exchange rate **(0.91),** inflation rate **(0.68)**, and stock price **(0.87).**
- **Exchange rate:** Positively correlated with inflation rate **(0.74)** and stock price **(0.87)**.
- Inflation rate: Moderately correlated with stock price **(0.52).**

Implications

These correlations support the theoretical framework that increased money supply leads to currency depreciation, stock market appreciation, and increased inflation. The relationships between these variables can be used to develop a productivity model and analyze economic conditions.

4.0 Productivity Model

To assess the combined impact of these variables on productivity, a model was created using normalized versions of:

- o Stock price
- o Exchange rate
- o Inflation rate

Productivity was calculated as a combined measure by subtracting the normalized exchange rate and inflation rate from the normalized stock price.

Formula:

$$Productivity = Stock\ Price\ (normalized) - Exchange\ Rate\ (normalized) - Inflation\ Rate\ (normalized)$$

Code Explanation:

```python
# Normalize the variables for comparability
df['Exchange Rate (normalized)'] = (df['Exchange_Rate'] - df['Exchange_Rate'].mean()) / df['Exchange_Rate'].std()
df['Stock Price (normalized)'] = (df['Stock Price'] - df['Stock Price'].mean()) / df['Stock Price'].std()
df['Inflation Rate (normalized)'] = (df['Inflation Rate (%)'] - df['Inflation Rate (%)'].mean()) / df['Inflation Rate (%)'].std()

# Calculate productivity as a combined measure of the three variables
df['Productivity'] = df['Stock Price (normalized)'] - df['Exchange Rate (normalized)'] - df['Inflation Rate (normalized)']

# Plot the updated productivity over time
plt.figure(figsize=(12, 6))
plt.plot(df['Date'], df['Productivity'], label='Productivity', color='purple')
plt.xlabel('Date')
plt.ylabel('Productivity')
plt.title('Updated Productivity Over Time in Nigeria (2004-2024)')
plt.legend()

# Save the plot as an image file
productivity_plot_file_path = '/content/drive/MyDrive/HNG Folder/Stage 5/Productivity_Over_Time.png'
plt.savefig(productivity_plot_file_path)

# Show the plot
plt.show()
```
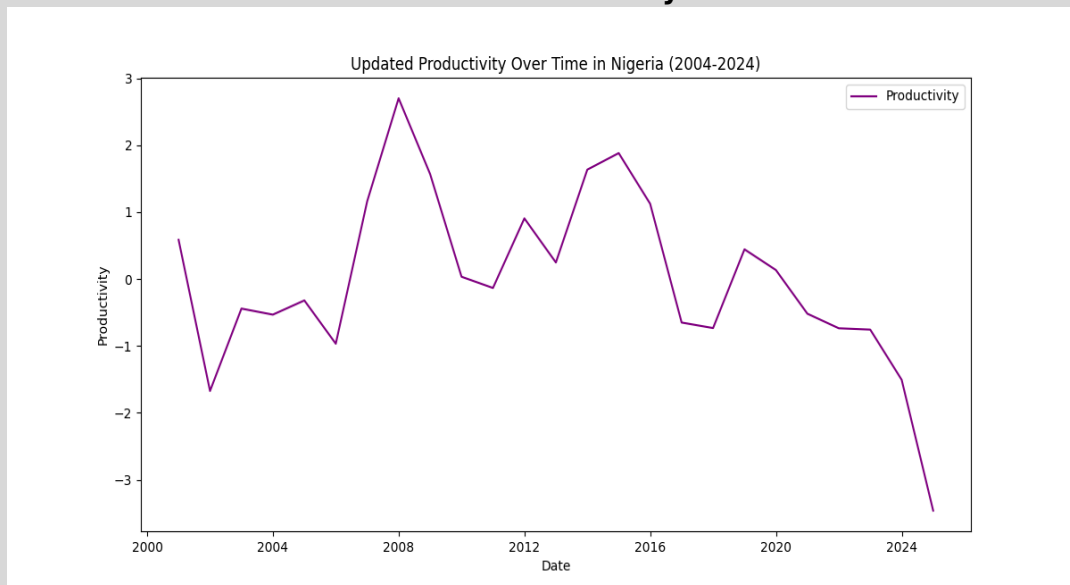
The resulting productivity plot showed fluctuations over time, with key observations:

Visualization of Productivity Model

- ➢ **Initial Period (2004-2008):** The productivity plot shows a moderately high level initially, with some fluctuation. There's a slight decline followed by a recovery around 2008. Possible explanations for this trend could include:
    - i. **Favorable Economic Policies:** Implementation of economic policies that promoted investment, business growth, or export diversification might have contributed to the initial rise in productivity.
    - ii. **Global Economic Conditions:** Favorable global economic conditions, such as high commodity prices for Nigerian exports, could have boosted economic activity and productivity in this period.
    - iii. **Structural Reforms:** Perhaps structural reforms undertaken in the early 2000s, such as privatization or improvements in the business environment, might have played a role in the initial productivity increase.
- ➢ **Mid Period (2008-2013):** A significant increase in productivity is observed around 2008, reaching a peak. This period might be associated with favorable economic conditions or policy changes that positively impacted the stock market relative to exchange rate depreciation and inflation. After the peak, there's a notable decline starting around 2010, suggesting these positive conditions might have reversed, or other negative factors came into play.
- ➢ **Stable Period (2013-2017):** From 2013 to 2017, productivity shows some fluctuation but remains relatively stable. This indicates a period where the combined effects of stock prices, exchange rates, and inflation did not cause significant changes in productivity.
- ➢ **Recent Period (2017-2024):** From 2017 onwards, there's a noticeable decline in productivity, reaching the lowest levels towards the period (2024). This trend suggests worsening economic conditions, where the negative impacts of exchange rate depreciation and inflation outweigh the positive effects of stock price increases.

Possible Interpretations:

- **Economic Policies and Events:** Peaks and troughs in the productivity plot can be linked to specific economic policies, global economic conditions, or significant events that impact the Nigerian economy. For example, favorable policies or global commodity price increases might have driven the productivity peak around 2008.
- **Exchange Rate and Inflation Dynamics:** The decline in productivity towards the end could be due to severe currency depreciation and high inflation, reducing the overall economic productivity despite any stock market gains.
- **Stock Market Influence:** Periods of rising stock prices positively impact productivity, but this influence can be mitigated by negative effects from exchange rate depreciation and inflation.

The productivity model, calculated as a function of normalized stock prices, exchange rates, and inflation rates, provides insights into the economic health of Nigeria over the period from 2004 to 2024. The observed trends suggest that while there have been periods of growth and stability, recent years show a decline in productivity, likely driven by unfavorable economic conditions.

5.0 Understanding Performance Relative to the Baseline and Currency Devaluation

To further interpret the trends in productivity and gain insights into Nigeria's economic health, we will now analyze these results in relation to a calculated baseline productivity and real currency devaluation.

Observed vs Baseline Productivity visualized

Observed vs Baseline Productivity Over Time in Nigeria (2004-2024)
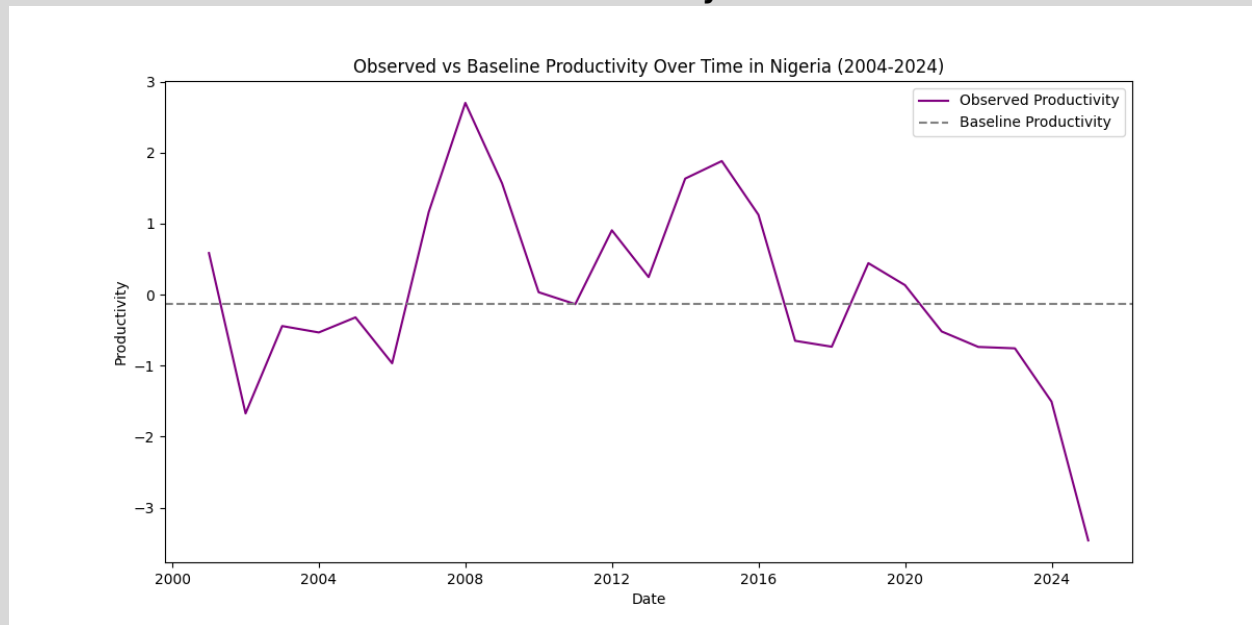
Observed vs Baseline Productivity Over Time in Nigeria (2004-2024)
- **Observation:**
    - The productivity shows significant fluctuations over time.
    - The baseline productivity (gray dashed line) is relatively stable, calculated as the median productivity over the entire period.
    - Periods of observed productivity above the baseline suggest better-than-average economic performance, while periods below the baseline indicate worse-than-average performance.
- **Implications:**
    - **Peaks (2008, 2013):** The peaks around 2008 and 2013 indicate periods of high productivity, which could be due to favorable economic policies, increased investment, or other positive economic factors.
    - **Troughs (2005, 2011, 2019):** The troughs indicate periods of low productivity, possibly due to economic downturns, unfavorable policies, or external shocks.
    - **Decline Post-2016:** The consistent decline in productivity from around 2016 to 2024 suggests a sustained period of economic challenges. This aligns with the increasing currency devaluation observed in the first plot.
    - **Recent Sharp Decline (2023-2024):** The sharp decline towards the end indicates a severe deterioration in economic conditions, possibly driven by extreme currency devaluation, high inflation, or other economic crises.

The observed productivity trends reflect periods of strength and weakness. The recent decline is a critical concern, highlighting the need for effective economic policies to stabilize and improve productivity

Real Currency Devaluation visualized

Real Currency Devaluation Over Time in Nigeria (2004-2024)
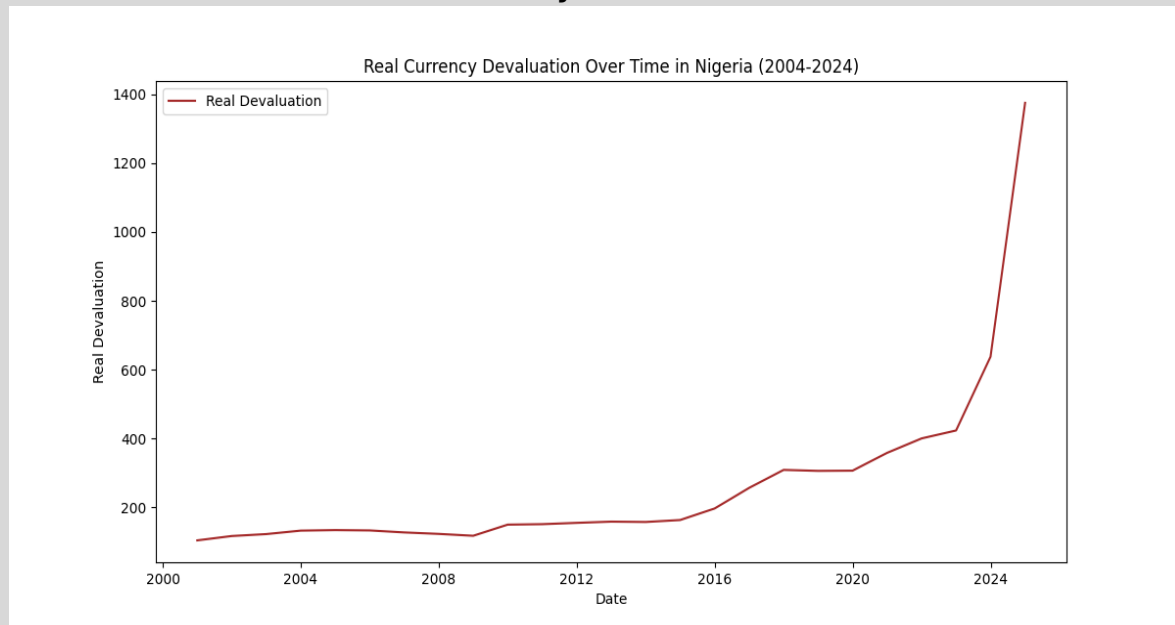
Real Currency Devaluation Over Time in Nigeria (2004-2024)
- **Observation:**
  - The plot shows a significant upward trend in real currency devaluation over time, especially after 2016.
  - The real devaluation remained relatively low and stable from 2004 to around 2015.
  - There is a noticeable sharp increase starting around 2022, reaching a peak in 2024.
- **Implications:**
  - **Initial Stability:** The period of relative stability from 2004 to 2015 suggests that there were consistent economic policies or external conditions that kept the currency stable.
  - **Recent Devaluation:** The sharp increase in real currency devaluation after 2016, particularly from 2022 onwards, indicates severe economic issues such as high inflation, significant exchange rate depreciation, or both.
  - **Economic Health:** Such a sharp increase in real devaluation is concerning and indicates a deteriorating economic situation where the currency is losing value rapidly against other currencies. This can lead to higher import costs, inflation, and overall economic instability.

The increasing trend in real currency devaluation signals significant economic distress. Addressing these issues requires comprehensive economic reforms.

Overall Economic Health:

- The combination of increasing currency devaluation and declining productivity suggests substantial challenges. Comprehensive reforms and stabilization measures are needed.

6.0 Conclusion and Recommendations

Economic Challenges:
The analysis of productivity, currency devaluation, and their relationships with inflation, exchange rate, and stock prices reveals significant economic challenges in Nigeria. The decline in productivity observed in recent years, coupled with the sharp increase in real currency devaluation, paints a concerning picture. These trends suggest a combination of factors negatively impacting the Nigerian economy.

Policy Implications:
Based on the findings, several policy recommendations can be considered:
- **Control Inflation and Stabilize Exchange Rate:** Implement policies to control inflation and stabilize the exchange rate. This could involve measures like tighter monetary policy, managing government spending, and addressing structural factors contributing to inflation.
- **Boost Productivity:** Foster economic growth through investments in key sectors like infrastructure, education, and technology. Additionally, policies that encourage private sector investment and innovation can contribute to productivity gains.
- **Promote Exports and Manage Imports:** Policies that encourage exports and discourage unnecessary imports can help improve the balance of payments and support the currency. Diversifying export markets can also mitigate the impact of fluctuations in global commodity prices.

Further Research or Future works:
The analysis presented here provides a foundation for further investigation. Here are some potential areas for future research:
- **Deeper Dive into Specific Periods:** A more detailed examination of specific periods, particularly the initial period (2004-2008) with its rise in productivity, could provide valuable insights into successful policies or external factors that contributed to this growth.
- **Incorporate Additional Variables:** Expanding the model to include other relevant variables, such as foreign direct investment, government debt, or global economic conditions, could offer a more comprehensive understanding of the factors influencing productivity and economic performance.
- **Disaggregate by Sector:** Analyzing the data by economic sector could reveal specific industries or areas driving productivity growth or decline. This could help policymakers target interventions and support for sectors with significant potential.