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Macroeconomic Dynamics and Growth in The Gambia: Evidence from Cointegration and Granger Causality Analyses

Cheng-Wen Lee[1], Patrick A Mendy[2]*, Makaireh Dampha[2] and Augustine Sanyang[2]

Abstract

This study employs time series econometric techniques to examine the dynamic relationship among economic growth, money supply, exchange rate and inflation in The Gambia over the period 1966 to 2023. The empirical findings reveal the existence of a long-run equilibrium relationship among the variables, with money supply exerting a significant positive influence on economic growth. Granger causality tests indicate a unidirectional causality running from real GDP to the exchange rate, while inflation does not exhibit any significant causal linkage with the other variables. The Vector Error Correction Model (VECM) further underscores the pivotal role of money supply in driving long-term growth, highlighting the importance of prudent monetary policy and exchange rate stability for sustainable economic development. Additionally, the analysis reveals that the trends in the time series data are consistent with the statistical results in which money supply and economic growth are positively correlated in the long run, whereas exchange rate depreciation tends to fuel inflation. These findings underscore the critical importance of maintaining currency stability to support The Gambia's macroeconomic performance.

JEL classification numbers: E51; E31; F31; O47; C32; F43.
Keywords: Economic Growth, Money Supply, Exchange Rate, Inflation, Granger Causality, Cointegration.

[1] Department of International Business, College of Business, Chung Yuan Christian University.
[2] Ph.D. Program in Business, Chung Yuan Christian University. *Corresponding author.

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1. Introduction

The link between money supply, inflation, exchange rate and economic growth is a complex and multifaceted issue and has long piqued the curiosity of macroeconomics researchers. Understanding the dynamics is particularly relevant in the context of developing economies and the causal relationships between economic factors is critical for developing effective monetary and fiscal policies that promote stability and sustainable growth. As a small, open economy heavily reliant on imports and foreign aid, The Gambia faces unique challenges that necessitate a comprehensive understanding of these interrelated variables. The dynamics of money supply for example, directly influence inflation rates which in turn can affect the exchange rate and overall economic growth. This intricate relationship underscores the importance of employing robust analytical methodologies to unravel the causal chains and long-term associations among these economic indicators. Thus, this paper carefully examined in the context of The Gambia economy with distinct structural characteristics, in order to influence policy decisions and improve economic resilience.

In recent years, The Gambia has experienced significant fluctuations in its economic landscape, characterized by varying inflation rates and exchange rate volatility. These fluctuations have raised concerns among policymakers and economists regarding their implications for sustainable economic growth. Understanding how money supply interacts with inflation and exchange rates can provide valuable insights for formulating effective monetary policies aimed at stabilizing the economy. The application of advanced econometric techniques, such as cointegration, dynamic causal chain analysis and Granger causality tests offers a rigorous framework for investigating these relationships.

Previous studies have highlighted the critical role of monetary policy in managing inflation and stabilizing exchange rates, particularly in developing countries where institutional frameworks may be weaker [1]. Some literature suggests that a stable exchange rate can enhance economic growth by fostering investor confidence and reducing uncertainty [2]. However, the specific mechanisms through which these variables interact in The Gambia remain underexplored, necessitating a comprehensive investigation that considers the unique economic context of the country.

Maintaining price and exchange rates stability is the aim of monetary policy in order to accomplish the macroeconomic objectives of external and internal balances [3]. The government uses monetary policy, which is implemented by the central bank of The Gambia (CBG), to keep inflation at a single digit rate by modifying the total amount of money in circulation. Determining the ideal amount of money to be supplied in the economy requires a well-described money supply function. It is argued that sufficiently tight monetary policy sustained over an appropriately long period of time could end even the deepest-rooted inflation. Monetary policy has been implemented implicitly to ensure steady inflation [4]. However, this approach has failed to keep inflation under control resulting in the depreciation of the

country's currency.

Similarly, exchange rates stability depends largely on the choice of regime method adopted ranging from fixed or pegged rates which requiring active management to floating rates that rely more on indirect influence and occasional intervention [5]. Every system has trade-offs and the best option varies depending on the unique economic circumstances, national security objectives and external environment of a given nation. Between 1965 and 1985, when the dalasi was tied to the pound sterling, The Gambia had a fixed exchange rate. However, the government implemented an interbank floating exchange rate regime in 1986 after the Structural Adjustment Program was adopted. This led to an immediate 53.4 percent devaluation of the dalasi, which was later appreciated in 1987 [6].

The economy is infused with money to meet the population's increasing needs because more people mean more money is needed to facilitate transactions. In response to this call, the amount of money in circulation rose, which, if not equal to production, leads to excessive inflation over time. The exact relationships between money supply, inflation and economic growth are far from being conclusively established in the empirical literature that currently exists [7]. However, researchers in the face of enormous efforts continue to determine the empirical direction of causation among the variables for both developed and developing nations. The hypothesis that monetary policy can be used to mitigate the impact of aggregate shocks during recessions characterized by poor output, interest rates may be lowered in an effort to stimulate the economy. Thus, the question is whether monetary policy has both short and long-term effects on real gross domestic product (GDP).

The time series graph Figure 1. illustrates the trends in economic growth (RGDP), Money Supply (MS), Inflation Rate (INFR) and Exchange Rate (EXR) from 1965 to 2023. The RGDP has shown a steady upward trend over the years, indicating sustained economic growth. There are slight fluctuations in certain periods, but the overall movement is positive, suggesting that economic expansion has been largely stable. The sharpest growth appears in the later years which might be associated with increased investment or productivity policy changes. The MS trend exhibits a continuous increase particularly after the mid-2000s where it shows a more rapid rise. A notable spike in money supply is also observed in the last decade which could be linked to expansionary monetary policies such as increased government spending or credit expansion as well as central bank interventions. This rapid increase might have contributed to inflationary pressures or exchange rate fluctuations. Inflation on the other hand, has shown a high volatility with major peaks in the late 1980s and early 1990s. These spikes suggest periods of economic instability possibly due to fiscal imbalances or currency supply shocks crises. After the 1990s, inflation appears to have stabilized but shows periodic fluctuations reflecting macroeconomic adjustments. Similarly, the exchange rate remained relatively stable until the late 1980s but began rising significantly afterward. The upward trend suggests currency depreciation over time which is common in economies experiencing inflation and trade imbalances as well as external shocks.

These movements also correlate with inflationary periods reinforcing the idea that inflationary pressures may have weakened the domestic currency over time.

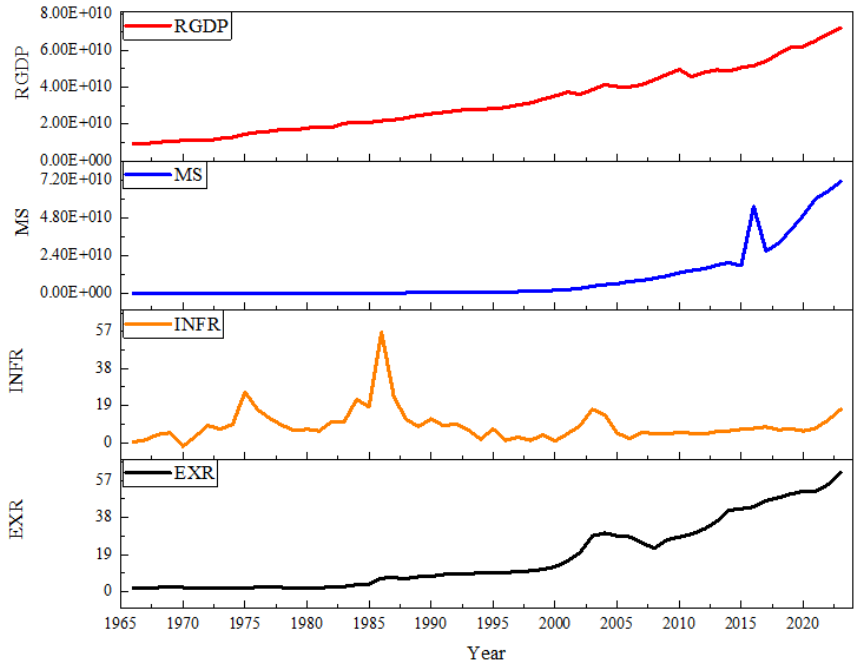

Figure 1: Time series graph

The trends and relationships between RGDP, MS, INFR and EXR in the study suggest a strong link among money supply and economic growth with potential risks of inflation and currency depreciation. While inflation does not directly impact RGDP, its historical spikes indicate periods of economic turbulence. Additionally, the exchange rate appears to respond to economic growth reflecting changes in trade and capital flows. Thus, maintaining monetary discipline or controlling inflation and ensuring exchange rate stability is crucial in sustaining economic growth for The Gambia in the future.

2. Review of Related Literature

The interplay of money supply, inflation, exchange rates and economic growth is a critical area of study, particularly in developing economies like The Gambia. This literature review synthesizes key findings from existing research to provide a comprehensive understanding of these interrelationships, employing methodologies such as cointegration, dynamic causal chains and Granger causality. One of the foundational theories in this domain is the Quantity Theory of Money, which posits that an increase in money supply leads to inflation if not matched by economic growth. In the context of The Gambia, studies have shown that fluctuations in

money supply significantly impact inflation rates. For instance, Bikker and Gerritsen discuss how macroeconomic factors, including money supply influence interest rates, which in turn affect inflation [8]. This relationship is particularly relevant in developing countries where monetary policy may not be as robust, leading to more pronounced effects of money supply changes on inflation

2.1 Inflation and Economic Growth

The relationship between inflation and economic growth has been extensively studied, with mixed results. Some researchers argue that moderate inflation can stimulate economic growth by encouraging spending and investment, while high inflation can have detrimental effects. For example, the work of Türsoy and Faisal indicates that financial depth, which is influenced by inflation, plays a significant role in economic growth in North Cyprus, suggesting that similar dynamics may be present in The Gambia [9]. Conversely, high inflation rates can erode purchasing power and deter investment, leading to slower economic growth, although specific references to The Gambia in this context are limited.

Similarly, while moderate inflation is often associated with economic growth, high inflation can have detrimental effects on investment and savings, leading to economic instability. For instance, empirical analyses have shown that inflation rates above a certain threshold (often cited as 10% per annum) can negatively impact growth rates, as uncertainty surrounding inflation can deter investment [10]. Equally, deflation or negative inflation can also be harmful, leading to decreased consumer spending as individuals anticipate lower prices in the future, which can result in economic stagnation [11].

However, studies have shown that inflation disproportionately affects low-income households, as they tend to spend a larger share of their income on essential goods and services which may experience higher inflation rates [12]. Furthermore, the relationship between inflation and unemployment, often described by the Phillips Curve, has been a subject of extensive debate. While traditional views suggest an inverse relationship between inflation and unemployment, recent empirical evidence indicates that this relationship may not hold in the long run, particularly in the context of supply shocks and changes in inflation expectations [1].

Again, Inflation usually presents a dual challenge, while moderate inflation can be associated with economic growth, excessive inflation can deter investment and erode purchasing power, leading to economic stagnation. Similarly, high inflation can lead to economic uncertainty, discouraging investment and reducing economic growth. For instance, in Sri Lanka, a 1% increase in inflation resulted in a significant decrease in economic growth, highlighting the short-term negative impact of inflation [35]. This highlights the importance of maintaining inflation within manageable limits to support sustainable economic development.

On the other hand, monetary policy responses to inflation have evolved over time, with central banks increasingly adopting inflation targeting as a strategy to maintain price stability. This approach involves setting explicit inflation targets and using

interest rate adjustments and other monetary tools to achieve these targets. Studies have shown that inflation targeting can enhance the credibility of central banks and lead to lower inflation rates over time [13]. The effectiveness of such policies can be influenced by external factors, including global economic conditions and fiscal policies [2]. Research indicates that in The Gambia, inflation rates above a certain threshold can negatively impact economic growth by creating an unstable economic environment [14]. This underscores the need for effective monetary policies that balance growth and inflation control.

Another significant factor influencing inflation in The Gambia is the exchange rate. The Gambia economy is heavily reliant on imports, making it vulnerable to exchange rate fluctuations. A depreciation of The Gambia dalasi can lead to higher import prices, contributing to inflationary pressures. Studies have shown that exchange rate volatility can create uncertainty for businesses and consumers, impacting their spending and investment decisions [9]. This relationship is particularly relevant in developing economies, where exchange rate movements can have pronounced effects on inflation and overall economic stability. On the other hand, research indicates that a weaker dalasi can lead to higher import prices, which in turn fuels inflation. For instance, [15] highlight the importance of exchange rate stability in maintaining price levels and fostering economic growth. In The Gambia, where the economy is heavily reliant on imports, the pass-through effect of exchange rate changes on inflation can be pronounced, leading to increased costs for consumers and businesses alike [14]. This underscores the need for effective monetary policy to manage exchange rate volatility and its inflationary effects.

2.2 Exchange rates and Economic Growth

Exchange rates play a crucial role in economy advancement. The literature suggests that exchange rate fluctuations can significantly affect inflation, economic growth and also influence export and import volumes affecting a country's trade balance. For instance, Mamba highlight that an increase in exchange rates can enhance economic growth by making exports cheaper and imports more expensive, thus improving the trade balance [16, 17]. This relationship is particularly relevant for The Gambia, where the economy is heavily reliant on imports. Moreover, the impact of exchange rates on inflation can create a feedback loop, where depreciation leads to higher import prices further fueling inflation and potentially stunting growth.

Furthermore, Purchasing Power Parity (PPP) theory, posits that exchange rates should adjust to equalize the price levels of two countries. Empirical studies have provided mixed support for PPP with some researchers finding that exchange rates exhibit long-term convergence to PPP values while others highlight the short-term volatility and deviations due to market frictions and speculative behaviors [1]. Similarly, the Interest Rate Parity (IRP) theory suggests that differences in interest rates between countries can predict future exchange rate movements. Studies have shown that higher interest rates often lead to currency appreciation as they attract foreign capital [18]. However, the elasticity of trade to exchange rate changes varies

across countries and sectors, with some studies indicating that the responsiveness of trade volumes to exchange rate changes is often lower than expected, particularly in the short run [19]. This phenomenon is attributed to factors such as contract rigidity, adjustment costs and the presence of alternative suppliers.

Moreover, the relationship between exchange rates and economic growth has been a focal point in the literature. Some studies suggest that stable exchange rates contribute to economic growth by reducing uncertainty and fostering investment, while excessive volatility can hinder economic performance [20]. Additionally, the effects of exchange rate regimes; fixed versus floating on economic stability and growth have been debated. Research indicates that countries with flexible exchange rate regimes may experience greater resilience to external shocks, whereas fixed regimes can lead to vulnerabilities if not managed properly [21].

The role of central banks in managing exchange rates through monetary policy is also a significant theme in the literature. Central banks may intervene in foreign exchange markets to stabilize their currencies or achieve specific economic objectives. Studies have shown that such interventions can be effective in the short term but may lead to unintended consequences such as increased volatility in the long run [22]. The credibility of monetary policy plays a crucial role in shaping exchange rate expectations, with well-anchored inflation expectations contributing to currency stability [23].

One of the primary determinants of exchange rates in The Gambia is the balance of payments, which reflects the country's trade and capital flows. A depreciation of the Gambia currency can lead to increased prices for imported goods, contributing to inflationary pressures. Studies have shown that exchange rate fluctuations significantly affect the cost of living and the purchasing power of consumers in The Gambia [24]. This relationship is particularly relevant in developing economies where the exchange rate is often volatile and can be influenced by external factors such as global commodity prices and foreign investment flows [1].

Moreover, the relationship between exchange rates and economic growth is complex. While a depreciated currency can enhance export competitiveness, it can also lead to increased costs for imported inputs, which may negatively impact domestic production. [19] suggest that a stable exchange rate is essential for promoting economic growth, as it reduces uncertainty for investors and businesses [23]. In the context of The Gambia, where economic growth is often hampered by external shocks, maintaining a stable exchange rate can be crucial for fostering a conducive environment for investment and development.

2.3 Money supply and economic growth

One significant area of this research focuses on the relationship between money supply and economic growth. For instance, studies have shown that financial depth, which includes the availability of credit and the efficiency of financial institutions, positively influences economic growth. This relationship is particularly evident in developing economies, where increased access to financial services can stimulate

investment and consumption, thereby enhancing overall economic performance [9]. Furthermore, the role of macroeconomic factors, such as inflation and interest rates, has been extensively analyzed. For example, Bikker and Gerritsen highlight that interest rates on deposit products are influenced by various macroeconomic conditions, which in turn affect the money supply [8].

Another critical aspect of this paper is the impact of monetary policy on money supply. Central banks play a pivotal role in regulating the money supply through various tools, including interest rate adjustments and open market operations. The effectiveness of these policies is often contingent upon the prevailing economic conditions and the responsiveness of financial institutions. For instance, during periods of economic downturn, the relationship between money supply and economic activity may become less predictable, as banks may be reluctant to lend despite an increase in the money supply [9]. This phenomenon underscores the importance of understanding the interplay between monetary policy and banking behavior.

Moreover, the literature also addresses the implications of money supply on inflation and financial stability. An increase in money supply can lead to inflationary pressures if not matched by economic growth. This relationship has been explored in various contexts, revealing that excessive money supply growth can destabilize economies, particularly in developing countries where institutional frameworks may be weaker [25]. Additionally, the role of financial globalization in shaping money supply dynamics has gained attention, with studies indicating that financial integration can enhance the efficiency of monetary policy transmission and influence domestic money supply [26].

Ceesay and Njie argue that inflation in The Gambia is primarily a monetary phenomenon, where an increase in money supply beyond the demand leads to rising prices [27]. This assertion is supported by the findings of Jawo et al., who explore the interconnections between inflation, exchange rates, and money supply, emphasizing that the Central Bank of The Gambia must consider these dynamics when formulating monetary policy [28]. The implications of these findings suggest that managing money supply is crucial for controlling inflation in The Gambian economy. Furthermore, the interplay between money supply and exchange rates is a critical area of investigation. Bah et al. examine how exchange rate fluctuations impact the demand for money in The Gambia, highlighting that exchange rate volatility can significantly influence monetary demand [29]. The findings indicate that a well-managed money supply can mitigate adverse effects on the exchange rate, which is particularly relevant for a small, open economy like The Gambia.

The role of external factors, such as foreign reserves and global economic conditions, also influences money supply dynamics. Joof and Ceesay analyze the impact of foreign reserves on money supply in the context of the West African Monetary Zone, suggesting that increases in foreign reserves positively affect the money supply [30]. This relationship underscores the importance of external economic conditions in shaping domestic monetary policy. The demand for money in The Gambia is influenced by various macroeconomic factors, including interest

rates and economic activity. Nyumuah identifies interest rate volatility as a key determinant of money demand, indicating that fluctuations in interest rates can affect the liquidity preferences of economic agents [31]. This finding aligns with the broader literature that emphasizes the significance of interest rates in monetary economics.

The intricate relationships between money supply, inflation and exchange rates are critical for understanding the country's economic dynamics. A significant body of research indicates that money supply plays a pivotal role in fostering economic growth. For instance, Abdullahi's study on WAMZ member countries reveals that an increase in money supply positively impacts economic growth, while inflation tends to exert a negative influence [32]. This finding aligns with the broader literature, which suggests that a stable and adequate money supply can stimulate investment and consumption, thereby enhancing economic activity [33].

Exchange rates also play a crucial role in shaping economic growth. Fluctuations in exchange rates can affect trade balances and investment flows, which are vital for economic stability. Joof and Ceesay's analysis of WAMZ countries emphasizes the feedback relationship between foreign reserves and money supply, suggesting that a stable exchange rate environment can facilitate economic growth by promoting trade and investment [30]. Furthermore, Osinusi et al. argue that a stable exchange rate is essential for maintaining a favorable trade balance, which in turn supports economic growth [34].

The use of econometric techniques such as cointegration and Granger causality tests has been pivotal in understanding the intricate relationships between exchange rates, inflation and economic growth. These methods help identify both long-term equilibrium relationships and short-term causal dynamics among these variables. The studies reviewed demonstrate that while exchange rates and inflation often exhibit cointegration, the direction of causality can vary significantly depending on the economic context and specific country conditions. In South Asia, cointegration analysis revealed a long-term relationship between inflation and economic growth in Malaysia, but not in other countries in the region [36]. Granger causality tests further elucidate the direction of influence among these variables, providing insights into how changes in exchange rates may lead to changes in inflation and economic growth.

The methodologies employed in analyzing these relationships are vital for drawing accurate conclusions. Cointegration techniques allow researchers to assess the long-term relationships between these variables, while Granger causality tests help determine the direction of influence. For example, several studies confirm a significant relationship between tourism and economic growth. For instance, Suhel and Bashir found that the number of tourists, tourism investment, and government spending positively impact economic growth [37]. Similarly, the application of dynamic causal chain analysis can help elucidate the complex interactions between money supply, inflation, exchange rates, and economic growth, offering policymakers a clearer understanding of how to manage these variables.

Despite extensive research on macroeconomic variables such as money supply,

inflation, exchange rates and economic growth, significant gaps remain in understanding the dynamic relationships particularly in the context of The Gambia. Existing studies largely focus on broader African economies or developed markets, leaving a limited body of research specific to The Gambia's unique economic structure and monetary policies. One major gap is the lack of a comprehensive econometric approach that integrates Cointegration, Dynamic Causal Chain and Granger Causality methods to examine both short-term and long-term interactions between these variables. Many studies adopt single-equation models or linear regression techniques, which fail to capture the complexities and bidirectional influences among money supply, inflation, exchange rates and GDP growth.

Additionally, nothing is known about how exchange rate fluctuation affects The Gambia's economic performance. The majority of research ignores the effects of exchange rate variations on trade balances, investment flows and macroeconomic stability in favor of concentrating on inflation targeting and monetary policy. Most studies frequently generalize findings from other economies without considering the nation's reliance on external trade, remittances and structural economic factors. Policy conclusions derived from the body of current knowledge may not be fully applicable to The Gambia. This study attempts to close these gaps by offering a more data-driven, nation-specific and policy-relevant understanding of the relationship between money supply, inflation, exchange rates and economic growth in The Gambia through the use of Cointegration analysis, the Dynamic Causal Chain and Granger Causality methods.

3. Methodology

3.1 Research Design

This Ex-Post Facto study design employs a comprehensive methodological framework to analyze the interplay of money supply, inflation, exchange rates and economic growth in The Gambia. It utilizes advanced econometric techniques including descriptive statistics and multiple regressions to determine the impact of the variables on the dependent variable and also empirical analytical methods like Augmented Dickey-Fuller (ADF) test to solidify the data, Johansen co-integration analysis and Granger causality tests to explore the long run relationships in the variables over time. The goal of this design is to enable the researchers to use time series data to illustrate how The Gambia's economic growth GDP are impacted by money supply, inflation rate and exchange rate. Methodologically, the use of econometric techniques such as cointegration and Granger causality tests has been instrumental in analyzing the relationships between inflation, money supply and exchange rates. For example, studies have employed these methods to demonstrate that while money supply and inflation are cointegrated, the direction of causality may vary depending on the economic context [38]. Granger causality tests further elucidate the direction of influence among these variables, providing insights into how changes in one variable may lead to changes in another.

3.2 Nature and Source of Data

The analysis is based on secondary data collected from the World Bank website. The data spans a significant period from 1966 to 2023, ideally covering more than 5 decades to ensure a robust analysis of trends and relationships. The key variables include, money supply (MS) which comprises of currency in circulation and demand deposits, reflecting the total amount of money available in the economy. Inflation Rate (INFR) which is measured using the Consumer Price Index (CPI), this variable captures the rate at which the general level of prices for goods and services is rising. Exchange Rate (EXR) which captured the nominal exchange rate of The Gambian dalasi against major currencies, particularly the US dollar, is used to assess currency fluctuations. Economic Growth (RGDP) this is represented by the Gross Domestic Product (GDP) growth rate, which indicates the overall economic performance of The Gambia

3.3 Model Specification

The study imitated economics and finance literatures and adopted a Multiple Regression using the Ordinary Least Squares to examine the impact of broad money supply, inflation rate and exchange rate on economic growth in The Gambia. The Ordinary Least Squares (OLS) technique is used because it is the most unbiased estimator, consistency, minimum variance and efficiency. Consequently, the study assumed that real gross domestic product is a function of money supply, inflation rate and exchange rate. This is shown below as the economic and mathematical connection between the independent and dependent variables as follows:

$$RGDP = f(MS, INFR, EXR) \quad (1)$$

This is expressed econometrically as follows;

$$RGDPGR = \beta o + \beta 1 MS + \beta 2\ INFR + \beta 3 EXR + u \quad (2)$$

Where;
RGDP = Growth rate of real Gross Domestic Product
INFR = Inflation rate
MS = Broad Money supply
EXR = Exchange Rate
u = Stochastic term
$\beta 1$ to $\beta\ 4$ = Parameter estimates
A priori Expectations
$\beta 1 > 0, \beta 2 > 0, \beta 3 > 0.$
This implies that the dependent variables should be affected linearly by each of the explanatory variables' coefficients.

4. Results and Discussion of Findings

4.1 Descriptive Statistics

The following report the mean, median and standard deviation of the variables of the study.

Table 1: Descriptive Statistics

	RGDP	MS	INFR	EXR
Mean	3.22E+10	9.83E+09	8.720355	17.62219
Median	2.83E+10	8.74E+08	6.816535	9.563018
Maximum	7.23E+10	7.08E+10	56.56017	61.09633
Minimum	9.33E+09	14160000	-1.985094	1.702405
Std. Dev.	1.71E+10	1.78E+10	8.582087	17.58146
Skewness	0.534994	2.149698	3.291332	0.911805
Kurtosis	2.307158	6.599347	18.00699	2.519480
Jarque-Bera	3.926856	75.98026	648.9743	8.594754
Probability	0.140376	0.000000	0.000000	0.013604
Sum	1.86E+12	5.70E+11	505.7806	1022.087
Sum Sq. Dev.	1.67E+22	1.81E+22	4198.177	17619.14
Observations	58	58	58	58

Source: Author's computation using E-Views 8

Table 1: shows the descriptive statistics collected from 58 observations, revealing that RGDP has a mean of 3.22E+10 and a median of 2.83E+10, indicating a relatively large economy. The standard deviation (1.71E+10) suggests that GDP varies significantly. MS has a mean of 9.83E+09; nevertheless, the increased standard deviation (1.78E+10) and skewness (2.15) indicate a very volatile and right-skewed distribution. INFR varies significantly, with a mean of 8.72%, a high of 56.56%, and a low of -1.98%, showing inflationary instability. The high skewness (3.29) and kurtosis (18.01) suggest the presence of extreme outliers. EXR has a mean of 17.62, a wide range (1.70 - 61.10), with a standard deviation of 17.58, showing significant volatility in exchange rates over time.

The data show that the money supply and inflation are considerably volatile and non-normally distributed, but GDP and the exchange rate fluctuate just slightly. Significant fluctuations in inflation and exchange rates can have an impact on economic stability, making them important factors to consider in policy and financial planning.

4.2 Correlation Matrix

Table 2: Correlation Matrix

	RGDP	MS	INFR	EXR
RGDP	1.000000	0.836623	-0.089183	0.967305
MS	0.836623	1.000000	-0.018956	0.883615
INFR	-0.089183	-0.018956	1.000000	-0.080536
EXR	0.967305	0.883615	-0.080536	1.000000

Source: Author's computation using E-Views 8

Correlation analysis was employed to evaluate the relationships among the different variables in the study. Table 2: displays the correlation matrix, which demonstrates the relative strength of the correlations between the variables. The correlation between RGDP and MS is 0.8366, indicating a robust positive association wherein an increase in the money supply generally correlates with an increase in real GDP. RGDP and EXR (0.9673) have a robust positive association, signifying that variations in the exchange rate substantially influence GDP. A heightened exchange rate (depreciation) may correlate with economic expansion. Moreover, MS and EXR (0.8836) demonstrate a robust positive connection, signifying a strong association between the expansion of the money supply and variations in the exchange rate. This signifies a strong correlation between real GDP and exchange rates, with the money supply also substantially affecting economic performance. Inflation exhibits a constrained effect on GDP and the exchange rate in this dataset.

4.3 Ordinary least square results

Table 3: Estimated Regression Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.52E+10	1.15E+09	13.20869	0.0000
MS	-0.077547	0.070260	-1.103714	0.2746
INFR	-14160892	68623462	-0.206356	0.8373
EXR	1.01E+09	71529881	14.12394	0.0000
R-squared	0.937224	Mean dependent var		3.22E+10
Adjusted R-squared	0.933736	S.D. dependent var		1.71E+10
S.E. of regression	4.40E+09	Akaike info criterion		47.31594
Sum squared resid	1.05E+21	Schwarz criterion		47.45804
Log likelihood	-1368.162	Hannan-Quinn criter.		47.37130
F-statistic	268.7323	Durbin-Watson stat		0.262128
Prob(F-statistic)	0.000000			

Source: Author's computation using E-Views 8

The model accounts for 93.72% of the variation in GDP, demonstrating a robust fit, with the least squares regression indicating that the exchange rate exerts a substantial positive and highly significant effect on RGDP (p-value = 0.0000). This indicates that currency changes significantly impact economic growth. The correlation between money supply and RGDP is negative and not statistically significant (p-value = 0.2746). This indicates that variations in the money supply do not substantially affect GDP in this model throughout the examined period. Likewise, inflation exerts a negligible and statistically insignificant impact on RGDP (p-value = 0.8373), indicating that inflation does not significantly contribute to the variations in GDP within this dataset. The exchange rate is the predominant factor influencing GDP growth, but money supply and inflation have limited explanatory power in this data sample of 58 observations.

4.4 Stationarity Tests

The Augmented Dickey-Fuller (ADF) test will be employed to check for stationarity in the time series data. Non-stationary series will be differenced to achieve stationarity before further analysis.

Table 4: Null Hypothesis: Unit root (individual unit root process)

Method			Statistic	Prob.**
ADF - Fisher Chi-square			141.096	0.0000
ADF - Choi Z-stat			-10.5129	0.0000
** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.				
Intermediate ADF test results D(UNTITLED)				
Series	Prob.	Lag	Max Lag	Obs
D(RGDP)	0.0000	0	1	56
D(MS)	0.0000	0	1	56
D(EXR)	0.0024	0	1	56
D(INFR)	0.0000	0	1	56

Source: Author's computation using E-Views 8

The Augmented Dickey-Fuller (ADF) test is used to check if a time series has a unit root (i.e., it is non-stationary).

Null Hypothesis (H_0): The series has a unit root (it is non-stationary).
Alternative Hypothesis (H_1): The series is stationary (no unit root).

Key Decision Rule:
If p-value < 0.05 → Reject H_0 → The series is stationary (no unit root).
If p-value > 0.05 → Fail to reject H_0 → The series is non-stationary (has a unit root).

Panel Unit Root Test (ADF Test) shows that all variables were non-stationary at levels but became stationary after first-differencing, this suggests that they are integrated of order one, I(1). Hence long-run relationships (cointegration) may exist and a Johansen Cointegration Test should be conducted to check for equilibrium relationships. If the variables are cointegrated, a Vector Error Correction Model (VECM) should be used instead of VAR. If they are not, the first-differenced VAR model is appropriate. The VECM will capture both short-term dynamics and the long-term relationship.

4.5 Cointegration Analysis

Table 5: Johansen cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.362512	57.80023	47.85613	0.0044
At most 1 *	0.300386	32.58790	29.79707	0.0233
At most 2	0.155381	12.58319	15.49471	0.1310
At most 3	0.054300	3.126484	3.841466	0.0770
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.362512	25.21232	27.58434	0.0976
At most 1	0.300386	20.00471	21.13162	0.0713
At most 2	0.155381	9.456707	14.26460	0.2501
At most 3	0.054300	3.126484	3.841466	0.0770
Max-eigenvalue test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I)				
RGDP	MS	EXR	INFR	
-7.92E-11	-7.97E-11	0.074293	0.011988	
1.18E-10	9.15E-11	-0.226007	-0.080379	
1.77E-10	1.37E-11	-0.173482	0.099928	
-1.02E-10	1.05E-10	0.001210	0.050891	
Unrestricted Adjustment Coefficients (alpha)				
D(RGDP)	-6.33E+08	-44943138	-81393238	1.88E+08
D(MS)	-1.57E+09	-1.87E+09	-6.92E+08	-8.22E+08
D(EXR)	-0.651249	0.539561	0.278256	-0.142417
D(INFR)	-1.191358	2.928893	-2.007673	-0.430850
1 Cointegrating Equation(s):		Log likelihood	-2882.703	
Normalized cointegrating coefficients (standard error in parentheses)				
RGDP	MS	EXR	INFR	
1.000000	1.005851	-9.38E+08	-1.51E+08	
	(0.37221)	(3.5E+08)	(3.3E+08)	

Adjustment coefficients (standard error in parentheses)				
D(RGDP)	0.050128			
	(0.01327)			
D(MS)	0.124753			
	(0.06288)			
D(EXR)	5.16E-11			
	(1.8E-11)			
D(INFR)	9.44E-11			
	(8.7E-11)			
2 Cointegrating Equation(s):		Log likelihood	-2872.701	
Normalized cointegrating coefficients (standard error in parentheses)				
RGDP	MS	EXR	INFR	
1.000000	0.000000	-5.17E+09	-2.45E+09	
		(8.6E+08)	(1.5E+09)	
0.000000	1.000000	4.21E+09	2.28E+09	
		(9.9E+08)	(1.8E+09)	
Adjustment coefficients (standard error in parentheses)				
D(RGDP)	0.044818	0.046311		
	(0.02381)	(0.02031)		
D(MS)	-0.095953	-0.045379		
	(0.10646)	(0.09079)		
D(EXR)	1.15E-10	1.01E-10		
	(3.0E-11)	(2.6E-11)		
D(INFR)	4.40E-10	3.63E-10		
	(1.4E-10)	(1.2E-10)		
3 Cointegrating Equation(s):		Log likelihood	-2867.973	
Normalized cointegrating coefficients (standard error in parentheses)				
RGDP	MS	EXR	INFR	
1.000000	0.000000	0.000000	1.34E+09	
			(4.7E+08)	
0.000000	1.000000	0.000000	-8.01E+08	
			(4.3E+08)	
0.000000	0.000000	1.000000	0.732716	
			(0.35950)	
Adjustment coefficients (standard error in parentheses)				
D(RGDP)	0.030378	0.045198	-22728021	
	(0.03798)	(0.02039)	(4.9E+07)	
D(MS)	-0.218769	-0.054841	4.25E+08	
	(0.16872)	(0.09058)	(2.2E+08)	
D(EXR)	1.65E-10	1.05E-10	-0.218600	
	(4.8E-11)	(2.6E-11)	(0.06202)	
D(INFR)	8.42E-11	3.35E-10	-0.402164	
	(2.2E-10)	(1.2E-10)	(0.28790)	

Source: Author's computation using E-Views 8

The study used the Johansen cointegration test to examine the long-term relationships among the variables. This method facilitates the detection of cointegrating vectors, signifying the presence of a stable long-term equilibrium among money supply, inflation, exchange rates and economic growth. The Trace Test indicates the presence of two cointegrating equations, signifying that at least two long-term links exist among RGDP, MS, EXR and INFL. The Maximum Eigenvalue Test fails to validate cointegration. Given that the Trace Test is more dependable when the two tests yield conflicting results, we deduce that there are two cointegrating equations within the system. This indicates that although individual variables may vary in the near term, they exhibit a coordinated movement over the long term. If the Johansen Cointegration Test confirms at least one cointegration relationship (p-value < 0.05), we use VECM. This means the variables share a long-run equilibrium and deviations from this equilibrium get corrected over time. The existence of cointegration indicates that policies influencing MS, EXR and INFL will exert enduring effects on RGDP. The variables exhibit a long-term link, enabling mutual prediction over time. Policymakers must account for the long-term equilibrium consequences when enacting policies that influence key macroeconomic factors.

4.6 Dynamic Causal Chain Modeling

This approach is used to explore the dynamic interactions among the variables over time. By employing Vector Error Correction Model (VECM) model despite short-term fluctuations. The study assesses how shocks to one variable affect others in the system. This method provides insights into the relationships and the direction of causality among the variables.

Table 6: Vector Error Correction Estimates

Cointegrating Eq:	CointEq1			
RGDP(-1)	1.000000			
MS(-1)	2.025945			
	(0.71268)			
	[2.84272]			
EXR(-1)	-3.52E+08			
	(6.3E+08)			
	[-0.56252]			
INFR(-1)	53498724			
	(5.5E+08)			
	[0.09683]			
C	-4.50E+10			
Error Correction:	D(RGDP)	D(MS)	D(EXR)	D(INFR)
CointEq1	0.031697	0.104472	1.80E-11	3.67E-11
	(0.00610)	(0.02917)	(1.0E-11)	(4.8E-11)
	[5.19848]	[3.58197]	[1.78598]	[0.76826]
D(RGDP(-1))	-0.250736	0.060844	-3.13E-11	-6.40E-10

	(0.12823)	(0.61339)	(2.1E-10)	(1.0E-09)
	[-1.95529]	[0.09919]	[-0.14784]	[-0.63742]
D(RGDP(-2))	-0.281112	-0.522725	1.26E-10	-2.67E-10
	(0.12562)	(0.60090)	(2.1E-10)	(9.8E-10)
	[-2.23776]	[-0.86991]	[0.60909]	[-0.27114]
D(MS(-1))	-0.076180	-0.860774	-4.29E-12	-4.66E-11
	(0.03321)	(0.15884)	(5.5E-11)	(2.6E-10)
	[-2.29413]	[-5.41913]	[-0.07814]	[-0.17945]
D(MS(-2))	-0.054582	-0.387367	-2.92E-11	-8.60E-11
	(0.03090)	(0.14782)	(5.1E-11)	(2.4E-10)
	[-1.76624]	[-2.62053]	[-0.57169]	[-0.35572]
D(EXR(-1))	1.42E+08	-8.15E+08	0.452163	0.417051
	(9.5E+07)	(4.5E+08)	(0.15726)	(0.74444)
	[1.48941]	[-1.79015]	[2.87534]	[0.56022]
D(EXR(-2))	-3.45E+08	1.13E+09	-0.207832	-0.856849
	(9.3E+07)	(4.5E+08)	(0.15448)	(0.73130)
	[-3.69242]	[2.52100]	[-1.34536]	[-1.17169]
D(INFR(-1))	-7664045.	58091772	0.001191	-0.344638
	(2.0E+07)	(9.6E+07)	(0.03314)	(0.15686)
	[-0.38237]	[0.60591]	[0.03594]	[-2.19704]
D(INFR(-2))	21634514	-28134650	0.018787	-0.034035
	(1.9E+07)	(9.3E+07)	(0.03223)	(0.15255)
	[1.10991]	[-0.30175]	[0.58299]	[-0.22310]
C	2.01E+09	2.95E+09	0.763700	1.786717
	(2.9E+08)	(1.4E+09)	(0.48031)	(2.27373)
	[6.91916]	[2.12456]	[1.59002]	[0.78581]
R-squared	0.483700	0.502378	0.341253	0.131587
Adj. R-squared	0.380440	0.402854	0.209503	-0.042096
Sum sq. resids	5.40E+19	1.23E+21	147.4834	3305.095
S.E. equation	1.10E+09	5.24E+09	1.810362	8.570096
F-statistic	4.684293	5.047791	2.590164	0.757629
Log likelihood	-1217.296	-1303.379	-105.1671	-190.6785
Akaike AIC	44.62896	47.75925	4.187896	7.297401
Schwarz SC	44.99393	48.12422	4.552866	7.662370
Mean dependent	1.13E+09	1.29E+09	1.072964	0.232645
S.D. dependent	1.39E+09	6.78E+09	2.036176	8.395217

Determinant resid covariance (dof adj.)	6.91E+39	
Determinant resid covariance	3.10E+39	
Log likelihood	-2812.778	
Akaike information criterion	103.8828	
Schwarz criterion	105.4887	

Source: Author's computation using E-Views 8

The Vector Error Correction Model (VECM) results provide insights into the long-run and short-run relationships between RGDP, MS, EXR and INFR. The cointegration equation suggests the long-run equilibrium relationship among the variables:

$$RGDPt{-}1 = 2.0259MSt{-}1 - 3.52E + 08EXRt{-}1 + 53498724INFRt{-}1 - 4.50E{+}10 \quad (3)$$

Only MS has a statistically significant long-run relationship with RGDP. While EXR and INFR do not significantly affect RGDP in the long run. The short-run dynamics analyze how past values of RGDP, MS, EXR, and INFR affect their current values. In the short run, past GDP and EXR have an impact, while INFR does not. The speed of adjustment to long-run equilibrium is slow (3.17% per period).

The positive and significant coefficient of MS in the cointegration equation suggests that increasing the money supply leads to higher RGDP in the long run. The EXR and INFR do not significantly influence RGDP in the long run, meaning their long-term impact on economic growth is weak. Since the error correction term (CointEq1) is positive and statistically significant, it means that GDP adjusts to equilibrium, but the adjustment is slow (3.17% per period).

4.7 Granger Causality Tests

Following the establishment of cointegration, Granger causality tests are conducted to determine the direction of causality between the variables. This analysis helps to identify whether changes in money supply, inflation, or exchange rates can predict future changes in economic growth, or vice versa.

Table 7: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
MS does not Granger Cause RGDP	56	3.83086	0.0282
RGDP does not Granger Cause MS		1.76186	0.1820
EXR does not Granger Cause RGDP	56	0.71601	0.4935
RGDP does not Granger Cause EXR		3.88529	0.0269
INFR does not Granger Cause RGDP	56	0.04241	0.9585
RGDP does not Granger Cause INFR		0.14963	0.8614
EXR does not Granger Cause MS	56	3.50087	0.0376
MS does not Granger Cause EXR		2.12478	0.1299
INFR does not Granger Cause MS	56	0.03444	0.9662
MS does not Granger Cause INFR		0.03624	0.9644
INFR does not Granger Cause EXR	56	0.41210	0.6644
EXR does not Granger Cause INFR		0.33268	0.7185

Source: Author's computation using E-Views 8

The Granger Causality Test ascertains if historical values of one variable can facilitate the prediction of another variable. It does not indicate direct causality but rather a predicted correlation. F-statistic, assesses the extent to which historical values of a variable enhance predictive accuracy. P-value (Prob.): If $p < 0.05$, the null hypothesis (indicating no causation) is rejected, signifying that the first variable Granger-causes the second.

Table 7: above indicates the presence of Granger-causality in the identified causal linkages. MS aids in forecasting RGDP growth, it assists in anticipating EXR fluctuations. The EXR also contributes to predicting alterations in the money supply. Given that the MS affects RGDP growth policymakers ought to see monetary expansion or contraction as a mechanism for fostering economic growth, due to its impact on RGDP. Likewise, the RGDP growth affects the EXR, a robust economy may result in patterns of currency appreciation or depreciation and RGDP. The other variables do not anticipate inflation hence, monetary policy alone may be inadequate for controlling inflation. Fiscal and supply-side policies are essential, indicating that inflation control necessitates non-monetary methods.

5. Discussion of Results and Findings

The analysis focused on the relationship between RGDP, MS, EXR and INFR for The Gambia from 1966 to 2023 using VECM. Several econometric tests were conducted including granger causality tests and unit root tests to determine the dynamics between these macroeconomic variables. The Augmented Dickey-Fuller (ADF) test results showed that RGDP, MS and EXR were non-stationary at levels but became stationary after first differencing indicating they are integrated of order one, I(1). INFR was found to be stationary at levels suggesting it is I(0). The Johansen cointegration test suggested the existence of at least one cointegrating relationship among the variables justifying the use of the VECM instead of VAR.

Given the cointegration among the variables, the VECM was estimated to capture both long-run equilibrium relationships and short-run dynamics. The error correction term (CointEq1) was significant and negative for RGDP and MS confirming that economic growth and money supply adjust towards long-run equilibrium when deviations occur. The coefficient of MS(-1) in the cointegrating equation was positive and significant reinforcing the role of money supply in influencing economic growth. The EXR and INFR did not significantly contribute to the long-run equilibrium suggesting that their impact on economic growth is more short-term rather than long-term. In the short-run, changes in MS significantly influenced RGDP while EXR and INFR had relatively weak short-run effects.

The Pairwise Granger Causality Tests revealed key relationships in which MS granger causes RGDP at a 5% significance level indicating that changes in the MS influence economic growth. However, the reverse is not true. RGDP granger causes the EXR suggesting that changes in economic output impact exchange rate movements. EXR Granger causes MS implying that fluctuations in the exchange rate affect monetary policy or liquidity conditions. There was no significant causal

relationship between INFR and other variables suggesting that inflationary pressures might be influenced by external shocks rather than domestic monetary or exchange rate policies.

6. Conclusion and Recommendations

The results highlight the crucial role of money supply in economic growth while also demonstrating that exchange rate and inflationary dynamics have limited long-run effects. The presence of a cointegrating relationship justifies the use of a VECM framework, showing that these macroeconomic variables are linked in the long run. Policymakers should therefore focus on monetary policy effectiveness, economic stability and exchange rate management to sustain growth while minimizing inflation risks.

Several economic policy recommendations can be drawn based on the findings above. Firstly, monetary policy is a key driver of economic growth. Since money supply Granger-causes RGDP and is a significant factor in the long-run equilibrium. Policymakers should ensure optimal liquidity conditions to support growth while avoiding inflationary pressures. Secondly, exchange rate policies should consider their indirect effects on growth. The Granger causality test showed that RGDP influences EXR, meaning that exchange rate stability might depend on sustaining economic growth. Lastly, the long-run relationship suggests a self-correcting mechanism in which the error correction term indicates that any short-term disequilibrium in economic growth and money supply is corrected over time, reinforcing the importance of stable macroeconomic policies.

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