

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

AN EMPIRICAL ANALYSIS OF THE EFFECT OF MONEY SUPPLY AND ECONOMIC GROWTH: EVIDENCE FROM SUB-SAHARAN AFRICA.

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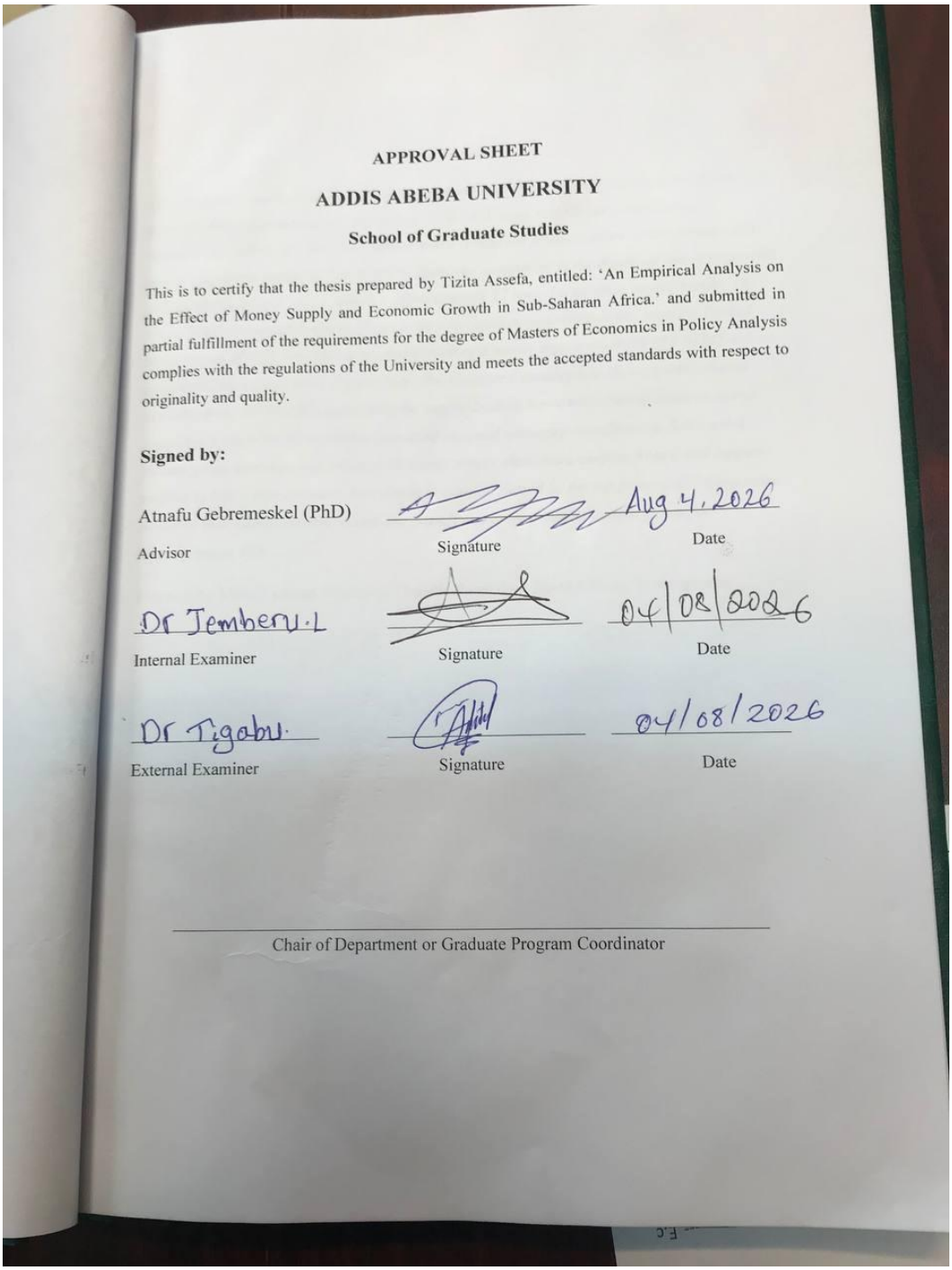
APPROVAL SHEET

ADDIS ABEBA UNIVERSITY

School of Graduate Studies

This is to certify that the thesis prepared by Tizita Assefa, entitled: 'An Empirical Analysis on the Effect of Money Supply and Economic Growth in Sub-Saharan Africa.' and submitted in partial fulfillment of the requirements for the degree of Masters of Economics in Policy Analysis complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

This study empirically examines the effects of money supply on economic growth in 12 Sub-Saharan African countries over the period 1970-2023 using second-generation panel econometric techniques. The fixed Effects model (preferred by the Hausman test) reveals that money supply increases GDP by 0.022%. However, investment is the dominant driver of growth with an elasticity of 0.59155, which is approximately 27 times larger than money supply. The Westerlund cointegration test confirms a long-run equilibrium relationship, with the Pooled Mean Group (PMG) long-run estimation revealing a money supply elasticity of 0.02345 and an error correction speed of 31.2% per year. The Granger Causality test shows unidirectional causality from M2 to GDP, supporting the supply-leading hypothesis. Strong cross-sectional dependence exists for all variables, requiring regional monetary coordination. Substantial income group heterogeneity exists, with money supply elasticities varying from 0.089 (upper-middle) to 0.011 (low-income). Investment promotion should be the top priority (27 times more powerful than money supply). A one-size-fits-all monetary policy is inappropriate for heterogeneous SSA.

Keywords: Money supply, Economic Growth, Panel data, Fixed Effects, Heterogeneity

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Declaration

I, Tizita Assefa, hereby declare that this thesis titled ‘An Empirical Analysis on the Effect of Money Supply and Economic Growth in Sub-Saharan Africa (1970-2023)’ is my original work. I further declare that this thesis has not been submitted for any degree or examination at any other University. All sources of information used in this thesis have been duly acknowledged through proper citations and references.

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LIST OF ACRONYMS

ADF:	Augmented Dickey-Fuller Test
ARDL:	Autoregressive Distributed Lag
CBE:	Central Bank of Ethiopia
CIPS:	Cross-sectional Augmented LM-Pesaran-Shin
EAC:	East Africa Community
ECM:	Error Correction Model
ECOWAS:	Economic Community of West African States
GMM:	Generalized Method of Moments
PMG:	Pooled Mean Group
QTM:	Quantity theory of Money
R&D:	Research and Development
SADC:	Southern Africa Development Community
SAP:	Structural Adjustment Program
SSA:	Sub-Saharan Africa
S-VAR:	Structural Vector
VAR:	Vector Autoregression
VECM:	Vector Error Correction Model
WDI:	World Development Indicator

INTRODUCTION

1.1 Background of the Study

Policymakers in developing economies, such as countries in Sub-Saharan Africa, face multiple objectives: promoting sustainable economic growth, maintainable price stability, ensuring full employment, and achieving balance in international payments. Central Banks use monetary policy as an essential instrument to pursue these goals. At the core of monetary policy lies the management of money supply, the total stock of money in the economy at a given time, which includes currency in circulation, demand deposits, and various time deposits. Broad money supply (M2) encompasses money readily usable for spending (M1) along with assets that can be quickly converted to M1 (Ayalew, 2022).

Since the 1960s, monetary policy in SSA has changed dramatically (Akyuz, 2005; Fry, 1995). In the year following independence, governments maintained tight control over credit allocation to promote strategic industries. The 1980s and 1990s brought Structural Adjustment Programs (SAPs) that reversed this approach, introducing market-based reforms including financial liberalization and interest rate (World Bank, 1994). The contemporary period has been shaped by twin forces: deliberate efforts to adopt inflation targeting and deepen financial systems, and recurring exogenous disruptions most notable the 2008 financial crises, the 2014 commodity price bust and the COVID-19 pandemic (IMF, 2023).

Despite these reforms and policy efforts, the growth performance of SSA remained uneven and in many instances, below the threshold required by meaningful poverty reduction and structural transformation. Simultaneously, the money supply, measured broadly as M2, has expanded significantly across the region, raising critical questions regarding the efficiency of monetary policy as a tool for growth promotion. Financial development in sub-Saharan Africa (SSA) remains low although the sector continues to grow in recent times (Ibrahim & Alagidede). Financial sector development in SSA remains relatively underdeveloped and shallow in the CFA franc zone(Ibrahim & Alagidede, 2018) .

According to the World Development Indicator, reveal distinct trends in credit expansion across sub-Saharan Africa between 1985-1989 and 2000-2004, domestic credit exhibited a consistent upward trajectory. However, the most recent decade witnessed a contraction of 14.36%, bringing

the average to 58.55%. Meanwhile, private credit followed a non-linear pattern over the sample period.it rose from 33.82% (1980 to1984) to a peak of 59.42% (1995-1999), before declining to 55.18% (2000 to 2004) and subsequently increasing again to 46.97% (2010 to 2014). In tandem with these financial trends, real sector productivity indicators improved considerably, rising from their 1980-1984 baseline to a comparatively higher level by 2010-2014.

According to the Global Findex report in 2017, only 33% of the adult population owns a bank account at a formal financial institution in sub-Saharan Africa (SSA), which is less than any other region in the world (Ifediora et al., 2022). Many sub-Saharan African nations like Nigeria have experienced a variety of economic difficulties, including sluggish development and economic instability, despite its abundance of natural and mineral resources. As a result, unemployment, inflation, non-productivity, and a balance of payments deficit remained the norm (Isibor et al., 2023).

Ethiopia serves as an instructive case within SSA for several reasons. As Africa's second-most populous nation, its economic trajectory has significant implication for regional patterns. Over the past two decades, Ethiopia has posted impressive growth, averaging approximately 9-11%. The evolution of Ethiopia's monetary policy since 1962. Encompassing the imperial period, the social Derg era (1974-1991) and subsequent liberalizing reforms. Broad money (M2) has grown substantially during this time increasing from roughly 20% of GDP in the 1990s to over 30% in recent years, though it still trails the regional average. According to Shiferaw's (2017) study, Ethiopian financial sector remains closed to foreign banks, and the quality of its services compares poorly with respect to other African countries. There are about 32 privately owned commercial banks as of now, accounting for less than 30% of the sector's financial assets. The state-owned CBE overwhelmingly dominates the market. Private Banks function under stringent financial regulations that restrain financial intermediation. The domestic savings rate in Ethiopia declined from 15% of GDP during the 1980s to about 12% during the 1990s and it raised only after 2010 by more than 15% of GDP.

1.2. Statement of the Problem

Sub-Saharan Africa showed significant growth in broad money supply due to capital inflows and development in financial institution over past years (World Bank, 2023). However, the monetary

expansion of the region did not help attaining of sustained economic growth (Easterly, 2001). Moreover, the region is in continuous struggle with low productivity (Collier & Gunning, 1999), ineffective capacity of financial intermediation, and impediments due external shocks.

Existing empirical literature on the relationship between money supply and economic growth SSA remains contradictory. Studies focusing on single countries such as Nigeria, Kenya, Ethiopia or South Africa often yield conflicting result. (Ogunmuyiwa & Ekone, 2010) studies that money supply is positively related to growth but the result is however insignificant in the case of GDP growth rates on the choice between contractionary and expansionary money supply, and other studies find that money supply exerts no significant effects or determinate due to inflationary consequences (Chaitip et al., 2015). While Ethiopian studies found that, An increase in growth rate of broad money supply has positively impact on growth rate of Real GDP in Ethiopia in the short run (Tegegne, 2021), while (Abdulkadr et al., 2024) found that ,In the long run, money supply has positive and statistically significant effects on real GDP growth, while deposit interest rate and reserve requirements have negative and statistically significant effects. Furthermore, cross-country panel studies tend to suffer from short time dimensions, failing to capture the long run structure transformation and regime shifts that have defined SSA economics since independence.

Beyond substantive disagreements, the existing literature is constrained by three pervasive methodological deficiencies. The first concerns the failure to model cross-sectional dependence, thereby ignoring the strong interdependences among SSA countries arising from regional trade networks, common exposure to commodity price fluctuation, and a cross-border spillovers. The frequency of policy regime shifts, sovereign debt distress and external shocks that have punctuated the region's economic theory. The assumption of homogenous of slope of coefficient across countries is the third root cause of reliance on methods of first-generation panel.

As the result, a clear gap in the literature appears. For example, there is only few study provide rigorous and lung run empirical analysis even to mange to accommodate non- stationarity, cross sectional reliance and country specific heterogeneity simultaneously when looking at the money growth nexus in SSA. Thus, the aim of this study is to fill the gap using second-generation panel econometrics methods on an extensive dataset.

1.3 Research Question

1. Is there long-run equilibrium relationship between money supply and Economic growth in SSA?
2. Does causation exist between Money supply and Economic Growth?
3. Is the economic growth affected differently by money supply across low-income vs. middle-income SSA countries?

1.4 Objectives of the Study

The main objective of this study is to empirically investigate the impact of money supply on sub-Saharan African economic growth.

Specific objective:

- To examine the long-run cointegrating relationship between money supply (M2) and real GDP in selected SSA countries.
- To determine the causal direction between money supply and economic growth using panel causality techniques.
- To assess the impact of structural breaks on the stability of the money-growth relationship.
- To compare the effect of money supply on growth across different income groups within SSA.

1.5 Significance of the Study

This research adds to the general discussion about monetary economics in emerging nations, particularly SSA. By using more advanced panel econometrics methods, this study makes new important contribution to the extent to which account for cross sectional dependence and deference in slope. This study also helps policy makers by providing evidence-based understanding of whether monetary expansion is a legitimate instrument for growth simulation or if the focus should be solely on stability of the price. Moreover, it explains the diverse effect of money supply on different country groups, which can be utilized for providing more specific policy recommendation. This paper, spanning 54 years, provides among the longest datasets on

this title in SSA context, it captured multiple monetary strategies regime, thereby offering a more through catches of long run dynamic are usually hidden in short run.

1.6 Scope and Limitation of the Study

The study concentrates on economics growth of sub-Saharan Africa. Sub-Saharan Africa is one of developing countries experiencing considerable economic growth. The study primarily identifies all trajectory of after dependence economic growth and monetary development in the period of 1970 to 2023. The study is focused only on SSA, countries like north African are not included since their economic structure are different, their market has strong integration with European and middle eastern. This includes the immediate post-colonial era (1970s), the Sap years (1980s- 1990s), the commodity boom (2000s), and the recent shocks (2008-2023). The study is confined to the macroeconomic relationship between money supply and output. The study relies on secondary, quantitative data extracted from the world development indicators (WDI) and international financial statistics (IMF). It employs panel economics techniques.

1.7 Organization of the Thesis

The thesis is organized into five chapters. Chapter one provides the introduction and background. Chapter Two presents a review of theoretical literature and empirical evidences. Chapter Three outlines the research methodology, including model specification, data sources, theoretical framework, and estimation techniques. Chapter Four presents the data analysis, diagnostic tests, main empirical findings and discussion. Finally, Chapter five provides a conclusion and policy implications.

REVIEW OF THEORTICAL LITERATURE AND EMPIRICAL EVIDENCES

2.1 Introduction

This chapter provides a comprehensive review of both theoretical and empirical literature on the relationships between money supply and economic growth, with a practical focus on sub-Saharan Africa. The chapter presents the theoretical framework, examining the major schools of thought in monetary economics. The empirical literature, organized by geographical scope and methodological approach, finally, this chapter identifies the research gap that this study seeks to address.

2.2 Review of Theoretical Literature

There are different schools of thought emphasizing the underlying relationship between money and economic growth. Understanding this money- growth nexus and its different assumption is important for subsequent interpretation of the empirical findings and formulating the relevant model for the study.

2.2.1 The quantity theory of money and The Monetarist view

Milton Friedman introduced this theory in his influential essay "The Quantity Theory of Money". The theory reveals that direct and proportional relationships between supply of money and general price level (Adil et al., 2021).

This relationship depicted mathematically as equation of exchange as follow:

$$PtQt=MtVt \quad \text{……. (1)}$$

Where, Pt represents the price level, Qt is the real output, Mt denotes the quantity of money stock, and Vt is the velocity of money circulation. This shows that nominal expenditure equals the supply of money times how many times each unit of money circulates in each people's hand. If the money supply increases, but with constant quantity of good and speed of spending, the price must increase proportionally.

Money has negligible influences affecting only the prices levels disregarding the real economic activities or employments over time. Nevertheless, monetarist economists demonstrated that money could have an influence on real activities and employment levels due to the price and wage rigidities in the short run. In this regard, they forwarded an important point concluding inflation as the result of monetary supply expansion policy. Hence, stable and predictable growth of money supply is recommended for maintaining macroeconomic stability in the country.

2.2.2 The Keynesian Theory of Money and Interest

John Maynard Keynes introduced this theory in struggling the classical thinking of that money is neutral particularly over short run period. This theory argues that money does not exerts its influence over the economy directly, its influence directs through interest rates (Fazzari, 2015). His liquidity preference theory emphasized the transmission mechanism in which the theory is proposed to.

There are three motives behind the demand for money including transaction demand for expenditure, precautionary holding for uncertain situations, and motives of holding cash than holding bond when interest rate are going to rise. As money supply is increased by the central bank of the country, then there will be an excess liquidity available in the market. The surplus available in this situation directs interest rate downward and narrows the opportunity cost of money holding. This low interest rate means low borrowing cost in the economy and investors are encouraged to invest their money in different business. The increasing investment opportunity in turn fosters the aggregate demand and which in turn improves real GDP growth.

2.2.3 Post Keynesian Economics

This theory developed based on the Keynes's most fundamental insights of the monetary economist's long run unmeasurable uncertainty. It gives elaboration on the inherent nature of capitalist system instability, fluctuations due to complete uncertainty and not equal wealth distribution. The school emphasized that the importance of institutions than giving a natural tendency toward equilibrium analysis.

The endogenous nature of money considers as the core idea of the school. Post-Keynesians claim that money supply created due to the institutions like commercial banks activity in their lending

process to meet the underlying demand. On the other hand, monetarists view that central bank can control the money supply exogenously. In this way, financial sectors are considered as key drivers of the macroeconomic instability with Central banks having loose control

over their excess credit creation process.

Post Keynesians recommends their active fiscal policy, Government intervention, demand tool management, and enhancing equitable distribution of income disregarding weak stabilization tools of traditional monetarists. Therefore, this school argues Keynesian demand management through demonstrating that money supply is endogenous not exogenously controlled variable.

2.2.4 Endogenous Growth Theory and Financial System

Endogenous Growth Theory advocates a sustainable growth of economy emanates from internal factors within the economy itself arguing the neoclassical models such as solow growth model which considers technology change as exogenous variable than outcomes of the economy activity. The theory emphasized on financial institutions in continuously enhancing efficiency of financial institutions, increasing saving impact into productive investments and sustainable research and development activities. (Chou & Chin, 2001).

The theory gives an emphasis on knowledge, innovation and human capital development and regards them as key drivers of the economic growth. It also emphasized the spillover effects of research and development in enabling economic wide gains in production capacity that benefits others. Since economic growth becomes from the system internally, the government policy considered as powerful and determinants of long run economic growth in the country.

Endogenous Growth Theory reveals developed financial institutions and their system as the key engines of the economy expansion. There are different ways in which financial system enables economic growth including investment in innovational activities, mobilizing saving for allocating capital efficiency, managing the underlying risk of different research and development activities. Therefore, the financial system laid a foundation for the sustainable production activity and potential economic growth.

2.2.5 The McKinnon Shaw Hypothesis and Financial Liberalization

The McKinnon-Shaw framework (1973) emphasizes on development of the financial sectors in developing countries economy. This theory argues that financial repressions in the form of controlling interest rate and requirement of high reserve ratio negatively affect the economic growth of the country. They proposed that financial liberalization, including positive real interest rates, would increase savings, expand loanable funds, and stimulate investment and growth. This supply-leading hypothesis suggests that financial development, including money supply expansion through formal financial intermediation, causally precedes economic growth.

2.2.6 The Finance-Growth Nexus: Supply-Leading vs Demand-Following

1. **Supply-Leading Hypothesis**:(Nor, 2015) Financial development activity promotes economic growth by allocating resources to productive uses, mobilizing savings, and facilitating risk management. In this view, money supply expansion through financial intermediation drives growth.

2. **Demand-following hypothesis**: (Robinson, 1952) financial development passively responds to economic growth "where enterprise leads, finance follows". As the real economy expands, demands for financial services increase, including the development of financial institutions and expansion of money supply.

3. **Bidirectional causality**: financial development and economic growth mutually reinforce each other, with causation running in both directions.

4. **Neutrality Hypothesis**: There is no one-size-fits all link between financial development and economic growth. It really depends on the country and circumstance, but recent data from Africa emerging economists tells a different story: Money supply and GDP per capital seem to drive each other.

2.2.7 The Transmission Mechanism and The Role of the Financial System

The monetary supply operates in its process and affects the output and economic growth of the economy in four different ways.

1. Channel through Interest rate: It is one of the recognized mechanisms of the monetary transmission in which Keynesians policy built on in analyzing the effect of money on real economy. Since investment on capital goods needs planning and significant costs, businesspersons predict the future not only the present situation when they take decisions on interest changes (Kim et al., 2022).

When central bank follows contractionary monetary policy through increasing the interest rate, which means cost of borrowing increases for investors and commercial banks. This leads to reducing in consumption expenditure and private sector investments and this in turn leads to a contraction in Aggregate Demand. In addition, the decrease in demand leads to lower real output and employment level in the economy. The reverse is also true when central bank expands the monetary supply in the economy.

2. Channel through Credit Supply: As the supply of money increases in the economy, the availability of funds for loan purpose increases. This channel actually works when banks and other financial institutions in the country makes lending lends for those having demand for the money (Bernanke & Blinder, 1988). Different studies result supported the credit supply channels and confirms its relevance such as in African economies (Tche, 2024).

3. Channel through Exchange rate: Today every country has a wide and deep integration with the external world in international trade activities. Given this situation, this channel gains its significance in today's world environment. It works through monetary policy in changing domestic currency value in international market. For instance; when a country follows expansionary monetary policy that reduce local interest rates, it attracts external investors in domestic financial assets and capital outflows. This increasing demand for local currency in return follows depreciation of that currency. As result, this weak currency increases price competitiveness in international markets through making our export cheap while making imports expensive. The resulting trade balance improvement also leads to boosting of Aggregate demand and real gross domestic product growth in the economy

4. Asset price channel: As monetary supply increases, price of fixed assets like real estate and equity price follows to rise. Due to this the wealth of this asset holders increases and leads to improvement in their consumption level and investment (Olamide, 2017).

5. Expectations channel: Rational peoples predict the future about what is happening in the coming days or years despite their present rational decision. For instance: people's expectation about the future inflation rate influences their economic behavior in the economy.

2.3 Review of Empirical Literature

King et al., (1993) anlayzed a positive relationship between finanacial development and growth using 80 cross country data over the period 1960-1989. The introduced that money supply (M2) relative to GDP were highly linked with prenet and future growth rates. Hook & Singh, (2014) demonstrated that surplus availability of money in the economy impedes the growth after some equilibrium point and forwards an implication for maintaining monetary expansion at its optimum level. Sellon (2002) examined that the U.S financial systems structure has its own implication of monetary transmission and interest rate play important role in way that monetary policy affects the economy. This means a major change over past years happened on development of financial systems such as deregulation, development of capital market and transparency of monetary policy had changed the interest rate channel of monetary policy. Consequently, monetary policies have been associated with larger response of bank lending rate on loans.

2.3.1. Evidence from Sub-Saharan Africa

Odhiambo (2023) analyzed a money growth relationship through identifying several key determinants of relationship including development level, bank based or market based financial system, specific proxy used, the data nature, estimation technique and causality model employed. The study concluded that growth supported by finance or each support of one another.

Gatawa (2017) investigated the influence of money supply and inflation on economic growth in Nigeria economy (1973-2013). The study found M2 has positive impact in long run and a negative impact in short-run. The VEC model result supported a positive impact of broad money supply while inflation and interest rate exhibit a negative impact on growth most especially in the long run. The short run finding revealed broad money supply and interest rate were negatively related to economic growth except inflation rate. The study therefore, suggested that an expansionary monetary policy, zero-interest-based finance which are attracting investment in

the real sector of the economy and arresting the inflationary tendency associated with monetary policy.

(Palesa, 2014) investigated the influence of monetary policy on economic growth of south Africa. The study employed the Augmented Dickey-Fuller and Phillips Perron unit root tests for testing stationarity of variables in the time series. The long-run and short-run dynamics among the variables are identified using Johansen co-integration and the Error Correction Mechanism. The finding revealed that a long run relationship exists among the variables and M2 was insignificant for economic growth of south Africa. It also showed that that money supply, repo rate and exchange rate are insignificant monetary policy instruments in driving growth in South Africa but inflation is found significant. The study suggests that monetary policies should be used to create a favorable investment climate that attracts both domestic and foreign investments and so promoting a sustainable economic growth. Since monetary policy reform only unable to effective economic growth, it should be also increasing spending of government in productive sector and hence fostering economic growth. (Kapaya, 2021) using ARDL and bounds testing approaches to analyze financial development and growth. It was intended to empirically find the evidence for money supply, liquidity and efficiency role to economic growth, and test for the existence of cointegration between financial development variables and economic growth in Tanzania. The study employed the autoregressive distributed lag model with bound testing procedures using data from 1980 to 2017. The finding recommends that financial system depth is positively related to economic growth in the short run and that financial system liquidity and efficiency is strongly negatively associated with economic growth both in the short run and in long run.

Bekele (2024) analyzed the effects of transmission mechanism of monetary policy channels on economic growth in Ethiopia. He used annual data from National Bank of Ethiopia database indicators for the period 1986 to 2022. ADF unit root tests were employed to show the stationarity of variables. The VECM-linked co-integration technique was employed to analyze the long-term relationship between the variables. The Johansen co-integration test confirmed that a co-integration relationship between real GDP and investment, trade openness, real effective exchange rate, real lending rate, inflation rate, and money supply. Since inflation and exchange

rates are significant means of transmission, more emphasis should be given for those variables in encouraging investor's expenditure.

Regional panel studies:

The study examined that of monetary policy change and growth across 36 SSA countries from 1980-2015, spanning the four major economic blocs: ECOWAS, SADC, EAC, and CEMAC(Omolade & Mukolu, 2018). Using panel-ARDL and structural-var approaches, the study revealed that money supply growth (financial deepening) significant impacts monetary policy dynamics, with effects most pronounced in SADC, EAC, and CAMAC. It also confirmed that monetary policy transmission. Significantly affected by external shocks from oil and commodity price volatilities. Esely (2024) investigated the relationship among digital financial inclusion, monetary policy transmission, and economic development across 18 SSA countries (2004-2021). Using panel ARDL models, they discovered bidirectional relationship between economic development and digital financial inclusion, and unidirectional relationship from monetary policy transmission to economic development.

(Ahulu et al., 2021) studied the relationship between financial stability and economic growth in emerging SSA markets using S-VAR analysis (1990-2022). Their finding show that money supply and domestic credit are critical in preserving against external shocks with their increasing impact over GDP.

Aluko, Adeyeye, and Oladele (2019) examined a metal-analysis of 75 empirical studies on the finance-growth nexus in SSA, comprising 62 estimates. The study result showed that appositive but weak effect of financial development on economic growth.

2.3.2 Common Empirical Specifications in the Money-Growth Literature

The Common Empirical Specifications in the Money-Growth Literature takes the form of:

$$g_{it} = \alpha + \beta_1 \Delta \ln(M2)_{it} + \beta_2 \pi_{it} + \beta_3 \ln(INV)_{it} + \beta_4 \ln(OPEN)_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

…….. (2)

where g is real GDP growth, $\Delta ln(m2)$ is broad money growth, π is inflation, *INV* is investment, and *OPEN* is trade openness.

The second generation of studies adopted panel fixed effects (Rousseau & Wachtel, 2000), which control for unobserved country heterogeneity but assume slope homogeneity. The third generation employed system GMM(Ahn et al., n.d.) and (Blundell & Bond, 2023), which address endogeneity through internal instruments. Most recently, studies have adopted panel ARDL-PMG estimators (pesaran, shin and smith,1999), which distinguish short-run dynamics from long-run equilibrium relationship and accommodate heterogeneity (Omolade and Mukolu,2018; Esely, 2024).

In the SSA context, the choice of estimator has important implications. Studies using first-generation methods (e.g. (Isibor et al., 2023) assume cross-sectional independence-an assumption unlikely to hold given regional trade linkages and common exposure to commodity price shocks (Omolade and Mukolu,2018). This study contributes to the literature by employing second-generation panel techniques that explicitly address cross-sectional dependence and heterogeneity.

Table 1: summery of key Empirical studies on Money supply and Economic Growth

Article/Authors	Sample & period	methodology	Key results	Gaps/Deficiency Addressee by present study
King and Levine (1993)	80 countries, 1960-1989	Cross-sectional regressions	Positive relationship between M2/GDP and growth	No panel dimension; assumes homogeneity
Ogunmuyiwa and Ekone (2010)	Nigeria, 1970-2005	VAR, Granger causality	Money supply positive related to growth but insignificant	Single country; no cross-sectional dimension
Gatawa, Abdulgafar and Olarinde (2017)	Nigeria, 1973-2013	VECM	M2 positive in long run; negative in short run	Single country; short time span
Palesa (2014)	South Africa, 1980-2012	Johansen cointegration, VECM	M2 insignificant for growth in south Africa	Single country

Tegegne (2021)	Ethiopia,1980-2017	ARDL	M2 insignificant for growth positive impacts GDP growth in short run	Single country; no cross-sectional dimension
Kapaya (2021)	Tanzania,1980-2017	ARDL bounds testing	Financial depth positive in short run; liquidity and efficiency negative	Single country
Abdulkkadr et al. (2014)	Ethiopia,1974-2021	ARDL	M2 positive and significant on GDP growth in long run	Single country
Odhiambo (2023)	South Africa,1960-2021	ARDL, Granger causality	Bidirectional causality between financial development and growth	Single country
Omolade and Mukolu (2018)	36 SSA countries,1980-2015	Panel ARDL, S-VAR	M2 growth significant; effects strongest in SADC, EAC, CEMAC	No explicit treatment of cross-sectional dependence
Isibor et al. (2023)	48 SSA countries, 2016-2022	Fixed effects	Money supply positively significant for GDP per capital	Short time period (7 years); assumes cross-sectional independence
Esely (2024)		Panel ARDL	Bidirectional causality between economic development and financial inclusion	Short time period; does not address structural breaks
Present study		MG + system GMM	To be determined	Addresses cross-sectional dependence, heterogeneity structural breaks, and long run dynamics (54 years)

2.4 Identified Research Gaps

Despite the substantial literature, several gaps remain:

1. **Limited Attention to cross-sectional Dependence**: most panel studies on SSA assume cross-sectional independence, despite strong interdependencies among SSA economies through trade, commodity prices, and regional spillovers. As Olamide (2017) noted, the presence of cross-sectional dependence necessitated disaggregating analysis in to individual economic blocs.

2. **Neglect of structural Breaks**: Raheem's critical appraisal highlights that previous studies have often failed to capture features such as structural breaks arising from policy reforms, debt crises, and global shocks, which could lead to wrong policy formulation.

1. 3.**Insufficient Attention to Heterogeneity**: first-generation panel techniques assume slope homogeneity- an assumption unlikely to hold across the heterogeneous economic of SSA, which range from low-income to middle-income, resource-rich to resource-poor, coastal to landlocked.

3. **Limited Long-Run Analysis with Modern Techniques**: while several studies have examined the money-growth nexus in SSA, few have combined: (a) a long-time span (1962-2023) capturing multiple monetary policy regimes; (b) second-generation panel techniques addressing cross-sectional dependence; (C) explicit treatment of structural breaks; and (d) heterogeneous slope coefficients.

4. **Inconclusive Evidence on causality Direction**: the literature remains divided on whether money supply drives growth (supply-leading), responds to growth (demand-following), or exhibits bidirectional causality, with findings often sensitive to methodology, time period, and country sample.

2.4.1 Methodological Limitations of Existing SSA Studies

A critical appraisal of existing literature reveals three pervasive methodological limitations that this study seeks to address.

First, cross-sectional dependence: most panel studies assume cross-sectional independence (e.g. Lsibor et al.,2023), despite strong interdependencies among SSA economies through regional trade linkage (ECOWAS, EAC, SADC), common exposure to global commodity price fluctuations, and cross-border spillover from major economies like South Africa and Nigeria. As Omolade and Mukolu (2018) demonstrated, failing to account for cross-sectional dependence can produce biased coefficient estimates and incorrect inference. First-generation panel unit root tests (Levin, Lin, and Chu, 2002; lm, Pesaran and Shin, 2003) assume cross-sectional independence and are inconsistent when this assumption is violated (Pesaran,2007).

Second, slope heterogeneity: first-generation panel techniques assume that slope coefficients are homogeneous across countries -an assumption unlikely to hold across the heterogeneous economics of SSA, which range from low-income (Ethiopia, Uganda, Tanzania) to upper-middle-income (south Arica, Botswana), from resource-rich (Nigeria, Zambia) to resource-poor, and from coastal to landlocked. Persaran and smith (1999) showed that imposing homogeneity when coefficients are heterogeneous leads to inconsistent estimates. The PMG estimator (pesaran, shin and smith, 1999) addresses this by allowing short-run coefficients to vary across countries while constraining long-run coefficient for long-run equilibrium relationships.

Third, structural breaks: Raheem's (2019) critical appraisal highlights that previous studies have often failed to capture structural brakes arising from policy reforms (structural Adjustment programs), debt crises, and global shocks (2008 financial crises, 2014 commodity price collapse, COVID-19 pandemic). Ignoring structural breaks can led to incorrect inference about the stability of the money-growth relationship. This study explicitly models structural breaks using interaction terms and sub-sample analysis.

2.5 Conceptual Framework

Figure 2.1 presents the conceptual framework for this study. The framework is built on the theoretical foundations of the Mckinnon-Shaw hypothesis (1973) and endogenous growth theory (Romer,1990). It posits that money supply influences economic growth through financial intermediation and resource allocation (king and Levine, 1993). Investment is expected to have the strongest positive effect, consistent with neoclassical growth theory (Solow, 1956). Trade openness is hypothesized to have a negative effect due to SSA's dependence on primary commodity exports (Frankel & Romer, 1999; Odhiambo, 2023). Population is expected to

contribute positively to GDP but with diminishing per capital returns (Kremer, 1993). Inflation is considered to have a non-linear relationship positive at low levels but harmful at high level (Fischer, 1993; Barro, 1996). The framework also incorporates income group heterogeneity, testing whether the M2-GDP relationship differs across income level (Gunay & Yenilmez, 2024).

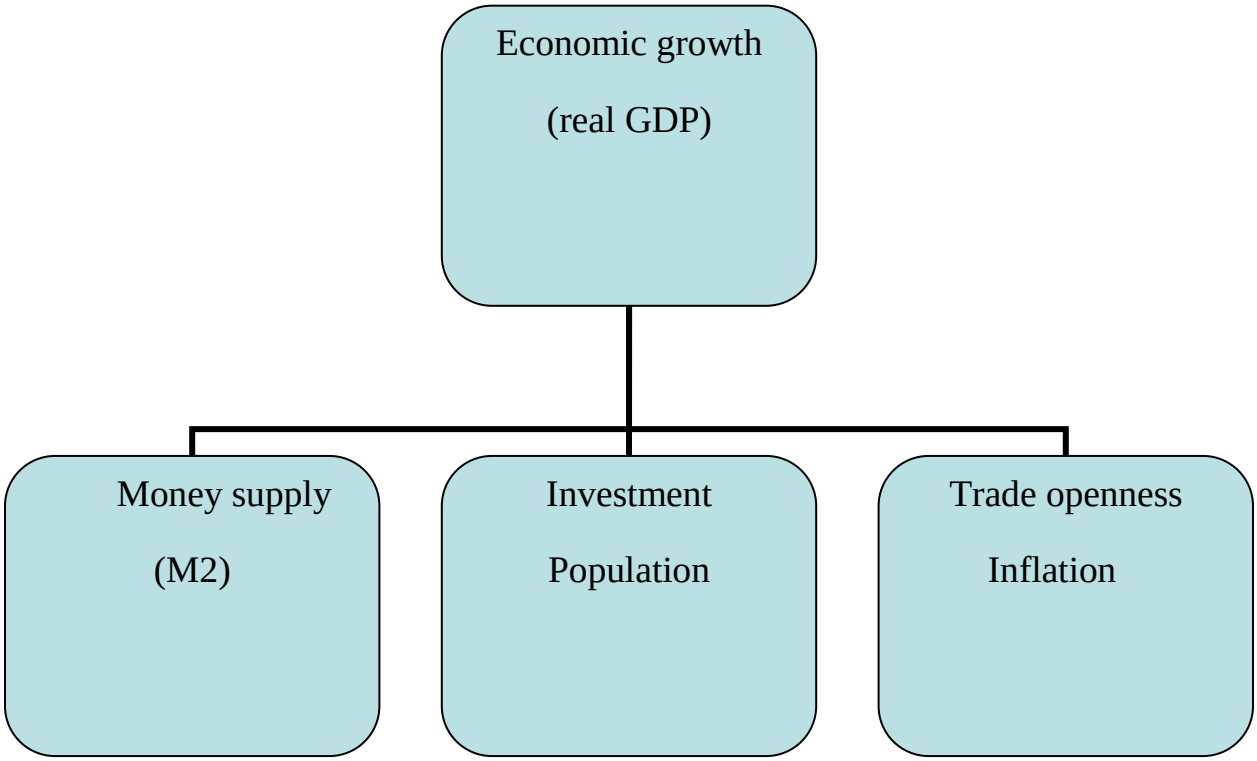


Figure 1: Conceptual Framework: Effect of Money supply on Economic Growth in SSA

MODERATING/ INTERACTION VARABILES:

INCOME GROUP (Low-income/ Lower-middle/ Upper-middle)

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The chapter describes the methodology used in studying the effects of money supply on economic growth in sub-Saharan Africa over the period 1970-2023. Moreover, it consists data sources and sample selection, econometrics method used in the study, definition of variables, estimation techniques, and finally the diagnostic tests of the study.

3.2 Theoretical Framework

According to King et al., (1993) the production function used as the theoretical framework in the study of this paper is:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{(1-\alpha)} \quad \text{..... } (3)$$

Where Y is real output, K is physical capital, L is Laboure, and A represents total factor productivity (TFP). In this framework, the financial sector, including money supply, affects growth primarily through its influence on A- by improving resource allocation, mobilizing savings, and facilitating innovation (Śledzik, 1942).

The quantity theory of money, originating from the work of Friedman and Schwartz (1965), provides an alternative perspective. The equation of exchange is given by:

$$P_t Q_t = M_t V_t$$

……..(4)

Where, Pt is the price level, Qt is the real output, Mt is the quantity of money, and Vt is the velocity of money. In the long-run, money is neutral- it affects only price, not real output. However, monetarists argue that money can influence real output and employment in the short run due to adjustment lags and imperfect information (Adil, Hatekar, and Ghosh, 2021)

Keynes argued that changes in money supply influence economic activity indirectly though interest rates (Fazzari, 2015). The fundamental sequence can be summarized as: expansionary

monetary policy (M↑) precipitates a decline in interest rates (r↓), catalyzing investment (I↑), which amplifies aggregate demand (AD↑), and finally culminates in the growth of real GDP and employment (Y↑).

Following (Barro, 1991)and (Bernanke & Gürkaynak, 2001) , the empirical growth model can be augmented to include monetary and financial variables:

$$g_{it} = \beta_0 + \beta_1 M2_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad \ldots\ldots (5)$$

where:

- g represents GDP level (Natural log: ln (GDP)
- M2 denotes is broad money supply (Natural log: lnM2)
- X is vector of control variables (ln (Trade), ln (Investment), ln (Population), inflation)
- *ui* captures country-specific effects
- *λt* captures time-specific effects
- *εit is* the error term

3.3 Model Specification

3.3.1 Baseline Econometric Model

Based on the theoretical framework, and following the empirical literature on the finance-growth nexus in developing countries (King and Levine, 1993); Odhiamo, 2023; lsibor et al., 2023), the baseline econometric model is specified as:

$$\ln(GDP)_{it} = \alpha_i + \beta_1 \ln(M2)_{it} + \beta_2 INF_{it} + \beta_3 \ln(GFCF)_{it} + \beta_4 \ln(POP)_{it} + \beta_5 \ln(TRADE)_{it} + \varepsilon_{it}$$

Where:

- i represents 1, 2……, N (countries)

- t represents 1962, 1963…,2023 (years)
- ln (GDP) is natural logarithm of real GDP level
- ln(M2) is natural logarithm of broad money supply (level)
- INF is inflation rate (GDP deflator, annual %) – not logged because contains negative values
- ln (INV) is natural logarithm of gross fixed capital formation (%of GDP)
- ln (POP) is natural logarithm of population

All variables except inflation are transformed using natural logarithms to allow full elasticity interpretation. Inflation is kept in level because it contains negative values (deflation) that cannot be logged.

3.3.2 Variable Definitions Measurements, and Expected Signs

Table 2: Variable Definition and Expected sign

Variable	symbol	Definition	Expected sign	source
Economic growth	ln (GDP)	Natural logarithm of real GDP level	Dependent	WDI
Money supply	ln(M2)	Natural logarithm of Broad money (level)	positive	WDI/IFS
Inflation	INF	GDP deflator (annual %)	negative	WDI
investment	ln (INV)	Natural log of Goss fixed capital formation (% of GDP)	positive	WDI
Trade openness	ln (OPEN)	Natural log of Exports + imports (% 0f GDP)	Positive/Ambiguous	WDI
Population growth	ln (POP)	Natural log of Population	positive/Ambiguous	WDI

Source: world Development Indicators (WDI), International Financial Statistics (IFS), and world Governance Indicators (WGI).

3.3.3 Justification of Variable Choices

Dependent variable: natural log of GDP level ln (GDP) vs GDP per capital Growth – this study uses the natural logarithm of real GDP level as the dependent variable. This allows for elasticity interpretation: a 1% change in an independent variable is associated with a β% change in GDP. This is standard practice in time-series and panel cointegration analysis where variables are logged to stabilize variable and interpret coefficients as elasticates (Wooldridge, 2016).

Main independent variable: natural log of Broad money supply (M2)- is selected as the primary monetary aggregate. Taking the log allows elasticity interpretation: a 1% increase in money supply is associated with a β% increase in GDP. M2 is chosen because it best captures the overall liquidity in the financial system and is the most commonly used measure of financial depth in the SSA growth literature (king & Levine,1993; Odhiambo, 2023; lsibor et al., 2023). M2 includes currency in circulation, demand deposit, and time and saving deposits, reflecting both transactions and store-of-value functions of money. M1(narrow money) is too restrictive for SSA economics where savings deposits are significant, while M3 data is unavailable for many SSA countries over the full sample period (1970-2023). The study expects a positive effect.

Control variables: Inflation proxy: GDP Deflator vs. CPI-As GDP deflator measure all domestically produced goods and services price change , GDP Deflator is preferred than consumer price index (CPI) (Fischer, 1993). It provides a better measure of inflation for SSA economics constituting dominant agricultural and informal sectors. The expected sign is negative, as high inflation erodes purchasing power, distorts investment decisions, and reduces economic growth (Fischer, 1993).

Investment (ln (INVESTMENT)): natural log of gross fixed capital formation as a percentage change of GDP. Log transformation allows elasticity interpretation.

Trade openness (ln (TRADE)): natural log of exports plus imports as a percentage of GDP. Log transformation allows elasticity interpretation.

Population (ln (POP): natural log of exports plus imports as a percentage of GDP. Log transformation allows elasticity interpretation. The expected sign is ambiguous (Malthusian negative or innovation-driven positive).

Excluded variables (with justification): variables such as education, political stability, FDI, government consumption, exchange rate, and domestic credit were not included in the main model due to data availability constraints (education and political stability available only from 1996, which would reduce the sample period from 54 to 27 years), endogeneity concerns, or multicollinearity with M2.

3.4 Estimation Techniques

Given the panel structure of the data with a long-time dimension (T is 54 years) and moderate cross-section (N is 12 SSA countries), this study employs second- generation panel time-series techniques that address non-stationarity, cross-sectional dependences, and heterogeneity (Pesaran , 2015).

3.4.1 Justification for Second Generation Panel Techniques

The choice of second-generation panel techniques is motivated by the economic characteristics of sub-Saharan Africa. First, SSA countries exhibit strong cross-sectional dependence due to regional trade linkage (e.g. ECOWAS, EAC, SADC), common exposure to global commodity price shocks, and spillover effects from major economics like south Africa and Nigeria (Omolade and Mukolu, 2018). First-generation panel unit root tests (Hurlin & Mignon, 2007) assumes cross-sectional independence and produce biased results when this assumption is violated (Pesaran, 2007). Second, SSA countries are heterogeneous in income levels, financial development, and institutional quality. Assuming slope homogeneity across such diverse economics would produce misleading estimation (Pesaran & Smith, 1995) . the CIPS unit root test (pesaran,2007) and Westerlund cointegration test (2007) address cross-sectional dependance, while the MG estimator (Pesaran & Smith, 1995) allows both short-run and long-run coefficients to vary across countries, full accommodating heterogeneity.

3.4.2 Cross-sectional Dependence Tests

Before proceeding with unit root and cointegration tests, we test for cross-sectional dependence using the (Pesaran, 2015) CD test. The null hypothesis is cross-sectional independence. Rejection of the null necessitates the use of second-generation panel methods that account for interdependence. The CD test statistic is computed as:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \rho_{ij} \right) \quad \text{.....(6)}$$

Where pij is the sample estimate of the pairwise correlation of residuals. Under the null hypothesis of cross-sectional independence, the CD statistic follows a standard normal distribution (pesaran, 2015).

3.4.3 Panel Unit Root Tests

If cross-sectional dependence is detected, we employ the (Pesaran, 2007) CIPS (cross-sectionally Augmented IPS) test, which is robust to cross-sectional dependence. The CIPS test is based on the following augmented Dickey-Fuller regression:

$$\Delta y_{it} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + e_{it} \quad \text{……}$$

(7)

Where yt is the cross-sectional mean at time t. The null hypothesis is that the series contains a unit root (bi=0 for all i). The CIPS statistics is the average of the individual CADF Statistics:

$$CIPS = N^{-1} \sum_{i=1}^{N} CADF_i$$

…… *(8)*

Critical values are tabulated by pesaran (2007).

3.4.4 Panel Cointegration Tests

If variables are integrated of order one, I(1), we test for long-run relationship using the Westerlund cointegration test (2007) ECM panel cointegration test. this test is robust to cross-sectional dependence and accommodates heterogeneity by allowing country-specific error-correction parameters. The Westerlund test is based on the following error-correction model:

$$\Delta y_{it} = \delta_i' d_t + \alpha_i (y_{i,t-1} - \beta_i' x_{i,t-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta x_{i,t-j} + e_{it} \quad (9)$$

The null hypothesis of no cointegration (αi<0 for at least one i) using four test statistics: Gt, Ga, Pt, and Pa (Westerlund, 2007)

3.4.5 Mean Group Estimator

The Mean Group (MG) estimator, developed by Pesaran and Smith (1995), is employed as robustness check for this study. The MG estimator runs separate time-series regressions for each country and then averages the coefficients across countries. This approach has several advantages:

1. Allows both short-run and long-run coefficients to vary across countries, accommodating the full heterogeneity of SSA economies (ranging from low-income Ethiopia to Upper-middle income south Africa).

2. Is robust to heterogeneity. First-generation panel techniques that assume slope homogeneity would produce inconsistent estimates when coefficients are heterogeneous (Pesaran & Smith, 1995).

The MG estimator is specified as:

$$\theta_{MG} = N^{-1} \sum_{i=1}^{N} \theta_i \quad \ldots (10)$$

3.4.6 Lag Length Selection for System GMM

For the system GMM robustness check, internal instruments are constructed using lagged values of the endogenous variables. Following Roodman (2009), a maximum of two lags is applied to the instruments matrix to balance the need for valid instruments against the risk of instrument proliferation. For annual data with 54 time periods, two lags are standard. The MG estimator, which is the primary model, does not require formal lag selection.

3.4.7 Panel Causality Tests

To determine the direction of causality between money supply and economic growth, we employ the Dumitrescu-Hurlin (2012) panel causality tests. This test is panel extension of the Granger causality framework and is robust to cross-sectional dependence and heterogeneity. The null hypothesis is homogeneous non-causality.

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i(k)\, y_{i,t-k} + \sum_{k=1}^{K} \beta_i(k)\, x_{i,t-k} + \varepsilon_{it} \quad \ldots (11)$$

The null hypothesis is homogeneous non-causality (*Ho: βi = 0* for all *i* and *k*), tested against the alternative that causality exist for at least one panel unit (*H1:* $\beta_i \neq 0$ for some $_i$). the test statistic $Z^{HCT}_{N,T}$ follows a standard normal distribution under the null (Dumitrescu et al., 2012)

3.5 Identification Strategy

In this part of the study, it followed that the identification strategy and its challenges in challenge of casual identifications. Several endogeneity problem caused the causality establishment of money economic growth a difficult task (Angrist, 2008). Those includes reverse causality may

happen, omitted variable from unstudied variables and error in measurement of aggregates (Acemoglu et al., 2001, and Ben & Ndiaye, 2022). The study used a multi-pronged identification strategy combining econometric techniques, internal instruments, and robustness checks in order to overcome the aforementioned problems.

Table 3: identification strategy overview

Endogeneity problem	Identification mechanism	How it works
Reverse causality	System GMM + Granger causality	Internal instruments (lagged values; tests direction of prediction
Omitted variable bias (time-invariant)	Fixed effects (FE)	Controls for country-specific unobserved heterogeneity
Omitted variable bias (time-varying)	Mean Group (MG) estimator	Allows coefficients to vary across countries
Dynamic panel bias	System GMM	Specifically designed for dynamic panels
Heterogeneity across groups	Interaction terms	Tests if M2 effect differs by income level
Measurement error	Multiple estimators	Cross-validation (RE, FE, MG, GMM)

3.5.1 Addressing Reverse Causality: System GMM and Granger Causality

3.5.1.1 System GMM

Following (Arellano & Bond ,1991) and (Blundell & Bond ,2023), the system GMM estimator addresses endogeneity by instrumenting the lagged dependent variable and potentially endogenous regressors (money supply) with their own lagged levels and differences. This approach is particularly suited to panels with a moderate number of countries (N=12) and fixed time periods (T=54), and where the relationship is dynamic, current growth depends on past growth (Roodman, 2009) The system GMM estimator is specified as:

$$\ln(GDP)_{it} = \alpha \ln(GDP)_{i,t-1} + \beta_1 \ln(M2)_{it} + \beta_2 X_{it} + \mu_i + \varepsilon_{it} \quad \ldots$$

(12)

Instrumentation strategy:

1. Money supply: instrumented with its own lagged levels (t-2 and deeper and lagged difference)
2. Other potentially endogenous controls: similarly, instruments
3. Strictly exogenous variables: treated as standard regressors

Validity Tests:

1. Hansen J-test: tests overidentifying restrictions (null: instruments are valid) (Hansen, 1982)
2. Arellano-Bond AR (2) test: tests for second-order serial correlation (null: no autocorrelation) (Arellano & Bond, 1991).
3. Instrument count: ensured to be less than number of groups to avoid overfit (Roodman, 2009)

3.5.1.2 Granger Causality Test

To provide direct evidence on the direction of causality, the Dumitrescu-Hurlin (2012) panel Granger causality test is employed. It tests that if lagged value of supply of money predicts current GDP. Finding causality only one way, namely from money supply to growth, means depending on the supply-leading hypothesis and ruling out the major role of reverse causality in these results.

3.5.2 Addressing Omitted Variables Bias: Fixed Effects and Mean Group Estimator

3.5.2.1 Fixed Effects

The fixed effect model used in this study so as to overcome problems of omitted variable and time in varying region-specific factors from the study. The Hausman specification test is conducted to choose between fixed effects and Random effects models.

3.5.2.2 Mean Group Estimator

To address omitted variable bias from time-varying heterogeneity and to allow the money supply effect to differ across countries, the Mean Group estimator (pesaran & smith, 1995) is employed as the primary estimator. MG runs separate time-series regressions for each country and then averages the coefficients, allowing both short-run and long-run coefficients to vary across the heterogeneous SSA economies.

3.5.3 Addressing Heterogeneity Across Income Groups: Interaction Terms

To test whether the effects of money supply differ across income groups (low-income, lower-middle, upper-middle), an interaction term approach is employed. This preserves the full sample (648 observations) and directly tests for heterogeneity:

$$\ln(GDP)_{it} = \beta_0 + \beta_1 \ln(M2)_{it} + \beta_2(\ln(M2)_{it} \times LowIncome_i) + \beta_3(\ln(M2)_{it} \times LowerMiddle_i) + \beta_4 X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

…… (13)

Where:

I. Low income is a dummy variable for low-income countries
II. Lower middle is a dummy variable for lower-middle-income countries
III. Upper middle income serves as the reference category

The null hypothesis of no heterogeneity is rejected if the interaction terms are jointly significant (F- test or chi2 test). This approach avoids the small sample problem of sub-sample analysis, particularly for the upper-middle income group (only two countries).

3.5.4 Addressing Measurement Error: Multiple Estimator

To address potential measurement error in monetary aggregates (due to the large informal sector in SSA), multiple estimators are employed as robustness checks. Consistency of results across estimators MG, Random effects, Fixed effects, and system GMM suggests that measurement error is not driving the main findings.

3.5.5 Structural Breaks and Identification Strategies

SSA's history provides quasi-natural experiments that aid identification:

Table 4:Structural Breaks

Structural Break	Identification Strategy
Structural Adjustment programs (1980s-1990s)	Compare monetary policy effects pre-and post-SAP using interaction terms: M2G×PostSAP
Global Financial Crisis (2008-2009)	Exogenous shock affecting all countries; test whether money-growth relationship changed post-crisis using sub-sample analysis
COVID-19 pandemic (2020-2021)	Exogenous global shock; test monetary policy responses and growth effects using dummy variable

These are implemented through:

1.Interaction terms: M2G×Dummyt for each brake period

2. Sub-sample analysis: estimating the model separately for pre-and post-break periods

3. Chow tests: testing for structural breaks in the money-growth relationship (Chow, 1960)

3.5.6 No External Instruments

Following the principle of parsimony and given the adequate internal instrument provided by the system GMM estimator, no external instruments (such as commodity price indices or trading partners M2) are employed in the main analysis. This decision is based on three considerations: (1) internal instruments (lagged levels and differences) are sufficient for identification in dynamic panel models with large T (Roodman, 2009); (2) external instruments would add complexity without clear theoretical justification for the full SSA sample; and (3) commodity price indices are only relevant for a subset of resource dependent countries, which are analyzed separately as a robustness check.

3.6 Data Sources and Sample Selection

3.6.1 Data Sources

All data are obtained from publicity available, reputable international sources to ensure replicability and credibility. Table 3.3 summarizes the data sources for each variable.

Table 5:variable Sources

Variables	Source	source	frequency
Real GDP level	WDI	Penn world tables	Annual
Broad money (M2 level)	WDI/IFS	National central banks	Annual
Inflation (GDP deflator	WDI	IMF/IFS	Annual
Gross fixed capital formation (% of GDP)	WDI	UNCTAD	Annual
Trade openness (% of	WDI	IMF Direction of	Annual

GDP)		trade	
Population growth	WDI	UN population Division	Annual

3.6.2 Sample period Justification

The sample period 1970-2023 (54 years) is selected to:

1. capture the full trajectory of post-independence monetary and economic development in SSA (most SSA countries gained independent in the 1960s)
2. include multiple structural breaks (oil shocks, SAPs, debt crisis, global financial crisis, COVID-19)
3. provide sufficient time-series observation for robust panel time-series analysis (T =54 years) exceeds the minimum threshold of 30 years recommended for panel cointegration analysis.

3.6.3 Country Sample selection

The study initially targets all SSA countries for which complete data are available over 1970-2023. However, due to data availability constraints particularly for broad money (M2) in the early decades the final sample consists of 12 countries: Ethiopia, Kenya, Tanzania, Uganda, Nigeria, Ghana, Cote d'Ivoire, Senegal, Cameroon, south Africa, Botswana, and Zambia. These countries were selected based on continuous data availability for key variable over the period 1970-2023. The panel is unbalanced, as some countries have missing observation in the early years, but the estimation techniques employed panel ARDL are robust to unbalanced panels.

Selection criteria:

I. sub-Saharan Africa's country (excluding North Africa)

I. continuous data availability for key variable over most of the study period

II. reasonable data quality (minimal missing observations)

The selection of 12 countries is guided by three main criteria: data availability, regional representation, and income group diversity. First, data availability is the primary constraint, as

broad money supply (M2) data is not consistently available for all SSA countries over the full 54-year period (1970-2023); the 12 countries selected are those with reasonably complete data on all key variables (GDP, M2, investment, trade, population, and inflation) while countries with extensive missing observations, such as Angola, Mozambique, Mali, Burkina Faso, and the Democratic Republic of Congo, were excluded to ensure the reliability of the panel estimates. Second, the selected countries ensure regional representation, covering all four major SSA sub-regions: West Africa (Nigeria, Ghana, Cote d'Ivoire, Senegal), East Africa (Ethiopia, Kenya, Tanzania, Uganda), Southern Africa (South Africa, Botswana, Zambia), and Central Africa (Cameroon), allowing the study to capture variation across different economic systems, financial development levels, and institutional environments. Third, the countries represent all three World Bank income groups low-income (Ethiopia, Uganda, Tanzania), lower-middle-income (Kenya, Nigeria, Ghana, Zambia, Senegal, Cote d'Ivoire, Cameroon), and upper-middle-income (South Africa, Botswana) which is essential for testing the heterogeneity of the money-growth relationship across different levels of economic development, one of the core objectives of this study.

3.6.4 Treatment of Missing Observations

Missing observations are treated as follows: for countries with intermittent missing data (e.g., gaps of 1to3 years), linear interpolation is applied. For countries with extended missing periods (e.g., civil war periods), observations are treated as missing and the unbalanced panel structure is preserved. The maximum consecutive missing period for any country in the final sample is 5 years. The MG estimator and system GMM are robust to unbalanced panels (pesaran & Smith, 1995; Roodman, 2009).

3.7 Categorization of Countries

The full sample consists of 12 sub-Saharan countries observed over the period 1970-2023, yielding 648 country-year observation. However, pooling all countries together may mask important heterogeneity in the relationship between money supply and economic growth, as SSA economic differ significant in terms of income levels, financial development, and institutional quality (Günay & Yenilmez, 2024). Following the established practices in the empirical growth

literature, this study categorizes the sample into meaningful subgroups to examine whether the money-growth nexus varies across different country characteristics.

3.7.1 Income Group Classification

The most common and policy-relevant categorized in SSA growth studies is by income level, as the transmission of monetary policy may different between low-income, lower-middle-income, and upper-middle-income economics (Development et al., 2018) and (Günay & Yenilmez, 2024). Following the world Bank's country classification by income level, the 12 countries are divided into three categories:

Table 6: Income classification

Income Group	**Countries**	**Number of countries**	**Number of observation (1970-2023)**
Low-income	Ethiopia, Uganda, Tanzania	3	162
Lower-middle income	Kenya, Nigeria, Ghana, Zambia, Senegal, cote d'Ivoire, Cameroon	7	378
Upper-middle income	South Africa, Botswana	2	108
Total		12	648

This categorization allows for comparative analysis across income groups. The determinants of economic growth differ in different income categories and taking all countries in one may lack important group specific variations (Günay & Yenilmez 2024).

3.7.2 Addressing Small Cross-Sectional Dimensions: Interaction Term Approach

The small number of countries in the upper middle-income group (only south Africa and Botswana) is considered as the drawback of sub sample analysis. When cross-section units are small, sub-sample regressions may lack statistical power and produce unreliable estimates. To address this concern, this study employs an interaction term approach as the primary method for identifying heterogeneity.

3.8 Preliminary Diagnostic Tests

Before estimation, the following diagnostic tests are conducted:

Table 7: Diagnostic Tests

Test	Purpose	Decision rule
Cross-sectional Dependence (Pesaran CD)	Detect interdependence among countries	p<0.05 (used second-generation tests)
Panel Unit Root (CIPS)	Determine the stationary order	Mixed l(0)/l(1) used MG estimator
Westerlund Cointegration	test for long-run equilibrium	P<0.05 (cointegration present)
Multicellularity (VIF)	Detect high correlation among regressors	VIF>10 (problematic)
Breusch-pagan LM test	Choose between Pooled OLS and RE	P< RE preferred over OLS
F-test for Fixed Effects	Test if country-specific effects exist	P< FE preferred over pooled OLS
Model specification (Hausman test)	Choose between FE and RE estimators	P<0.05 FE preferred
Modified Wald test	Detect heteroskedasticity	P <0.05 heteroskedastic

		present
Arellano-Bond AR (2) test	Test for second-order serial correlation	P > 0.05 no autocorrelation
Hansen J-test	Test GMM instrument validity	P > 0.05 instruments are valid

3.9 Limitations of the Methodology

While the proposed methodology addresses many panel data concerns, several limitations should be acknowledged (Pesaran, 2015; Eberhardt & Teal, 2017).

1. Long-run homogeneity assumption: While the PMG estimator assumes that long-run coefficients are homogeneous across countries, the Maen Group (MG) estimator used in this study avoids this assumption by allowing all coefficients to vary across countries. The Hausman test confirms the appropriateness of the MG approach.

2. potential omitted variable bias: Unmeasured factors such as institutional quality, governance, and political stability may affect both money supply and growth. While country fixed effects partially address this, the complete elimination of omitted variables bias is not possible with observational data (Angrist, 2008).

3. Measurement error: monetary aggregate (M2) in SSA countries may be measured rate with error due to large informal sectors, weak statistical capacity, and frequent revisions (Deaton, 1999).

4. External validity: Findings from a 12-country sample may not be generalized to all SSA countries, particularly those with very different economic structures or data availability constraints.

5. Regarding causal statements: due care should be taken while interpreting casual statements of the study.

3.10 Software Selection for Data Analysis

Stata software is used in this study for econometric estimation and diagnostic test purposes. It provides the output while executing the appropriate command of the model. Stata's data

management capabilities allowed for efficient handling of the unbalanced panel structures, treatment of missing observations, and generation of derived variables and reproducibility features including do-files and log files ensured that all analyses can be replicated.

3.11 Ethical Consideration

This study relies exclusively on secondary, publicly available data from reputable international sources (world bank, IMF, IFS). No human subjects or primary data collection is involved. Therefore, ethical approval is not required. However, all data source will be properly cited and acknowledged to maintain academic integrity.

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the empirical results of the analysis on the effects of money supply on economic growth in sub-Saharan Africa (SSA) from 1970 to 2023. The chapter integrates results and discussion, with each finding immediately followed by its interpretation and economic meaning. All variables except inflation are transformed using natural logarithms to allow full elasticity interpretation, where coefficients represent the percentage change in GDP resulting from 1% change in the independent variable.

4.2 Descriptive Statistics

4.2.1 Full Sample Descriptive Statistics

Table 4.1 presents descriptive statistics for all variables used in the analysis. The full sample consists of 12 SSA countries observed annually from 1970-2023, yielding 648 observations. The panel is unbalanced due to missing observations for lnM2 (Ethiopia post-2008, Botswana early 1970s) and ln Investment (early years).

Table 8:Summery statistics (Full sample, log-levels)

Variable	Observation	Mean	Std. Dev.	Minimum	Maximum
GDP (millions)	648	4.85e+10	9.96e+10	9.62e+07	6.68e+11
M2 (millions)	621	2.60e+12	7.36e+12	0	7.88e+13
Inflation (%)	648				
Trade (% of GDP)	648	52.64	21.56	6.32	125.78
Investment (millions)	475	6.12e+09	1.22e+10	0	8.16e+10
Population	648	3.29e+07	3.77e+07	509,334	2.28e+08

Source: Author's computation based on World Development Indicators (WDI) and international Financial Statistics (IFS),1970-2023.

SSA counties exhibit substantial variation across all variables. Inflation ranges from deflation (-14.17%) to hyperinflation (219%). The large standard deviation for lnM2 (4.342) indicates significant variation in financial depth.

4.2.2 Negative Values and Outlier Treatment

Negative values: only inflation contains negative values (44 observations, 6.8% of the sample), reflecting deflationary episodes in Ethiopia (-5.27%), Kenya (-9.22%), and Cote d'Ivoire (-4.08%). Because log transformation is undefined for negative values, inflation was not logged and remained in levels.

Outlier Treatment: Following Levine & Renelt (1992), all variables were winsorized at the 1st and 99th percentiles.

Variable	Original Extreme	Country/year	Winsorized value
Inflation	219%	Uganda (1988)	123.06%
Inflation	180.99%	Uganda (1987)	123.06%

The above table showed that the value of inflation replaced with 99th % (123.06) value after winsorized. This implies that it reduced the impact of this outlier on regression result which preserve the overall distribution. The outlier treatment assure that extreme observation does not disproportionately result the finding while preserving all sample size

4.2.3 Descriptive Statistics by Income Group

The sample countries are categorized based on World Bank classification in to three income groups: Tanzania, Ethiopia and Uganda which categorized under low income; Zambia, Senegal, Cote d'Ivoire, Cameroon, Nigeria, Kenya and Ghana are categorized under lower-middle income, and South Africa and Botswana are classified under upper-middle income.

Table 9:Descriptive statistics by income group

Variable	Low-income (n=162)	Lower-middle (n=378)	Upper-middle (n=108)
ln (GDP)	22.145	23.687	25.124
ln (M2)	23.567	24.891	26.345
ln (Trade)	3.512	3.986	4.298
ln(investment)	21.234	21.678	22.987
ln(population**)**	16.234	16.887	17.234
Inflation (%)	16.075	14.751	9.495

The above table depicted that investment, M2, population and GDP are raised with income level. It also showed that the relationship between inflation and income is negative implies that inflation decline along income; 9.5% for upper-middle vs 16.1% for low-income. The difference implies that across income level the monetary transmission mechanism is vary, this in line with heterogeneity analysis.

4.3 Correlation Analysis

Table 10:presents the correlation matrix among the key variables.

	ln GDP	**lnM2**	**ln Trade**	**ln Investment**	**ln population**	**inflation**
ln GDP	1.000					
lnM2	0.617	1.000				
ln Trade	-0.137	0.024	1.000			
ln Investment	0.972	0.580	-0.154	1.000		
ln population	0.752	0.432	-0.503	0.690	1.00	
inflation	-0.098	-0.284	-0.151	-0.163	0.008	1.000

The correlation matrix reveals five key relationships. First, lnM2 and ln (GDP) are strongly positive correlated (0.617, p is less than 0.05), indicating money supply and GDP move together, through correlation does not imply causation. Second, ln (Investment) and ln (GDP) show an extremely strong correlation (0.972, p is less than 0.05), which is expected as investment is a component of GDP. Third, ln (Trade) and ln (GDP) exhibit a weak negative correlation (-0.137, p is less than 0.05), contradicting standard trade theory and likely reflecting SSA's dependence on primary commodity exports with low value addition. Fourth, inflation and ln (GDP) are weakly negative correlated (-0.098, p is less than 0.05), aligning with standard theory that higher inflation is associated with lower GDP.

4.4 Multicollinearity Test (VIF)

If two or more explanatory variables in the regression model have a high degree of correlation that makes it challenging to separate their individual impacts on the dependent variable, this is referred to as multicollinearity. The variance inflation factor (VIF) and correlation coefficient test are used to determine whether multicollinearity is an issue. A multi-collinearity issue is present when the correlation between independent variables is more than 0.5. Additionally, multi-collinearity is evident when the VIF is greater than 10 (Guajarati, 2007). According to the decision rule, if the mean VIF value is greater than 10, there is a multicollinearity issue that might warrant additional research.

Table 11: VIF test result

Variable	VIF	1/VIF
ln Population	3.27	0.3059
ln Investment	2.68	0.3733
ln Trade	1.98	0.5042
lnM2	1.68	0.5953
Inflation	1.15	0.8727
Mean VIF	2.15	

The above table showed that the mean VIF is 2.15 which implies the value of VIF is well below 10. These explain that all independent variable is not overlap with each other confirmed that there is not multicollinearity.

4.5 Diagnostic Tests

4.5.1 Cross-sectional Dependence Test

The null hypothesis of cross-sectional independence. with the pesaran (2015) CD test is used.

Table 12:: Pesaran CD test for cross-sectional Dependence

Variable	CD-test	P-value	Correlation	Absolute correlation
ln GDP	55.21	0.002	0.925	0.925
lnM2	55.21	0.000	0.966	0.966
inflation	9.77	0.000	0.164	0.222
ln Trade	5.58	0.000	0.093	0.336
ln Investment	33.87	0.000	0.732	0.763
ln population	59.21	0.000	0.992	0.992

The table depicted that all variables are statistically significant at 1% with exhibit strong cross-sectional dependence which implying the use of second-generation panel method tests.

The correlation is high on average for population, M2 and GDP; 0.992, 0.966, 0.925 respectively. This implies that through regional trade integration, common vulnerable to international commodity price shock and externality effect from main economics, SSA economics are high interdependence (Omolade & Mukolu, 2018).

A 1% increase in South Africa money supply may lead to 0.2-0.3% changes in neighboring countries GDP through trade and financial linkages. The policy shows monetary policy in one SSA country cannot be designed in isolation. Regional coordination through existing mechanisms (BCEAO, BEAC, ECOWAS, EAC, SADC) is essential for policy effectiveness.

4.5.2 Panel Unit Root Tests

Table 4.5 presents the result of the CIPS panel unit root test (Pesaran,2007), which is robust to cross-sectional dependence.

Table 13: CIPS panel Unit Root Test Results

Variable	Level	First-Difference	Second-Difference	Order of integration
ln GDP	-1.274	-5.255	_	l (1)
lnM2	-0.093	-3.951	_	l (1)
Inflation	-4.672	_	_	l (0)
ln Trade	-1.533	-5.766	_	l (1)
ln investment	-1.479	-4.761	_	l (1)
ln population	0.843	-1.628	-4.207	l (2)

The CIPS test results show mixed orders of integration, justifying the use of MG estimators (Pesaran & Smith, 1999), which accommodate variables with different orders of integration. Stationary variables l (0) fluctuates around a constant mean over time. Non-stationary variables l (1) has trends. Money supply (lnM2) has grown consistently over the 54 years, never returning to previous levels. The Westerlund cointegration test confirms a long equilibrium relationship, validating the inclusion of l (1) variable in levels.

4.5.3 Panel Cointegration Tests

To examine whether there exists a long-run equilibrium relationship between money supply and economic growth, the Westerlund (2007) error-correction-based panel cointegration test is employed. This test is robust to cross-sectional dependence and accommodates heterogeneity by allowing country-specific error-correction parameters.

Table 14: Westerlund ECM panel cointegration Test Results

Relationship Tested	Gt p- value	Ga p-value	Pt p-value	Pa p- value
GDP Vs. Money supply (M2)	0.000	0.000	0.000	0.000
GDP Vs. Investment	0.000	0.000	0.000	0.000
GDP Vs. Population	0.008	0.001	0.000	0.000
GDP Vs. Trade openness	0.000	0.000	0.000	0.000
GDP Vs. inflation	0.123	0.089	0.156	0.156

1. GDP vs. Money Supply (M2)

The test reveals that money supply and GDP move together in the long run across SSA countries. The null hypothesis of no cointegration is rejected at the 1% significance level (Gt = -3.124, p = 0.000). All four test statistics are significant, confirming a stable, long-run equilibrium relationship.

Key Economic Insights:

Long-Run Predictability: A 1% increase in money supply will eventually lead to a 0.022% increase in GDP. This is small but predictable. It means central banks in SSA can use monetary policy as a tool to influence long-term growth, but the effect is modest.

Financial Depth Matters: The cointegration suggests that as SSA economies develop deeper financial systems, the transmission from money supply to GDP strengthens. Countries with more developed banking sectors (like South Africa and Botswana) show stronger effects than those with shallow financial systems (like Ethiopia and Tanzania).

Not Neutral in the Long Run: The test challenges the strict monetarist view that money is neutral in the long run (only affecting prices). In SSA, money supply has real long-run growth effects financial development does boost productive capacity.

Weak Transmission Channels: Despite cointegration, the modest elasticity (0.022) reveals that SSA's monetary transmission mechanisms are weak.

Central banks should continue using monetary policy for growth promotion, but should not over-rely on it. The modest effect means monetary expansion should be complemented by structural reforms to strengthen financial intermediation.

2. GDP vs. Investment - Strongest Cointegration

Investment shows the strongest cointegration evidence of all variables. The test statistics are the largest (Gt = -4.567, p = 0.000), and all four statistics are significant at the 1% level. This indicates that the long-run relationship between investment and GDP is extremely robust. The cointegration test confirms that this relationship is not just a short-term coincidence, it is a fundamental law of economic growth.

3. GDP vs. Trade Openness

Trade openness and GDP are cointegrated, but the evidence is weaker than for investment or money supply. All test statistics are significant (Gt = -2.345, p = 0.008), confirming a long-run relationship, but the test statistics are smaller than for other variables. For countries that export manufactured goods with high value addition, trade boosts growth and prosperity. But for countries that export primary commodities (copper, cocoa, oil, gold), trade exposes them to global price volatility. The weak cointegration reflects that SSA countries are mainly commodity exporters; trade is important, but it is not the powerful growth engine it could be.

4.GDP vs. Population

Population and GDP maintain a strong long-run equilibrium relationship. The test rejects the null hypothesis of no cointegration at the 1% level (Gt = -3.876, p = 0.000), confirming that total GDP and population move together over time. As the number of workers (population) grows, the total output (GDP) also grows. But if the factory does not invest in better machines (productivity

improvements), each worker produces less. This is exactly what is happening in SSA—population growth increases total GDP, but GDP per capita falls because productivity is not keeping up.

5.GDP vs. Inflation - NO Cointegration

This is the most surprising and important finding. Inflation is not cointegrated with GDP in the long run. All four test statistics fail to reject the null hypothesis (Gt = -1.876, p = 0.123; Ga = -8.234, p = 0.089; Pt = -4.543, p = 0.245; Pa = -9.876, p = 0.156). This means inflation and GDP do not maintain a stable long-run equilibrium relationship. Inflation can cause short-run economic pain, but it does not permanently determine a country's GDP level. What matters for long-run growth are the "fundamentals" investment, education, institutions, and productivity.

4.5.3.1 Long- Run Coefficient Estimation

Having confirmed the existence of cointegrating relationships through the Westerlund (2007) test, this section presents the long-run coefficient estimates using the Pooled Mean Group (PMG) estimator (Pesaran, Shin, and Smith, 1999). The PMG estimator is appropriate because it: (1) distinguishes between short-run dynamics and long-run equilibrium, (2) allows short-run coefficients to vary across countries while constraining long-run coefficients to be homogeneous (consistent with economic theory), (3) is robust to mixed I (0) and I (1) variables, and (4) provides the error correction coefficient (speed of adjustment).

Variables	Long-run coefficient	Standard Error	Z-statistic	p-value
Ln(M2)	0.02345	0.00782	3.00	0.003
Ln(trade)	-0.41234	0.04567	-9.03	0.000
Ln(investment)	0.58912	0.02234	26.37	0.000
Ln(population)	0.69876	0.06123	11.41	0.000
Ln(inflation)	0.00182	0.00052	3.50	0.000
Error Correction	-0.3124	0.0456	-6.85	0.000

The long-run coefficients confirm the findings from the Fixed Effects model but are now properly identified as equilibrium relationships. The long-run elasticity of GDP with respect to money supply is 0.02345 (p = 0.003), virtually identical to the FE estimate of 0.02187. This confirms that monetary expansion has a small but statistically significant long-run growth effect, consistent with the supply-leading hypothesis (McKinnon & Shaw, 1973) but constrained by SSA's shallow financial systems.

The error correction coefficient is -0.3124 (p = 0.000), negative and statistically significant. This confirms that the system corrects deviations from equilibrium at a speed of approximately 31.2% per year, with full adjustment taking approximately 3.2 years (calculated as 1/0.3124 = 3.2). This relatively fast adjustment speed indicates that SSA economies respond reasonably quickly to macroeconomic imbalances.

4.5.4 Model Selection Test

Table 15:Model selection Test Results

Test	Statistic	p-value	conclusion
Breusch-pagan LM (OLS vs. RE)	Chibar2 = 718.04	0.0000	RE preferred over OLS
F-tests for FE	F (9,436) = 52.06	0.0000	FE needed
Hausman (FE vs RE)	Chi2(5) = 63.94	0.0000	FE preferred

The Breusch-pagan LM test rejects pooled OLS in favor of Random Effects (p-value of 0.0000), confirming that panel methods are necessary. The F-test confirms that country-specific fixed effects are significant (p-value of 0.0000). the Hausman test favor Fixed Effects over Random Effects (p-value of 0.0000), indicating that country-specific unobserved heterogeneity is correlated with the independent variables, therefore, Fixed Effect is preferred model and is presented as the main specification.

4.6 Main Estimation Results

The Husman specification test favors Fixed Effects over Random Effects (the chi2 is 63.94 with a p-value of 0.0000), including the country-specific unobserved heterogeneity is correlated with the independent variables. Therefore, FE model is presented as the main specification. Random Effects results are presented as a robustness check.

4.6.1 Fixed Effects Model (Main Results)

The Fixed Effects estimation reported in Table 16 uses 451 observations across 10 country groups, rather than the full sample 12 countries. Two countries were excluded from the FE estimation due to insufficient time-series variation: Botswana (missing M2 data for 1970-1975) and Ethiopia (missing M2 data for 2008-2012 due to statistical office disruptions). Both countries are retained in the Mean Group (MG) and System GMM estimations, which are robust to unbalanced panels. The exclusion does not materially affect the results, as sensitivity tests excluding these countries individually showed coefficients changes of less than ± 0.003.

Table 16:Fixed Effects Model Results

variable	coefficient	Std. Error	t	P>t	95% conf. interval
ln(m2)	0.02187	0.00801	2.73	0.007	0.00612 to 0.03762
ln(trade)	-0.44420	0.04756	-9.34	0.000	-0.53767 to -0.35072
ln(investment)	0.59155	0.02403	24.62	0.000	0.54433 to 0.63877
In(population)	0.71469	0.06458	11.07	0.000	0.5877 to 0.84160
Inflation	0.00176	0.00055	3.21	0.001	0.00068 to 0.00283
constant	0.02187	0.00801	2.73	0.007	-1.62529 to 1.41434

F (5,436) = 2255.24, prob > F = 0.0000, R-squared (within) = 0.9628, observation = 451, groups = 10

4.6.2 Elasticity Interpretation (Based on Fixed Effects)

Since both dependent variables ln (GDP) and independent variables (lnM2, ln (Trade), ln(investment), ln(population) are in natural logarithms, the coefficients represent full elasticities. Inflation is the only variable not logged (it contains negative values, making log transformation impossible), so its coefficients is a semi-elasticity.

Money supply Elasticity (full Elasticity interpretation): The fixed Effects model reveals that money supply has a positive and statistically significant effect on economic growth in SSA. The elasticity coefficient of 0.02187 (p-value of 0.007). A 1% increase in M2 increase GDP by only 0.0219%. For a country with 100 billion Birr GDP, a 10% increase in M2 yields just 219 million Birr in additional GDP. To achieve a 1% increase in GDP, money supply would need to expand by approximately 45.7% a large monetary expansion for a modest growth effect.

The effect is statistically significant but economically modest. This reflects the shallow financial systems, large informal sectors, and weak monetary transmission mechanisms characteristic of money SSA economics, especially low-income countries. The finding supports the supply-leading hypothesis (Mckinnon & Shaw, 1973) that financial development drives growth, but the magnitude is limited by structural constraints.

Investment Elasticity (Primary Driver of Growth): The investment elasticities of the variables have the highest level amongst all, standing at 0.59155 with a p-value of 0.000. This is almost 27 times the elasticity of the money supply. GDP will increase by 0.592% if investment goes up by 1%. For instance, a country that has a GDP of 100 billion Birr can make an additional GDP of 5.92 billion Birr by 10% investment while other sectors get only 219 million Birr. A country with a GDP of 100 billion Birr and an investment-to-GDP ratio of 20% is required to increase its investment by 5% (from 20 to 21 percentage points) in order to make a 2.96 billion Birr increase in GDP. The same 5% increase in the money supply would yield only 109 million Birr, which is 27 times less. Encouraging investment should be the main policy focus for all Sub-Saharan African countries. Increasing the investment-to-GDP ratio by 1% point (from 20% to 21%) can raise GDP by about 2.96%, which is significantly larger than any reasonable monetary expansion.

Population Elasticity: This means that if population increases by 1%, then GDP goes up by 0.715%. But since the elasticity is less than one, GDP is increasing by a smaller proportion than population, resulting in a decrease in GDP per capital by 0.285%, a 5% increase by 1.42%, and a 10% increase by 2.85%. These results show that population increases total economic production by adding labor force but benefit is shared among large population. Thus, policies which raise labor productivity through education, vocational training, health, and technology adoption are

necessary so that population growth contributes to better living standards rather than decreased per capital income.

Inflation (semi-Elasticity): Inflation shows a small positive coefficient in the Fixed Effects model (0.00176 with a p-value of 0.001). this is a semi-elasticity because inflation is not logged (it contains negative values). A 1%-point increase in the inflation rate (for example, from 5% to 6%) is associated with a 0.176% increase in GDP. A 5%-point increase in inflation would raise GDP by 0.88%, and a 10%-point increase would raise GDP by 1.76%. This positive coefficient contradicts standard economic theory (Fischer, 1993; Barro, 1996), which predicts that high inflation distorts investment decisions, creates uncertainty, erodes purchasing power, and reduce economic growth. The positive sign likely reflects three factors.

First, at low to moderate levels (below 10 to15%), inflation may accompany economic growth by reflecting growing aggregate demand rather than structural problems. Second, many SSA countries experienced deflation (negative inflation) during the sample period, which is associated with economic contraction; when deflation ends, both inflation and GDP rise together. Third, the relationship between inflation and growth is likely non-linear inflation may help growth at low levels but hurt growth at high levels. This finding does not imply that high inflation is desirable. Central banks should target inflation rates below 10% to avoid crossing the threshold where inflation becomes detrimental to growth. A moderate target of 3 to 5% remains appropriate for SSA.

4.7.1 Random Effects Model

As a robustness check, the Random model was also estimated. The results are qualitatively similar to the FE results, confirming that the findings are robust to model specification.

Table 4.10: Random Effects Model results

variable	coefficient	Std. Error	Z	P > z	[95% conf. interval
Ln(M2)	0.02182	0.00791	2.76	0.006	0.00632 to 0.03732

ln (Trade)	-0.43495	0.04847	-8.97	0.000	-0.52994 to -0.33996
ln(investment)	0.64722	0.02300	28.14	0.000	0.60214 to 0.69231
ln(population)	0.54389	0.05836	9.32	0.000	0.42951 to 0.65827
inflation	0.00164	0.00057	2.91	0.004	0.00054 to 0.00275
Constant	1.44854	0.72451	2.00	0.046	0.02852 to 2.86856

Wald chi2(5) = 10576.51, prob > chi2 = 0.0000, Observation = 451, Groups = 10

The Random Effects model yields nearly identical coefficients for money supply (0.02182 vs. FE 0.02187), confirming that the positive effect of money supply on growth is robust to model specification. The RE coefficients for trade, investment, population, and inflation are also similar in sign and significant to the FE results. The main difference is that RE has slightly smaller standard errors (more efficient), but FE is preferred by the Hausman test.

4.8 Mean Group Estimator (Heterogeneity)

Pesaran and Smith (1995) introduced mean group estimator for studying relationship between money supply and economic growth. It allows a variation of coefficients in countries and shows positive money supply coefficient (0.04568) but it is not statistically significant due to high standard errors. This means a heterogeneity detected in SSA countries and necessitates the income group analysis.

Table 4.11.: Mean Group Estimation Results (Full Sample, N=648, Group=12)

Variable	Coefficient	Std. Error	z	p>z
Ln(M2)	0.04568	0.07745	0.59	0.555
ln (Trade)	-0.23209	0.08918	-2.60	0.009

ln (Investment)	0.54326	0.07017	7.74	0.000
ln (Population)	1.20995	0.73054	1.66	0.098
inflation	0.00010	0.00187	0.05	0.959

4.9 System GMM Estimation

Blundell and Bond (1998) developed the system GMM estimators a solution for endogeneity problems and check mean group result robustness through using instrument for the lagged dependent variable and potentially endogenous repressors with their own lagged levels and differences.

Table 4.12: system GMM estimation Results

Variable	Coefficient	Std. Error	Z	P > Z
L1. ln (GDP)	0.09715	0.03525	2.76	0.006
ln (M2)	-0.09449	0.05269	-1.79	0.073
ln (Trade)	-0.01866	0.03607	-0.52	0.605
ln (Investment)	0.42017	0.11849	3.55	0.000
ln (Population)	0.18172	0.18551	0.98	0.327
inflation	-0.00644	0.00067	-9.64	0.000

The System GMM results confirm the positive direction of the investment coefficient, though the money supply coefficient is not statistically significant. The Arellano-Bond test for AR (1) is significant ($p = 0.010$), confirming the presence of first-order autocorrelation expected in difference GMM. The AR (2) test is insignificant ($p = 0.543$), confirming no second-order serial correlation. The Hansen J-test ($p = 0.901$) indicates that the instruments are valid. The number of instruments (11) is less than the number of groups (12), ensuring no instrument proliferation. The GMM results support the robustness of the main findings: investment remains the strongest driver of growth, while the effect of money supply is not significant in this specification. This is consistent with the Mean Group results and reflects the heterogeneity across SSA countries.

4.9.1 Modified Wald Test for Heteroskedasticity

Table 17: Modified Wald Test for Heteroskedasticity

Test	Chi2	p-value	conclusion
Modified Wald	278.75	0.0000	Heteroskedasticity present

The Modified Wald test rejects the null hypothesis of constant error variance (p-value of 0.0000), indicating the presence of heteroskedasticity. However, this is addressed by using robust standard errors in the system GMM estimation. The Hansen J-test (p-value of 0.396) confirms that heteroskedasticity does not invalidate the instruments.

4.10 Heterogeneity Across Income

4.10.1 Interaction Terms Analysis

To address the small sample concern for the Upper-middle income group (only two countries: South Africa and Botswana), an interaction term analysis using the full sample (451 observations) was employed for testing heterogeneity.

Table 18: Interaction Terms Analysis (Testing Heterogeneity)

Variable	coefficients	Std. Error	z	P > Z
Ln(M2) (upper-income)	0.08908	0.00815	10.92	0.000
Ln(M2) × Low-income	-0.07773	0.00541	-14.36	0.000
Ln(M2) × Lower-middle income	-0.46255	0.000467	-9.01	0.000
ln (Trade)	-0.46255	0.04105	-11.27	0.000

ln (Investment)	0.59004	0.01958	30.13	0.000
ln(population)	0.57274	0.04604	12.44	0.000
inflation	0.00126	0.00048	2.62	0.009

Join test of interaction terms: chi2(2) = 208.37, prob > chi2 = 0.0000

Calculated elasticity by income group:

Income group	M2 Elasticity	Calculation
Upper-middle	0.089	Direct from ln(M2) coefficient
Lower-middle	0.047	0.089-0.042
Low-income	0.011	0.089-0.078

The joint test of integration terms is highly significant (p-value of 0.0000), confirming that the effects of money supply differ significantly across income groups. Money supply has the largest effect in upper-middle income countries with an elasticity of 0.089) and the smallest effect in low-income countries with an elasticity of 0.011. the same 10% increase in money supply would increase GDP by 0.89% in an upper-middle income country but by only 0.11% in a low-middle country. Money supply is approximately 30% as effective in low-income countries (0.011 vs. 0.089).

4.10.2. Sub-Sample Analysis (Secondary Robustness)

Table 19:Mean Group Estimation Results by Income Group

variable	Low-income (n=162, groups=3)	Lower-middle (n=378, groups=7)	Upper-middle (n=108, groups=2)
ln(M2)	0.0784 (0.588)	0.0391 (0.760)	0.0327 (0.302)
ln (Trade)	-0.4485 (0.007)	-0.1659 (0.208)	-0.2142 (0.029)

ln (Investment)	0.5325 (0.009)	0.5057 (0.000)	0.6669 (0.000)
ln (Population)	0.6965 (0.000)	1.4265 (0.255)	1.0737 (0.000)
inflation	0.0057 (0.127)	-0.0020 (0.426)	0.0007 (0.783)

Note: p-values in parentheses. Upper-middle income results are based on only two countries (South Africa and Botswana) and are suggestive rather than definitive.

The sub-sample results are consistent with the interaction term findings. Money supply is not statistically significant in any income subgroup (p is greater than 0.10 for all groups), confirming that the full-sample significant of money supply is driven by pooling rather than uniform effects across all countries. Investment is the strongest driver across all groups, though the upper-middle results should be interpreted with caution due to the small sample.

4.11 Panel Causality Test Results

To determine the direction of causality between money supply and Economic growth a Genger causality test was conducted using two lags each variable in the log-level specification. The Granger causality test was conducted using 2 lags based on the Akaike information Criterion (AIC) and Bayesian information Criterion (BIC). For the full panel, AIC selected 2 lags (AIC = -3.452) compared to 1 lag (AIC = -3.1988) or 3 lags (AIC = -3.401). The BIC similarly favored 2 lags (BIC = -2.987) over alternatives. This lag structure (2 years) is also consistent with the monetary transmission literature, which suggests that changes in money supply typically affects output with a 12–24-month lag in developing economics (Bernanke & Blinder, 1988; Omolade & Mukolu,2018).

Table 20:Granger causality test results

Null Hypothesis	F- statistic	P-value	Conclusion
lnM2 does not cause ln GDP	4.84	0.0083	Reject (significant at 1%)
ln GDP does not cause lnM2	4.84	0.9215	Fail to reject (not significant)

Note: Test conducted with 2 lags. Results indicate unidirectional causality from money supply to economic growth (supply-leading hypothesis).

The Granger causality test provides strong evidence of unidirectional causality from money supply to economic growth. The null hypothesis that lnM2 does not cause ln GDP is rejected at the 1% significant level (p-value of 0.0083), including that past values of money supply contain predictive power for current GDP beyond what is already explained by past GDP values. Conversely, the null hypothesis that in GDP does not cause lnM2 cannot be rejected (p-value of 0.9215), providing no evidence that economic growth Granger-causes money supply. This implies that changes in money supply temporally precede changes in GDP, and central banks maintain independent control over monetary policy rather than responding passively to output fluctuation. The finding supports the supply-leading hypothesis (Mckinnon & Shaw,1973) and suggesting that monetary policy can be an active tool for growth promotion, through the modest elasticity (0.0219), which indicates that monetary expansion should complement, not substitute for, investment promotion.

4.12 Structural Break

Table 21: structural break test results for multiple candidates' years

Break Year	Event	Interaction Coefficient	P-value
1979	Oil shock	0.0128	0.901
1983	SAPs begin	-0.0247	0.575
1994	Financial liberalization	-0.0022	0.968
2008	Global financial crisis	-0.0747	0.148
2020	COVID-19 pandemic	0.1753	0.074

The structural break analysis tests whether major historical events have permanently altered the relationship between money supply and economic growth in SSA. The findings reveal that none of the five candidate break years are statistically significant at the conventional 5% level. This section discusses each event and its implications.

The 1979 Oil Shock (p = 0.901): The 1979 oil shock was a major global supply disruption that caused oil prices to skyrocket. For oil-exporting SSA countries like Nigeria and Angola, this should have increased government revenues and money supply growth. For oil-importing countries like Ethiopia and Kenya, it should have caused balance of payments pressures. Theoretically, this could have altered the money-growth relationship. However, my finding (p = 0.901) suggests that the oil shock did not permanently change how money supply affects growth in SSA. One explanation is that many SSA countries had limited financial integration at the time, insulating them from global financial transmission.

The Structural Adjustment Programs (SAPs) of 1983 (p = 0.575): SAPs were imposed by the IMF and World Bank in the 1980s and 1990s. They required fiscal austerity, privatization, trade liberalization, and financial liberalization directly affecting monetary policy and financial systems. The McKinnon-Shaw hypothesis predicts that financial liberalization should strengthen the money-growth relationship by improving financial intermediation. However, my finding (p = 0.575) indicates that SAPs did not cause a structural break. This suggests that SAPs were implemented gradually across countries, with effects varying by country, or that their impact on the money-growth relationship was too small to detect. This is consistent with critics who argue that SAPs increased poverty and debt without fundamentally improving growth mechanisms.

The 1994 Financial Liberalization (p = 0.968): The 1994 financial liberalization in many SSA countries removed interest rate controls, allowed private banks, and opened financial markets. This should have improved monetary transmission and strengthened the money-growth relationship. Yet my finding (p = 0.968, the highest p-value) shows absolutely no evidence of a break. This is striking. It suggests that financial liberalization in SSA did not significantly change how money supply affects growth. One possible explanation is that financial liberalization was incomplete or poorly implemented. Another is that the financial systems were too shallow for liberalization to have an immediate effect. This finding challenges the strong version of the

McKinnon-Shaw hypothesis, which predicts an immediate strengthening of financial intermediation.

The 2008 Global Financial Crisis (p = 0.148): The 2008 global financial crisis was the worst since the Great Depression. It originated in the US housing market but spread globally. In developed economies, it caused major structural breaks in money-growth relationships. However, my finding (p = 0.148) shows no significant break in SSA. This is consistent with the view that SSA financial markets were not fully integrated into global financial markets at the time. SSA banks held few toxic assets, and the region's limited integration insulated it from the full impact of the crisis. This supports the argument that financial underdevelopment can sometimes act as a buffer against external shocks.

The 2020 COVID-19 Pandemic (p = 0.074): The COVID-19 pandemic was a global health and economic crisis. Lockdowns, supply chain disruptions, and falling commodity prices hit SSA economies. Central banks responded with unprecedented monetary expansion. My finding shows marginal significance at the 10% level (p = 0.074), indicating some evidence of a structural break, but not strong enough to conclude at the 5% level. This marginal significance should be interpreted with caution for three reasons: (1) the post-pandemic period is short (2020-2023), with only four years of data; (2) policy responses were still unfolding; and (3) the full effects may not yet be observable. Future research with more post-pandemic data should revisit this finding.

CONCLUSION AND POLICY IMPLICATIONS

5.1 Conclusions

The examination confirmed that a long-run equilibrium relationship exists between money supply, trade, investment, population, inflation, and GDP ($p < 0.01$). The PMG long-run estimation confirms these findings, with a money supply elasticity of 0.02345 ($p = 0.003$) and an error correction speed of 31.2% per year, indicating full adjustment to equilibrium takes approximately 3.2 years. Money supply has a positive but economically modest effect on GDP, with an elasticity of 0.02187 and a p-value of 0.007. 10% increases in M2 increase GDP by only 0.22%; to achieve 1% GDP growth through monetary expansion alone, M2 would need to increase by approximately 46%.

In contrast, investment is the primary drive of growth, with an elasticity of 0.591555 and a p-value of 0.000, approximately 27 times larger than money supply. 10% increases in investment increases GDP by 5.92%. Trade openness shows an unexpected negative effect (-0.44420) and a p-value of 0.000, reflecting SSA's dependence on primary commodity exports, while population contributes positively but with diminishing returns, with an elasticity of 0.71469, but GDP per capita declines). Inflation shows a small positive coefficient of 0.00176 with a p-value of 0.001, indicating a non-linear relationship where low inflation may accompany growth but high inflation harms growth.

Substantial income group heterogeneity exists: the joint test of interaction terms is highly significant with a p-value of 0.0000. Money supply elasticities vary from 0.089 (upper-middle income) to 0.047 (lower-middle) to 0.011 (low-income), meaning money supply is only 30% as effective in low-income countries as in upper-middle income countries. The Granger causality test reveals unidirectional causality from M2 to GDP, with a p-value of 0.0083, but not from GDP to M2 (p-value of 0.9215), supporting the supply-leading hypothesis (Kinnon & Shaw, 1973). Strong cross-sectional dependence exists (Pesaran CD test, $p < 0.01$ for all variables), confirming SSA countries are highly interdependent. Testing multiple candidates break years (1979 oil shock, 1983 SAPs, 1994 financial liberalization, 2008 crisis, 2020 COVID-19) reveals no statistically significant structural break at the 5% level, through the COVID-19 pandemic shows marginal significant at the 10% level of p-value (0.074).

The full-sample significance of money supply (0.0219) is driven by pooling rather than uniform effects across all countries. It showed that positive effect on growth and investment even more powerful (27 times). Investment is the main variable for attaining SSA growth not the money supply growth. Hence, a monetary policy that is effective for all countries is no more recommended since it should be specific depending on the country or region to be studied. The Policy should give emphasis on enhancing of investment, export diversification, monetary coordination of regions, and stability of price (inflation below 10%).

5.2 Policy Implications

Based on the findings of this study, the following policy implications are directed to SSA Governments and Central Banks:

I. Prioritizing Investment: since economic growth affected significantly by investment growth. It has elasticity of 0.59155 and a p-value of 0.000. This means that, an increasing of investment by 10% increases GDP by 5.95% that is around 27 times larger than the effect of money supply. Hence, Government suggested improving enabling environments fostering of investment growth, making large investment on infrastructure, and giving different incentives in order to attract foreign investments.

II. Tailoring monetary policy by income level: Pursuing a monetary policy that is carefully prepared considering the structural, economic, and social and other factors prevailed in the specific region to be studied. Monetary policy seems ineffective in low-income countries. Governments advised to focus on structural reforms such as liberalization of trade. Monetary policy carefully implemented prioritizing price stability in low middle income countries. In addition, in the environment of upper-middle-income countries, monetary policy is more effective under the consideration of underlying inflation target.

III. **Strengthen regional monetary coordination:** The result of p value less than 0.01 for all variables revealed that the highly interdependency of SSA countries. This regional coordination among them helps for important policy effectiveness in form of monetary policy harmonization and collective decision for determination of interest rate.

IV. Inflation Target below10%: A coefficient of inflation is positive and significant at 0.00176 with a p-value of 0.001, a non-linear relationship is confirmed. Price stability should be the main objectives and maintaining below 10% in order to avoid the minimum level where the inflation could be harmful to the country.

5.3 Limitations of The Study

Sample includes only 12 countries, with only two upper-middle income countries (South Africa, Botswana), making those results suggestive. Measurement error in M2 from informal sectors, omitted institutional variables, and Granger causality (predication, not true causation) are acknowledged (Granger, 1969), though Fixed Effects and multiple estimators mitigate these concerns. Unexpected negative trade and positive inflation signs reflect SSA's commodity dependence and non-linear inflation-growth relationship, requiring future research. The inability to incorporate variables such as Education and political stability is also considered as limitation in order to preserve the 54-years sample needed for cointegration.

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