Monetary Policy and Monetary Integration in the Economic Community of West African States (ECOWAS): Dynamic Macro Panel Analyses

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others

Dedication

To the memory of my late father, Mr. Joseph Alex Tucker, my role model who not only supported my desire for academic excellence, but also instilled in me the virtues of diligence, devotion, and perseverance.

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Abstract

Monetary integration has constituted an overarching objective of the Economic Community of West African States (ECOWAS) as reflected in the introduction of the ECOWAS Monetary Cooperation Programme (EMCP) in 1987 that defines the collective policy measures necessary to achieve a harmonised monetary system. The adoption in 2014 of a pragmatic single-track approach to monetary integration by the year 2020 and the formal adoption in June 2019 of the ‘Eco’ as the name for the single currency under the proposed ECOWAS monetary union underscore the ECOWAS authorities’ determination to forge ahead with establishment of the monetary union. In spite of the progress in instituting the requisite policy and institutional framework, there has been a dearth of empirical studies to meaningfully inform the process of harmonization of monetary policy and the transition from country-specific monetary policy to a common monetary policy framework.

This thesis contributes to filling the gap through research on important monetary policy issues in the ECOWAS by drawing on the advancement in macro panel estimation techniques. The first empirical paper investigates the viability of monetary targeting as a policy framework for the proposed common monetary policy by assessing the stability of the conventional money multiplier and the postulates of the endogenous money theory. Employing both first- and second-generation panel unit root tests and advanced panel cointegration and granger causality techniques, the results indicate that the money multiplier has been unstable. In addition, causality is shown to run from bank credit to the monetary base, broadly in line with postulates of the endogenous money theory. The second essay investigates the determinants of the demand for money in the ECOWAS by applying the common correlated effects mean group (CCEMG) and the augmented mean group (AMG) estimators. The study identified real income and inflation as the key determinants of money demand, but uncovered evidence of long-run instability in the money demand function. The final empirical chapter examined the transmission mechanism of monetary policy in the ECOWAS region by adopting the dynamic heterogeneous panel structural VAR technique developed by Pedroni (2013). Monetary policy was found to be ineffective, with weak or inoperable channels of monetary transmission. Indications of asymmetries in the country-specific responses to the common monetary policy shock were revealed.

The study concludes that monetary targeting is inappropriate as a framework for conducting a common monetary policy and that a framework based on interest rate signalling, such an Inflation Targeting (IT) Lite, could be adopted at the inception of the union while the prerequisites for a full-fledged IT regime are being instituted. Deliberate efforts to deepen financial markets and strengthen policy credibility are needed to enhance the effectiveness of the common monetary policy.

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List of Abbreviations

ADF	Augmented Dickey-Fuller
ASEA	African Securities Exchanges Association
AMG	Augmented Mean Group
ARDL	Autoregressive distributed lag
ARIMA	Auto Regressive Integrated Moving Average
BEAC	Banque des États de l'Afrique Centrale (Central Bank of CAEMU)
BCEAO	La Banque Centrale des États de l'Afrique de l'Ouest (Central Bank of WAEMU)
BCRG	Central Bank of the Republic of Guinea
BCV	Central Bank of Cape Verde
BIC	Bayesian information criteria
BOG	Bank of Ghana
BRVM	Bourse Regionale des Valeurs Mobilieres (Regional Stock Market for WAEMU)
BSL	Bank of Sierra Leone
BSM	Buffer Stock Model
BVAR	Bayesian VAR
CADF	Cross-sectionally augmented ADF
CBG	Central Bank of The Gambia
CBL	Central Bank of Liberia
CBN	Central Bank of Nigeria
CAEMU	Central African Economic and Monetary Community (CEMAC is the French acronym)
CET	Common External Tariff
CCEMG	Common correlated effects mean group
CDP	Common Dynamic Process
CFA	Communauté Financiére d'Afrique (Common currency of WAEMU)
CIPS	Cross-sectionally augmented Im, Pesaran and Shin
CMA	Common Monetary Area

DFE	Dynamic Fixed Effects
DOLS	Dynamic ordinary least squares
DSGE	Dynamic Stochastic General Equilibrium
EAC	East African Community
EAMU	East African Monetary Union
ECB	European Central Bank
ECEC	Eastern Caribbean Economic Community
ECF	Extended Credit Facility
ECOWAS	Economic Community of West African States
ECT	Error Correction Term
ECM	Error Correction Model
EMCP	ECOWAS Monetary Cooperation Programme
EMTN	European Monetary Transmission Network
EMU	European Economic and Monetary Union
ETLS	ECOWAS Trade Liberalization Scheme
FAVAR	Factor Augmented VAR
FMOLS	Fully modified ordinary least squares
GCC	Gulf Cooperation Council
GMM	Generalized method of moments
GSE	Ghana Stock Exchange
GVAR	Global VAR
IFS	International Financial Statistics
i.i.d	independently and identically distributed
IMF	International Monetary Fund
IT	Inflation Targeting
LIC	Low income countries
MG	Mean Group
MFSM	Monetary and Financial Statistics Manual
MPAC	Monetary Policy Advisory Committee
MPC	Monetary Policy Committee

MPR	Monetary Policy Rate
MRR	Minimum Rediscount Rate
OMO	Open market operations
NCC	National Coordinating Committee
NPISHs	Non-profit institutions serving households
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PAM	Partial Adjustment Model
PMG	Pooled mean group
PSVAR	Panel Structural Vector Autoregression
PURT	Panel unit root test
ROA	Return on Assets
ROE	Return on Equity
SADC	Southern Africa Development Community
SAP	Structural Adjustment Program
SCF	Stabilization and Cooperation Fund
SMP	Staff-Monitored Program
SSA	Sub-Saharan Africa
SVAR	Structural Vector autoregression
UNECA	United Nations Economic Commission for Africa
UIP	Uncovered interest rate parity
VAR	Vector Autoregression
VECM	Vector Error Correction Model
WAEMU	West African Economic and Monetary Union
WACB	West African Central Bank
WACH	West African Clearing House
WAMA	West African Monetary Agency
WAMZ	West African Monetary Zone
WAMI	West African Monetary Institute
WAMU	West African Monetary Union

Chapter 1 Introduction

1.1 Background and Research Motivation

The past few decades have witnessed growing aspirations by groups of countries in different regions of the world to gravitate towards some form of economic and monetary integration. The motivation has been driven by the myriad of macroeconomic and development benefits that are perceived to accrue from assuming membership of these blocs which range from the reduction in transaction costs on account of increasingly integrated regional goods and capital markets to the elimination of disturbances in relative prices that may arise from volatility in exchange rates, in the case of monetary union. Downsides arising from the inability to deploy monetary instruments to contain overheating of the economy or resort to the exchange rate as adjustment mechanism to mitigate country-specific external shocks are often considered subordinate.

The formation of the European Economic and Monetary Union (EMU) and the establishment of the European Central Bank (ECB) in 1999 together with introduction of the single currency, the euro, have served as an impetus towards pursuing greater integration. Recent calls for a rethinking of the EMU given the experiences of the Eurozone debt crisis and the enduring macroeconomic and structural challenges (Majone, 2012) have not dampened the enthusiasm for monetary integration. The renewed drive, over recent years, by countries of the Gulf Cooperation Council (GCC) towards monetary union and the Eastern Caribbean Economic Community (ECEC) towards full-fledged economic and currency union (IMF, 2012) underscores this determination.

In sub-Saharan Africa (SSA), there appears to be special attraction to the idea of economic and monetary integration, with some form of arrangement in the South, Central, East and Western regions of the continent. In the South, a Common Monetary Area (CMA) has existed within the Southern Africa Development Community (SADC) since 1986 and it entails a fixed exchange rate arrangement among South Africa, Lesotho, Namibia, and Eswatini. Under the conditions of the CMA agreement, the national currencies of the other three countries are pegged (at par) to the South African rand, though the rand maintains a floating exchange rate arrangement against other currencies. In Central Africa, the Central

African Economic and Monetary Union (CAEMU) has its currency, the CFA[1] franc, pegged to the Euro and operates a common monetary policy under a single central bank, BEAC[2]; while, in the East, the treaty to establish the East African Community (EAC) came into effect in 2000 among the following partner members: Burundi, Kenya, Uganda, Rwanda, and the United Republic of Tanzania, though the protocol for the establishment of the EAC Monetary Union was signed in 2013.[3]

In West Africa, the Economic Community of West African States (ECOWAS)[4] has made appreciable progress in developing the requisite policy and institutional structures towards establishing a monetary union which is currently scheduled to take effect in 2020. The union would involve a merger of the West African Economic and Monetary Union (WAEMU), the West African Monetary Zone (WAMZ), and Cabo Verde. Established in 1994, the WAEMU is a union of eight francophone West African countries that seek to promote economic development of its member countries through economic and monetary integration.[5] These countries operate a common central bank, BCEAO[6], and share a single currency, the CFA Franc, which is pegged at par to the euro. The member countries of the WAMZ[7] declared their intention, in the year 2000, to create a monetary zone as a first step towards achieving the vision of ECOWAS for a wider monetary union in the region. Once established, the WAMZ was expected to ultimately merge with the WAEMU and any other country in the subregion that demonstrates interest and commitment to the regional integration efforts.

To build a stronger foundation for monetary integration and fast-track realization of its principal objectives, including the establishment of a common central bank and introduction of a single currency, the ECOWAS Monetary Cooperation Program (EMCP) was introduced in 1987. The EMCP outlines the timeline for attaining these objectives and defines the requisite policy agenda including trade integration and the harmonization of monetary policy frameworks, financial sector policies and institutions, and the exchange rate regimes. To

[1] CFA is French acronym for Communauté Financiére d'Afrique, the common currency used by member countries of CAEMU and WAEMU.
[2] BEAC is French acronym for Banque Centrale des Etats de l'Afrique de l'Ouest (the central bank of CAEMU)
[3] The EAC now includes South Sudan which acceded to the Treaty in April 2016 and became a full member in August 2016.
[4] The ECOWAS comprises 15 member countries including Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.
[5] The WAEMU comprises the following countries: Benin, Burkina Faso, Cote d'Ivoire, Guinea Bissau, Mali, Niger, Senegal, and Togo.
[6] BCEAO is the French acronym for La Banque Centrale des États de l'Afrique de l'Ouest.
[7] The WAMZ comprises The Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone.

facilitate macroeconomic convergence of member countries, the EMCP also includes a multilateral surveillance mechanism that closely monitors progress towards attaining stipulated macroeconomic convergence criteria. Performance in respect of these convergence criteria has been inconsistent, including at the level of the WAMZ and the WAEMU, and the pace of policy harmonization slow, creating undue delays in the actualization of the union. In fact, agreed deadlines for introducing the second regional currency had to be revisited.[8] This lacklustre progress towards monetary integration prompted the ECOWAS authorities in 2014 to abandon the two-track approach in favour of an outright establishment of a monetary union by all its 15-member countries by the year 2020. To reaffirm their commitment to the monetary integration process, the Authority of Heads of States and Governments of ECOWAS at their summit held in Abuja, Nigeria on June 29, 2019, formally adopted the 'Eco' as the name for the new common currency under the proposed ECOWAS monetary union.

In spite of the enthusiasm that has been demonstrated by the political authorities in the region and the strides in instituting the requisite policy and institutional frameworks, there has been limited research to guide policy decisions during the preparatory phase and the take-off period of the proposed union. The dearth of empirical studies is even more pronounced in the area of monetary policy where such research is needed to meaningfully inform the process of harmonization of monetary policy and the transition from country-specific monetary policy to a single monetary policy framework. This stands in sharp contrast with the EMU, where, in the run-up to and following the establishment of the ECB, a myriad of studies was conducted to inform institutional and policy formulation, including by the Eurosystem Monetary Transmission Network (EMTN) that comprised staff of the ECB and the national central banks.

1.2 Research objectives and Contribution

This thesis focuses on filling the gap outlined in the previous section through research on key monetary policy issues that are germane to the monetary integration process in the ECOWAS. Its contribution assumes the form of three empirical essays that draw from recent advancements in macro panel estimation techniques.

[8] The launch date for the WAMZ currency was postponed several times, from January 2003 to December 2005 and then to December 2009 and later January 2015. (UNECA, 2015)

The first empirical paper investigates the viability of monetary targeting as a policy framework for a common monetary policy in the proposed monetary union by assessing the stability of the conventional money multiplier and the postulations underpinning the endogenous money theory. Like most SSA economies, monetary authorities in the ECOWAS have relied significantly on monetary aggregates as nominal anchor to achieve their ultimate policy objective of stable inflation. Assuming a direct relationship between the monetary base, under the effective control of the central bank, and the money supply, monetary authorities tend to exercise control over monetary aggregates thereby containing inflation within stipulated targets or at levels consistent with their governments' overall development agenda. The acceleration of financial innovation in the region may have weakened the underlying multiplier relationship and the experiences of the 2008/09 global financial and economic crisis whereby increases in bank reserves occasioned by quantitative easing did not translate into equivalent monetary expansion have questioned the operability of the conventional money multiplier, both in principle and practice (Goodhart, 2017).

As the authorities work towards developing an appropriate monetary policy framework to conduct a common monetary policy, this study assesses the stability of the money multiplier to determine whether a monetary targeting regime could serve as a plausible option. The vast majority of the research on the money multiplier has focused on monetary developments in individual countries. This study enriches the empirical literature on the subject by adopting a panel data framework that employs advanced panel methodologies. The stability of the money multiplier is investigated using both first generation panel unit root tests—assuming cross section independence—and a second-generation panel test—accommodating cross section dependence. In addition, the long-run association between the key components of the money multiplier—broad money and the monetary base—is assessed using panel cointegration tests that accommodate heterogeneity and cross section dependence. Similarly, drawing from the theoretical and empirical literature on endogenous money, the causal relationships between the key monetary aggregates—broad money, the monetary base, and the money multiplier—and bank credit to the private sector are investigated with the help of a dynamic panel causality test.

The second empirical essay investigates the key determinants of the demand for money in the ECOWAS region and whether there exists a long-run stable money demand relationship in the region. A stable money demand is also an important underlying assumption on which monetary targeting is predicated, in addition to the money multiplier examined in the preceding essay. It ensures a long-run relationship between monetary aggregates and key macroeconomic variables, such as inflation and real income, which often serve as target variables for monetary policy. From a broader perspective, stability of the demand for money provides a basis for using monetary aggregates in the conduct of monetary policy irrespective of the monetary policy regime in operation. Against this backdrop, knowledge of the demand for money in the ECOWAS would help inform the choice of a suitable monetary policy regime for conducting a single monetary policy and also establish the extent to which developments in monetary aggregates would provide forward guidance towards achieving policy targets.

The handful of studies on the demand for money in the ECOWAS have either focussed on individual member countries or on the sub-monetary groupings—WAEMU and the WAMZ. This essay fills the vacuum created by the absence of comprehensive research on money demand in the region. In addition to its policy implications for the proposed ECOWAS monetary union, the study makes an empirical contribution to the estimation of money demand that have applied macro panel data methods. Unlike most panel studies on money demand, it employs dynamic macro panel techniques, notably the common correlated effects mean group (CCEMG) estimator of Pesaran (2006) and the augmented mean group (AMG) estimator of Eberhardt and Teal (2010), both of which accounts for cross sectional dependencies in the data series.

The final empirical chapter examines the transmission mechanism of monetary policy in the ECOWAS region within a panel vector autoregressive (VAR) framework. Specifically, it investigates the impact of common monetary policy impulses on the economies of individual member countries and the region as a whole. An understanding of the monetary policy transmission mechanism in the prospective member countries provides an insight into the how monetary policy is conducted within a common framework and also informs the process of harmonisation of the monetary policy infrastructure across member countries. The existence of asymmetries in the impacts of policy across member countries would imply disproportionate distribution of the costs of disinflation and undermine the effectiveness of the common monetary policy. Unlike the monetary integration process in the EMU which benefitted from extensive research on the monetary policy transmission mechanism in the run-up to the establishment of the ECB, there is no evidence of empirical work to examine the monetary policy transmission mechanisms in the ECOWAS. Instead, most of the studies on the subject have been country-specific, with a few on the WAEMU region.

This study contributes to filling this gap by investigating the monetary policy transmission mechanism at the level of ECOWAS. Specifically, this study employs the dynamic heterogeneous panel technique developed by Pedroni (2013). This technique helps address the problem of inconsistent estimates and possible misleading inferences obtained using the individual VAR procedure on data of insufficient length. However, unlike most conventional panel methods, which assume homogeneous dynamics among the members of the panel, the Pedroni (op. cit.) approach allows for heterogeneous country-specific dynamics and accommodates cross-sectional dependencies. The technique decomposes the monetary shock into common shocks—shocks impacting all member countries—and idiosyncratic shocks—shocks predominantly affecting a single country—and generates member specific responses to both shocks. The identified common shocks are used to capture the exogenous common monetary policy shock. Within the dynamic panel framework, the plausible channels of monetary policy transmission in the ECOWAS are investigated. The study also contributes to the existing knowledge on monetary policy transmission by presenting a comprehensive review of the empirical studies on current and prospective monetary unions. It appraises the various empirical methodologies that have been adopted to investigate current and prospective regional monetary arrangements around the world.

1.3 Organisation of the Thesis

The next chapter, Chapter 2, presents an overview of the institutional arrangements and policy frameworks in respect of the monetary integration process in the ECOWAS. It provides background information on the ECOWAS, highlighting the integration process in the two sub-monetary groupings: the WAEMU and the WAMZ. The multilateral surveillance mechanism and policy priorities followed since the inception of the EMCP are outlined. An assessment of individual country and overall performances in respect of the macroeconomic convergence criteria is then undertaken. The chapter also presents the monetary policy frameworks adopted in the ECOWAS member countries and provides an insight into how the conduct of monetary policy has evolved over the years. A brief overview of the state of development of the financial markets in the region is presented on the basis of some key financial soundness, financial depth and financial access indicators, benchmarked against the SSA and advanced economies averages. The chapter serves to inform the analyses in the next three empirical chapters.

Chapter 3 presents an assessment of the stability of the conventional money multiplier, a key assumption underlying the monetary targeting framework that has been adopted by most ECOWAS countries. It also examines the alternative theoretical perspective of the money creation process espoused by the endogenous money theory. Testable hypotheses in respect of the money multiplier are investigated using a range of panel unit root tests and both the Pedroni (2004) residual-based panel cointegration test and the Westerlund (2007) error-correction-based panel cointegration technique. Robustness check of the results is undertaken by employing the Westerlund and Edgerton (2008) panel cointegration test, which is robust to structural breaks and cross-sectional dependence. With respect to the postulates of the endogenous money theory, the Dumitrescu and Hurlin (2012) panel Granger non-causality test is applied to the related testable hypotheses.

Chapter 4 examines the relationship between the demand for money and its determinants in the ECOWAS. It seeks to investigate the long-run stability of the money demand function, with a view to informing the decision on an appropriate monetary policy framework within which the common monetary policy could be effectively conducted. Unlike most research studies on money demand within the ECOWAS, the study is undertaken within a dynamic macro panel framework. Diagnostic tests of the data series are carried out using the both first- and second-generation panel unit root tests and the estimations proceed by employing an array of dynamic panel estimators, with the common correlated effects (CCE) estimator applied to both the baseline and parsimonious models. The robustness of the results is confirmed by the augmented mean group (AMG) estimator, which also accommodates cross section dependence, and by using a higher frequency dataset.

Chapter 5 examines the monetary policy transmission mechanism in the ECOWAS. It reviews the conventional channels of monetary policy transmission in the broader context of SSA economies while focusing on the ECOWAS and presents a comprehensive appraisal of the empirical literature on monetary policy transmission in monetary unions. The study employs the dynamic heterogeneous panel technique developed by Pedroni (2013) which allows for heterogeneous country-specific dynamics and accommodates cross-sectional dependencies. Identification of the unanticipated common monetary shock proceeds by imposing short-run recursive restrictions on the common component of the composite shock.

Member specific responses to the common shock are analyzed to determine the existence of potential asymmetries and the panel responses provide an insight into union-level dynamics. Transmission variables are incorporated into the baseline model to examine the viability of the channels of monetary policy transmission in the region.

Chapter 6 presents a summary of the findings of the empirical chapters and concludes the Thesis. The policy implications of the findings are then discussed.

Chapter 2 ECOWAS - Institutional arrangements and Policy frameworks for Regional Monetary Integration

This chapter presents an overview of the institutional arrangements and policy frameworks in respect of the monetary integration process in the ECOWAS. It serves to inform the empirical and policy analyses in the subsequent chapters. The chapter commences with a brief background information on the ECOWAS, highlighting developments in the two sub-monetary groupings: the WAEMU and the WAMZ. A synopsis of the ECOWAS Monetary Cooperation Programme (EMCP) which defines the policy priorities and multilateral surveillance mechanism for integration in the region is then presented, followed by an assessment of performance in respect of the macroeconomic convergence criteria. Lastly, the monetary policy frameworks in the ECOWAS member countries are presented, together with an overview of the state of financial sector development.

2.1 Background

The ECOWAS is a regional economic bloc established on May 28, 1975.[9] According to the Treaty of Lagos signed by member states at its inception, the economic community aims to promote cooperation and development in all spheres of economic activity and establish a mechanism for payments settlement among member states. A Revised ECOWAS Treaty came into effect in 1993 that sets out the policy measures required to achieve the community's overarching objectives and these include the harmonisation and co-ordination of national policies, national investment codes, and standards and measures; the promotion of integration programmes, projects and activities; and the establishment of a common market through trade liberalisation, the adoption of a common external tariff and common trade policy, and the removal of obstacles to the free movement of persons, goods, services, and capital between member states.

A formal decision (ECOWAS Decision A/DEC/5/6/83) to create an ECOWAS monetary zone was reached in 1983 with a view to strengthen regional economic integration and address the impediments to deepening intra-regional trade emanating from the limited currency convertibility in the region. Accordingly, the ECOWAS Monetary Cooperation Programme (EMCP) was launched in 1987 to facilitate the process of monetary integration

[9] At present, the ECOWAS comprises fifteen member countries—Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Cabo Verde joined ECOWAS in 1977. All other countries are founding members.

in the sub-region and defines the roadmap for attaining policy and institutional harmonisation and macroeconomic convergence among member countries prior to the establishment of a common central bank and launch of a single currency. The ECOWAS is comprised of two distinct sub-groupings—WAEMU and WAMZ—both of which have instituted a framework for convergence and integration.

2.1.1 West African Economic and Monetary Union (WAEMU)

The WAEMU was established in 1994 comprising mainly of francophone West African countries that share a common currency—the CFA franc—with the overarching aim to promote economic and monetary integration among its members. The WAEMU Treaty outlines its goals which include strengthening the economic and financial competitiveness of the member states, securing convergence in economic performances and policies, creating a common market and harmonising relevant policy and institutional frameworks. Founded to replace the West African Monetary Union (WAMU)[10], the WAEMU was established following the devaluation of the CFA franc in 1994. As Seck (2013) puts it,

> *"WAEMU was created as an appropriate framework for the development and execution of reforms and initiatives related to restoring macroeconomic equilibrium among the zone's countries, building the credibility of the currency, revitalising the economy through private investment, intensifying intra-zone trade and returning to budgetary discipline" (Seck, 2013 in Ayuk and Kabore (eds) pp. 20-21).*

WAEMU has since its inception made progress in developing a strong policy and institutional framework to support the integration process. Among these is the establishment of a customs union, that includes common external tariff and preferential tariff on trade between member countries. The WAEMU operates a common central bank, BCEAO, which has responsibility for formulating and implementing monetary policy, ensuring the proper functioning of the payment system and preserving the stability of the regional financial system. The common currency, the CFA franc, is fully convertible into the euro, and, as a statutory requirement, a share of the pooled foreign exchange reserves of WAEMU member countries is kept at the Banque de France (50 percent at present, down from 65 percent initially)[11].

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[10] By the early 1990s, the WAMU was characterized by severe internal and external macroeconomic imbalances, including deteriorating terms of trade, low foreign exchange reserves, and fiscal indiscipline, culminating in the devaluation of the CFA franc in 1994.

[11] 'The Franc Zone' Fact Sheet No.127. Banque de France Communications Directorate, July 2010.

A Regional Pact of Convergence, Stability, Growth, and Solidarity was adopted in 1999, amended in 2003 and 2009, with a view to strengthen economic convergence, reinforce macroeconomic stability, accelerate economic growth and enhance solidarity among member states. To this end, the Pact specifies the following set of primary and secondary convergence criteria which member states are expected to observe:

Primary Criteria:

- Ratio of basic fiscal balance to nominal GDP (Key criterion) ≥ 0%
- Ratio of outstanding domestic and external debt to nominal GDP ≤70%
- Average rate of annual inflation: ≤ 3% per year
- Variation in the stock of domestic and external payment arrears:
  - ✓ Domestic arrears: non-accumulation of arrears during the current functioning period
  - ✓ External arrears: non-accumulation of arrears during the current functioning period

Secondary Criteria:

- Ratio of the wage bill to tax revenues ≤ 35%
- Ratio of domestically financed public investments to tax revenues: ≥ 20%
- Ratio of the current account deficit in relation to nominal GDP ≤ 5%
- Ratio of tax to nominal GDP ≥ 17%

Performance in respect of these convergence criteria has been mixed, with several of the key criteria unobserved in 2015 and 2016 (see IMF, 2018a p. 12).

2.1.2 West African Monetary Zone (WAMZ)

The WAMZ was established in April 2000 following the signing of the 'Accra Declaration' defining the objectives and institutional arrangements of a second monetary zone in West Africa.[12] The rationale for establishing the zone was to create the enabling macroeconomic environment that would pave the way for a merger with the WAEMU as a strategy towards monetary integration in ECOWAS. The WAMZ agreement provides for the setting up of a common Central Bank, the West African Central Bank (WACB), a Stabilization and Cooperation Fund (SCF) and the West African Monetary Institute (WAMI). The introduction of a single currency was considered pivotal in ensuring price stability, sound

[12] The WAMZ comprises six member countries: The Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone. Liberia formally joined the zone in February 2010.

fiscal and monetary conditions, and sustainable balance of payments for its member countries. In line with the statute of the WACB, the common Central bank will seek to maintain price stability as its main objective.

A set of macroeconomic convergence criteria was set out to support effective harmonization of macroeconomic policies and sustain macroeconomic stability in the zone once monetary integration takes effect. This comprises primary and secondary convergence criteria as follows:

Primary Criteria:

- Budget deficit, excluding grants in % of nominal GDP: ≤ 4%
- Inflation rate (end of period): < 10%
- Financing by the central bank of the budget deficit in relation to the fiscal revenues of the previous year ≤ 10%
- Gross external reserves (in months of imports): ≥ 3 months

Secondary Criteria:

- Fiscal revenues in percentage of GDP ≥ 20%
- Wage bill in % of nominal GDP ≤ 35%
- Public investments financed at national level in % of fiscal revenues ≥ 20%
- Real interest rate > 0%
- Nominal exchange rate (+ / - 15%)
- Non-accumulation of arrears

Observance of the stipulated convergence criteria has over the years been lacklustre, resulting in repeated postponement of the commencement date for monetary integration in the zone. Assessed against the rationalised ECOWAS convergence criteria, discussed in the next section, none of the six member states met all the criteria at end-2016.

2.2 ECOWAS Monetary Cooperation Programme (EMCP)

The EMCP was introduced in 1987 (Decision A/DEC.2/7/87) as an effort by the authorities to facilitate the process of monetary integration in the region and involves the adoption of collective policy measures geared towards achieving a harmonised monetary system and common monetary institutions. The EMCP laid out a systematic timeline that entails short-term, medium-term and long-term objectives to be achieved over a period of about ten years. The short-term objectives focused on improving the payment systems to facilitate intra-regional trade and transactions. This required strengthening of the institutional framework of the West African Clearing House (WACH)[13], introducing a credit and guarantee fund mechanism in the WACH, and extending the range of eligible products and transactions channelled through the mechanism. Over the medium term, regional currency convertibility is to be achieved through greater use of national currencies in conducting intra-regional trade transactions, whereas in the long term an ECOWAS Single Monetary Zone is to be established featuring a common monetary authority that implements a common monetary policy and issues a common convertible currency. The pooling and management of foreign reserves of member states, and the formulation of a common policy on short-term external liabilities arising from trade and balance of payments financing, are also considered important long-term objectives. To attain these medium and long-term objectives, policies would involve liberalisation of trade, the removal of exchange control restrictions, and the alignment and harmonisation of exchange rates across member states.

Implementation of the EMCP entails monitoring fulfilment of stipulated macroeconomic convergence by member states. Macroeconomic convergence is considered critical to fostering macroeconomic stability by ensuring sustainable fiscal and external current account positions and the maintenance of low and stable rates of inflation. More importantly, adherence to the convergence framework enhances the effectiveness of a common monetary policy by contributing to minimising potential asymmetric impacts of shocks to member states. These conditions not only serve as prerequisites for success of the proposed monetary union, they position member states on a trajectory of high and sustainable growth. To this end, a set of macroeconomic convergence criteria was adopted in 1999 to be observed by

[13] Established at the inception of the ECOWAS in 1975, the WACH served as a multilateral payment facility to promote trade within West Africa. It was later transformed to WAMA.

member states (Decision A/DEC.7/12/99). Compliance with these criteria[14], comprising primary and secondary components, provides a basis for joining the monetary union.

To further strengthen the surveillance mechanism and accelerate establishment of a monetary union in the face of weak convergence performances across member states, a Macroeconomic Convergence and Stability Pact was established in June 2012 (Supplementary Act A/SA.4/06/12). Under this Pact, monetary integration is to be attained in two stages: the Convergence stage and the Performance, Stability and Consolidation stage. During the Convergence Stage (January 2012 – December 2016), member states were to focus on implementing policies to achieve the primary convergence criteria. This was to be followed by the Performance, Stability and Consolidation stage (effective January 1, 2017) whereby member states were expected to strengthen policy implementation to achieve sustained economic growth.[15] The Macroeconomic Convergence and Stability Pact also provided for the reformulation and consequent harmonisation of convergence criteria within the ECOWAS in view of differences in convergence criteria and convergence horizon between ECOWAS and the sub-regional groupings—WAEMU and WAMZ.

In 2015, the macroeconomic convergence criteria for ECOWAS were rationalized to ensure uniformity in the assessment of macroeconomic convergence performance, including at the level of WAEMU and WAMZ (Supplementary Act A/SA.01/12/15). This culminated in a reduction of the secondary criteria from seven to two criteria. The operating set of convergence criteria as at end December 2018 are outlined below and forms the basis for assessing convergence performance in section 2.3.[16]

Primary Criteria:

- Ratio of budget deficit, including grants (commitment basis) to GDP : $\leq 3\%$
- Average annual inflation rate : $< 10\%$ (with a goal of ≤ 5 percent by end-December, 2019)
- Central bank financing of Budget Deficit : $\leq 10\%$ of previous year's tax revenue
- Gross external reserves : ≥ 3 months of imports

[14] The macroeconomic convergence criteria were modelled after the Maastricht Treaty of 1991 developed in the run-up to the establishment of the European Economic and Monetary union.
[15] In line with the Supplementary Act A/SA.4/06/12, the timeline for the Convergence stage was amended to January 1, 2016 to December 31, 2019 and that for the Performance, Stability and Convergence stage amended to January 1, 2020.
[16] A matrix of the key timelines in the monetary integration process is presented in Table 2.1 below.

Secondary Criteria:

- Nominal exchange rate : stable (+ / - 10%)
- Total public debt to GDP : ≤ 70%

Policy harmonisation forms an important component of the EMCP roadmap to facilitate integration of policy and institutional frameworks across member states. Areas of particular focus include trade, monetary policy and financial sector frameworks, payments system development, and statistical harmonisation (WAMI, 2017; ECOWAS Commission, 2017).

Trade integration in the ECOWAS has involved implementation of trade-related protocols and conventions within a unified framework that would facilitate establishment of a common market in the region. These include an ECOWAS Trade Liberalisation Scheme (ETLS) that seeks to abolish trade and non-trade barriers and a Common External Tariff (CET) being implemented by most member countries. On harmonisation of monetary policy frameworks, a diagnostic study on the transition to a common monetary policy framework in ECOWAS is being undertaken as a first step towards harmonising the diverse frameworks in operation across member states (see section 2.4 for details). With different levels of development of the financial sector in member countries, financial sector integration is considered paramount to fostering the overall monetary integration process. The integration of the financial sector thus involves harmonisation of banking supervision and regulatory frameworks, harmonisation of regulations governing current and capital account transactions, and the harmonisation and adoption of regional accounting and financial reporting frameworks.

The payment systems harmonisation has focussed on the establishment of a common platform that would allow for interfacing of existing systems across member countries to ensure efficient payments, clearing and settlements of transactions in the region.[17] The regional payments system has been instituted in most member countries and common regulations governing the system drafted. Statistical harmonisation, for its part, has involved developing common methodological guides and harmonisation frameworks, together with

[17] A Payments System development project in the WAMZ involving The Gambia, Guinea, Liberia and Sierra Leone was funded by the African Development Bank totaling US$30 million was successfully completed in 2016. The main components of the project include Real Time Gross Settlements System and Scriptless Security Settlement System (RTGS/SSS), Core Banking Application (CBA), and Automated Cheque Processing and Automated Clearing House (ACP/ACH) (WAMI 2017).

Table 2.1: Key Timelines of the ECOWAS Monetary Integration Process

Date	Milestone	Objective	Legal Framework/Instrument
June 1983	Formal decision to create an ECOWAS Monetary Zone	To promote monetary and financial integration and facilitate trade among member states	ECOWAS Decision A/DEC.5/6/83
July 1987	Introduction of the ECOWAS Monetary Cooperation Programme (EMCP)	To implement collective policy measures to achieve a harmonized monetary system and create a single monetary zone	ECOWAS Decision A/DEC.2/7/87
July 1993	Establishment of the West African Monetary Agency (WAMA)	To monitor and coordinate the implementation of the EMCP	Protocol A/P.1/7/93
December 1999	Adoption of Macroeconomic Convergence Criteria for implementation of the EMCP	To ensure proper convergence of the macroeconomic policies of member states	ECOWAS Decision A/DEC.17/12/99
April 2000	Formation of the West African Monetary Zone (WAMZ)	To establish a second monetary zone that would subsequently merge with the WAEMU to form the ECOWAS monetary union	ECW/AGR/WAMZ/1
December 2001	Creation of the Mechanism for Multilateral Surveillance	To monitor the process of convergence of economic and financial policies of member states	ECOWAS Decision A/DEC.17/12/01
May 2009	Adoption of the Roadmap for the ECOWAS single currency in 2020	To facilitate creation of a second regional currency in 2015 and an ECOWAS-wide regional currency in 2020	Decision of the Convergence Council, May 25, 2009
June 2012	Establishment of the Macroeconomic Convergence and Stability Pact	Formal commitment to achieve monetary union in two stages: Convergence stage and Performance, Stability and Consolidation stage	Supplementary Act A/SA.4/06/12
July 2014	Two-tracked approach to monetary integration abandoned in favour of outright establishment of a monetary union	To fast-track commencement of monetary union in ECOWAS	Decision of the Authority of Heads of State and Government at the 45th Ordinary Session, July 10, 2014
December 2015	Rationalization of the Macroeconomic Convergence Criteria	To ensure uniformity in the assessment of macroeconomic convergence performance across WAEMU and WAMZ	Supplementary Act A/SA.01/12/15
June 2019	ECOWAS decision to name the single currency 'ECO'	To demonstrate commitment to the monetary integration process	Decision of the Authority of Heads of State and Government at the 55th Ordinary Session, June 29, 2019

Source: West African Monetary Agency (www.amao-wama.org) capacity building of officials of member countries, in the areas of National accounts, Consumer price index, and Balance of payments.

Some progress has been accomplished in the harmonisation of exchange rates regimes and the exchange rate mechanism in the ECOWAS. On the fiscal front, an ECOWAS fiscal transition programme is being implemented that entails harmonisation of taxation of member countries in advance of the establishment of the ECOWAS Customs Union.

The process of harmonisation of national policies under the EMCP and close monitoring of the performance of ECOWAS member states against the stipulated macroeconomic convergence criteria is monitored through a multilateral surveillance mechanism that comprises different structures. The organs assigned direct responsibility for multilateral surveillance include: the Convergence Council, composed of Ministers of Finance and Central Bank Governors of ECOWAS, that performs general oversight of the convergence process; the Technical Monitoring Committee, that monitors the convergence process and ensures that national policies and programmes are aligned with the objectives of the EMCP; and the Joint Secretariat, comprising officials of two specialized agencies, the West African Monetary Agency (WAMA) and the ECOWAS Commission, which support the work of the Technical Monitoring Committee and the Convergence Council.[18] National Coordinating Committees (NCCs) are constituted in each member country to provide ancillary support to WAMA and the Joint ECOWAS Secretariat.

2.3 Performance in respect of the ECOWAS macroeconomic convergence criteria

This section presents an assessment of the performance of ECOWAS member states in respect of both the primary and secondary macroeconomic convergence criteria. It covers the period 2012 to 2016, reflecting the adoption of the Macroeconomic Convergence and Stability Pact up into the latest assessment by the ECOWAS Commission. In addition to annual convergence performances, the average position is reported for each member state over the reporting period as an indication of overall regional commitment towards achieving monetary integration.

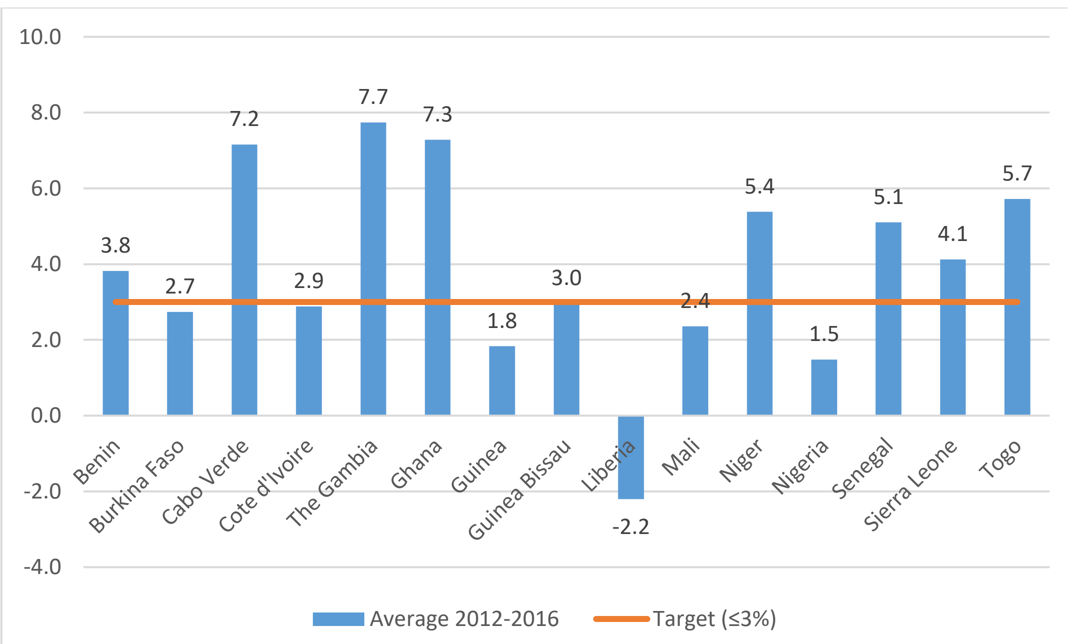
[18] The WAMA has the broader responsibility for ensuring the establishment of a single monetary zone in West Africa and works in coordination with the West African Monetary Institute (WAMI) responsible for driving the process of monetary integration in the WAMZ.

2.3.1 Primary convergence criteria

- **Ratio of budget deficit, including grants (commitment basis) to GDP : $\leq 3\%$**

The performance of member states in relation to this criterion was challenging, with more than half of the member states failing to observe the ≤ 3 percent target in most of the years, with the exception of 2013 when 8 countries were successful (Appendix A.1.1). At the country level, Cabo Verde, The Gambia and Ghana appear to have performed less favourably, exceeding the criteria throughout the reporting period. Regarding the average position for the period 2012 to 2016 depicted in Figure 2.1 below, only seven member states observed the criteria. Performance in terms of the number of countries fulfilling the criteria stagnated over the last three years. The broadly unfavourable performance could be attributed to challenges in mobilising revenues to meet the increasing budgetary needs of member states. Fiscal discipline, notably the rationalization of government spending, would contribute to enhancing the performance of member states.

Figure 2.1: ECOWAS - Ratio of budget deficit to GDP

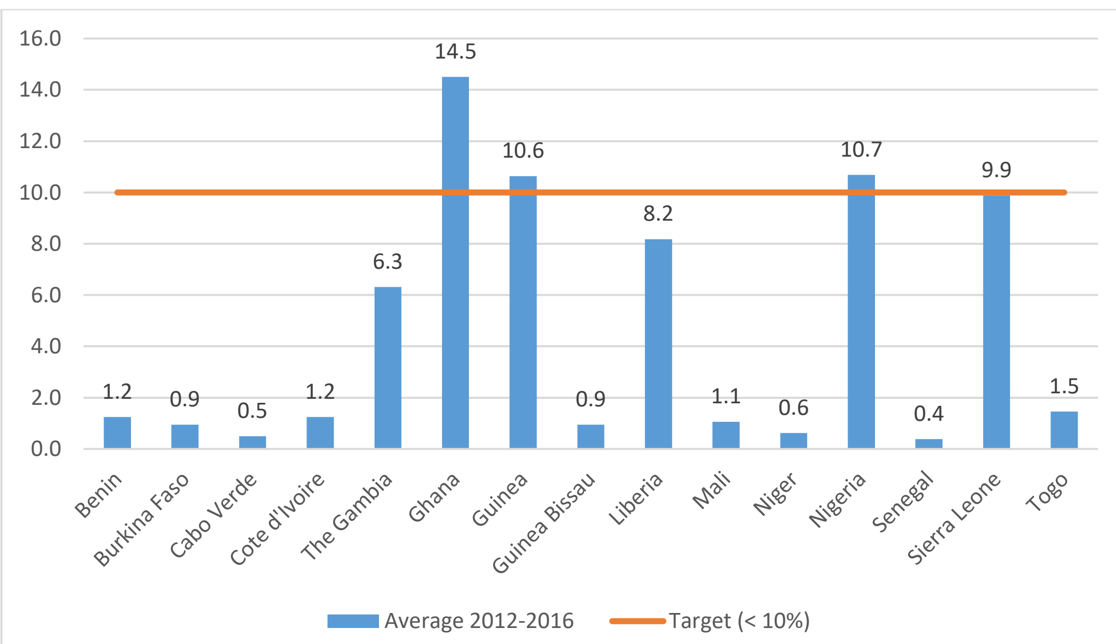


Source: ECOWAS Commission

- **Average annual inflation rate : < 10%**

Under this criterion, the annualized inflation rate is expected to average less than 10 percent for each member countries, with a maximum rate of 5 percent targeted by end December 2019. Overall performance in respect of the inflation criterion has been generally encouraging, as up to 80 percent of the member states consistently achieved the target (Appendix A.1.2). WAEMU countries have performed relatively well, averaging less than 2 percent for the entire period. This positive development could not be unconnected with benefits from the fixed parity of the CFA Franc to the euro and the consequent anchoring of inflation to that in the Euro area. Most of the countries within the WAMZ have had to contend with episodes of severe inflationary pressures, with relatively high inflation outcomes for Ghana, Guinea, Nigeria and Sierra Leone. The depreciation of the domestic currencies of these countries relative to the US dollar and the high pass-through to consumer prices largely accounted for the recorded inflation rates. Notwithstanding, overall performance for the ECOWAS indicates that 12 member states met the inflation criterion on average as shown in Figure 2.2.

Figure 2.2: ECOWAS - Average annual inflation rate

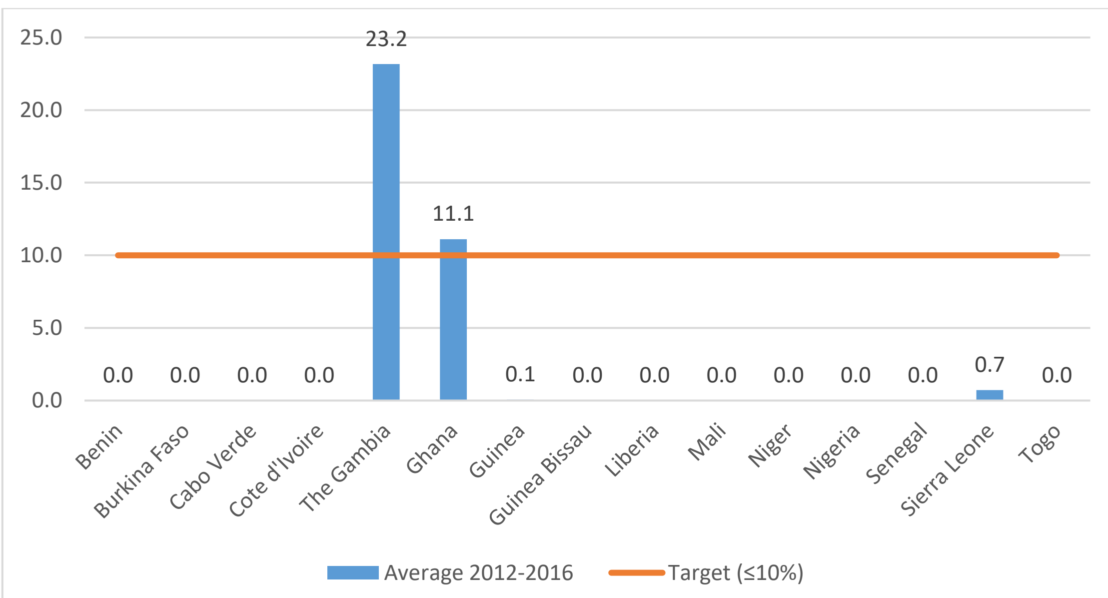


Source: ECOWAS Commission

- **Central bank financing of Budget Deficit: ≤ 10% of previous year's tax revenue**

  The financing of the budget deficit by the central bank is assessed in relation to the previous year's tax revenue and set at a target not exceeding 10 percent. This criterion aims at fostering macroeconomic stability by minimising fiscal dominance or monetary accommodation of the budget deficit. Countries in the WAEMU refrained from central bank financing throughout the period consistent with BCEAO statutory legislation.[19] Cabo Verde, Guinea, Liberia, and Nigeria also mostly maintained zero central bank financing. For The Gambia, Guinea and Sierra Leone, the central banks continue to accommodate the budget deficits of their central governments. The enactment of relevant legislation abolishing central bank financing of the budget, and strict adherence, where already instituted, should be prioritised.

Figure 2.3: ECOWAS - Central bank financing of the Budget Deficit (as a ratio of previous year's tax revenue)



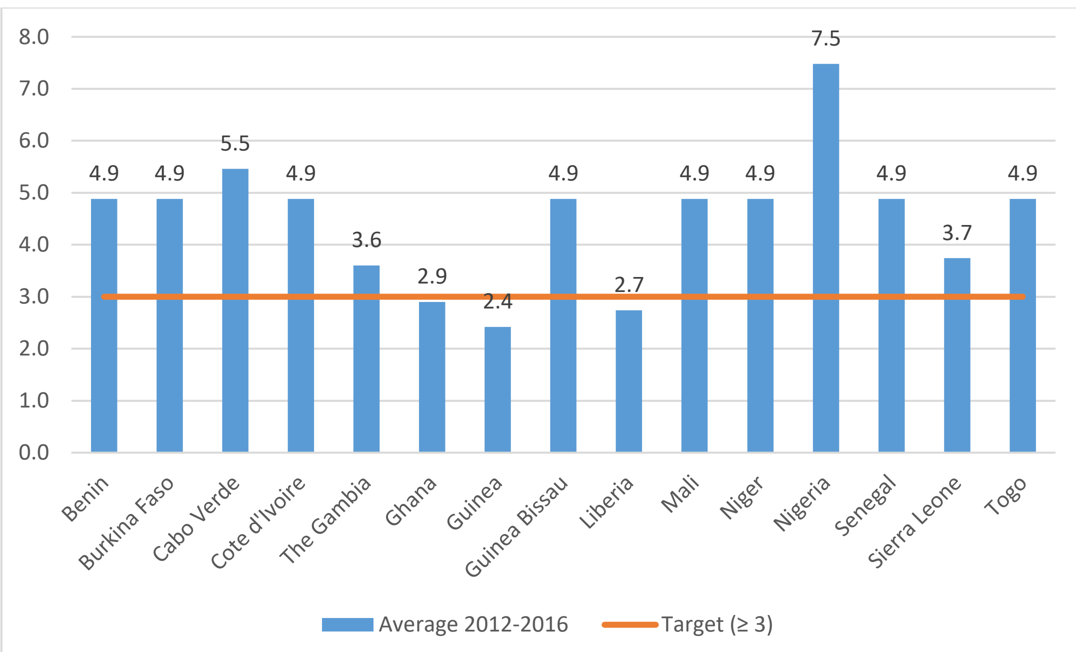
Source: ECOWAS Commission

[19] 'On September 19, 2002, the WAEMU Council of Ministers decided to shift the financing of government fiscal deficits from central bank direct advances to the issuance of securities on the regional capital market. Within-year advances by the BCEAO to governments will, however, continue to be allowed to smooth temporary cash-flow fluctuations.' (IMF, 2003, p. 16).

- **Gross external reserves: ≥ 3 months of imports**

This criterion requires that gross external reserves should be kept at levels to cover at least three months of import of goods and services.[20] Maintaining foreign reserves at comfortable levels provides much-needed buffer against external shocks. Countries with the WAEMU maintain the same level of gross foreign reserves in months of import annually on account of the pooling of foreign reserves in the context of implementation of the common monetary policy framework in the union. Throughout the period, reserves were kept well above the target, averaging 4.9 percent. Cabo Verde and Nigeria have held substantial reserves at 5.5 and 7.5 months of imports cover on average, respectively. Ghana, Guinea and Liberia recorded reserves levels below the stipulated criterion. Overall, performance has been favourable with at least 11 countries meeting the target annually and 12 countries when averaged over the reporting period.

Figure 2.4: ECOWAS - Gross external reserves (in months of Imports)



Source: ECOWAS Commission

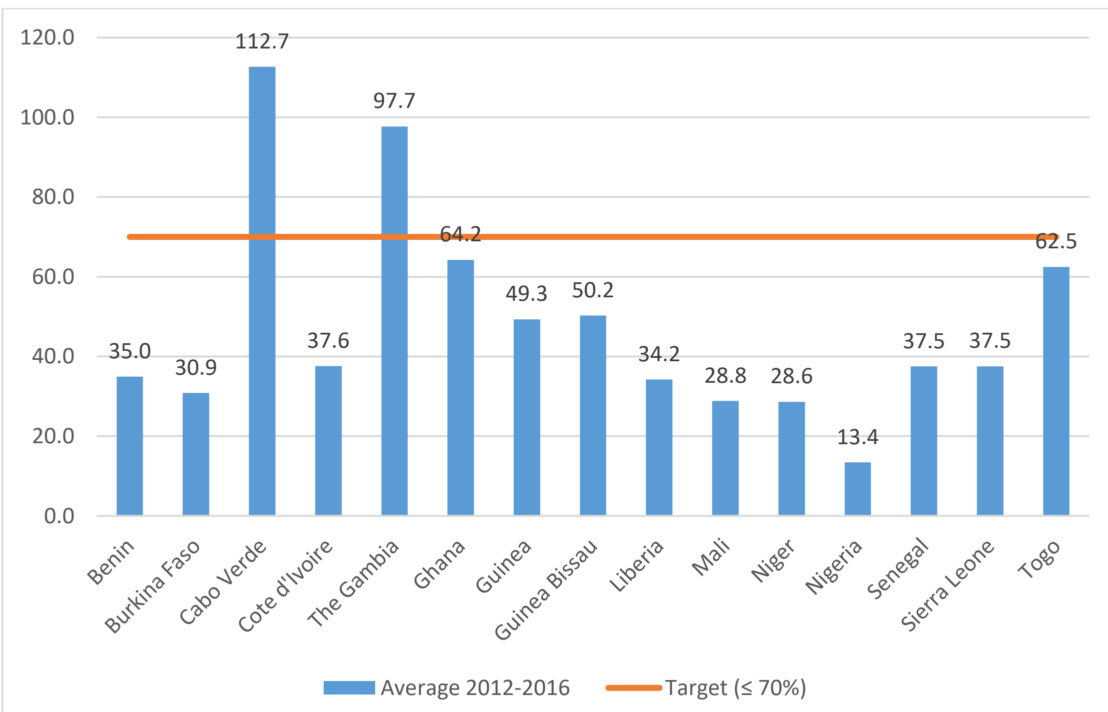
[20] This criterion was revised to 3 percent from 6 percent following amendment of the Macroeconomic Convergence and Stability Pact in 2015 in line with the ECOWAS Supplementary Act XX

2.3.2 Secondary Convergence Criteria

- **Total public debt to GDP : ≤ 70%**

The criterion on total public debt as a percentage of nominal GDP is set at a maximum of 70 percent. Overall, performance in relation to this criterion has been favourable with at least 11 countries achieving the target consistently. When averaged over the reporting period, thirteen member states recoded debt ratios below the target as depicted in Figure 2.5 below. At the individual member state level, Cabo Verde and The Gambia exceeded the 70 percent threshold annually throughout the period, averaging 113 percent and 98 percent, respectively. While the rest of the member states were on average within the target, the debt ratios for Ghana and Togo followed an upward trajectory closing at 73 percent and 79 percent, respectively, in 2016, breaching the stipulated threshold (Appendix A.2.1).

Figure 2.5: ECOWAS - Ratio of total public debt to GDP

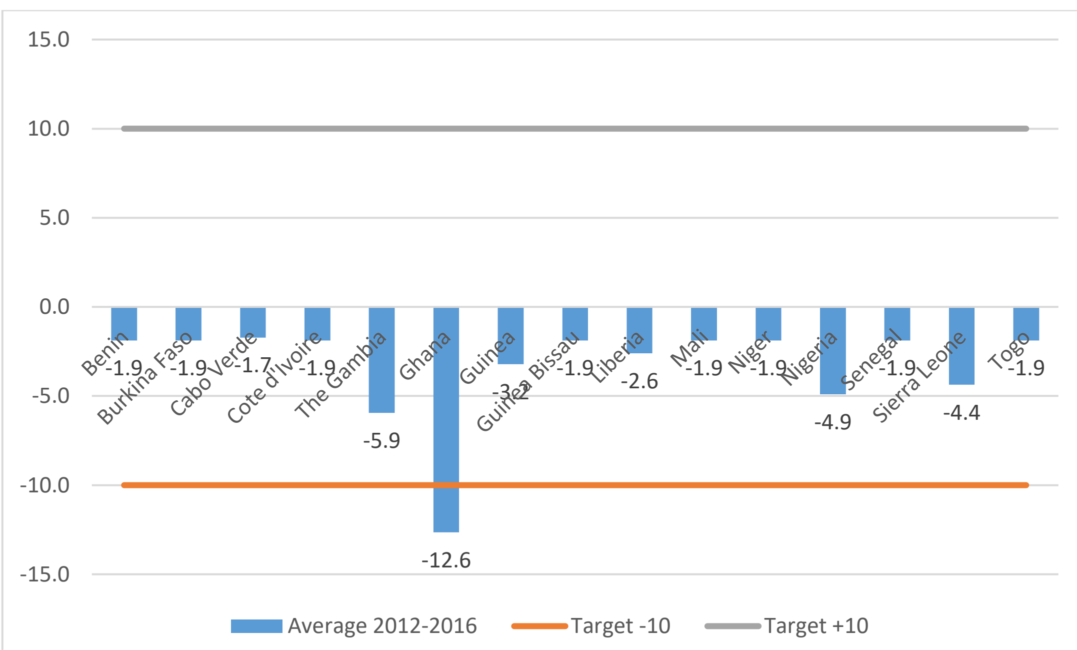


Source: ECOWAS Commission

- **Nominal exchange rate: stable (+ / - 10%)**

The criterion on the nominal exchange rate requires variation of the domestic currencies of member states to be contained within a band of plus or minus 10 percent. As evident from Figure 2.6 below, movements in exchange rates in the ECOWAS were on average characterized by persistent annual depreciation. The CFA Franc, on account of its fixed parity to the euro for all WAEMU member countries, recorded the least depreciation on average of 1.9 percent and remained within the band throughout the period. The Ghanaian Cedi is the only currency that breached the exchange rate band on average at 12.6 percent depreciation, driven mainly by the significant depreciations in 2014 (32 percent) and 2015 (16 percent). Moreover, exchange developments in respect of the Guinean Franc, the Nigerian Naira and the Sierra Leonean Leone were unfavourable in 2016 relative to the stipulated band as they recorded depreciation rates of 16 percent, 24 percent and 19 percent, respectively.

Figure 2.6: ECOWAS - Nominal Exchange Rate Variation

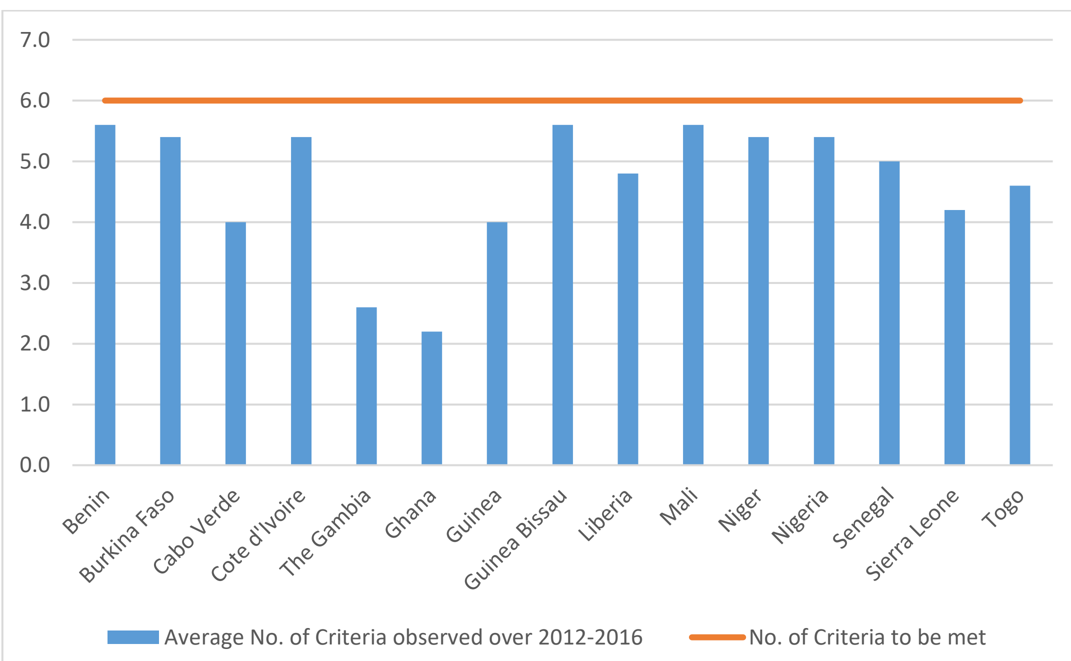


Source: ECOWAS Commission

2.3.3 Overall performance assessment

Overall performance of ECOWAS member states in relation to the macroeconomic convergence criteria appears favourable over the period 2012 – 2016 averaging 4.7 out of the six criteria, though it masks the marked deterioration in performance in 2016. WAEMU countries performed strongly averaging 5 or better, with the exception of Togo which scored 4.6 (Figure 2.7). Cabo Verde exhibited consistency meeting 4 criteria annually throughout the period, with room for improvement on the fiscal front in containing the budget deficit and public debt. For most WAMZ member states, notably The Gambia, Ghana, and Sierra Leone, there was evident deterioration in achieving the criteria as reflected in the attainment of only 2 criteria by 2016 from 4 in 2012 (see Appendix A.3 for details). However, whereas Sierra Leone met 5 criteria in 2014 and 2015, for The Gambia only 2 criteria and 1 criterion, respectively, were met in these years. The number of countries attaining all the six criteria which had reached five by 2014 and then in 2015, reduced drastically to zero in 2016. While performance could be considered as encouraging for some countries, especially those in the WAEMU sub-region, the goal of macroeconomic convergence appears to be daunting in view of the diverging outcomes for the sub-regional groupings.

Figure 2.7: ECOWAS - Overall Macro Convergence Performance (2012 -2016)



Source: ECOWAS Commission

2.4 Overview of Monetary policy frameworks and Financial sector developments

This section provides an insight into the conduct of monetary policy in member countries of ECOWAS, highlighting important aspects of the evolution of the frameworks. The trend in the key monetary policy variable(s) is analysed against movements in the objective variables, notably inflation and real GDP growth. This is followed by a brief overview of the state of development of the financial markets in the region on the basis of some key indicators in respect of financial soundness, financial depth and financial access, in some cases, benchmarked against the sub-Saharan Africa (SSA) and Advanced economies averages.

2.4.1 Monetary policy framework and financial sector development in the WAEMU

The responsibility for formulation and implementation of monetary policy in the WAEMU is assigned to a common central bank, the BCEAO, representing the eight member countries of the union. The national branches support policy implementation by providing the platform for monetary operations. The conduct of monetary policy in the WAEMU region has evolved over the years, and, with it, its objectives. At the onset, the focus of the common monetary policy was to maintain foreign exchange reserves at an appropriate level in order to support the fixed parity of the CFA franc against the euro and to ensure its convertibility. Towards this end, on an annual basis, the BCEAO sets the limit on domestic credit for each member country in line with its targets on net domestic assets and gross foreign assets determined within the framework of an IMF financial programming exercise (IMF, 2003).

In this regard, monetary policy was pursued through the use of direct monetary management instruments, which included credit ceilings for the individual banks, mandatory interest rates limit for bank transactions, and administrative allocation of central bank advances. While the use of the system of direct monetary instruments may have helped enhance the ability of the BCEAO in achieving the target on net foreign assets in view of the administered interest rates, control over the level of domestic credit and limited capital mobility, due to inefficiencies in resource allocation and interest rate distortions associated with direct instruments, the continued use of direct instruments was considered untenable.

Within the context of implementation of a structural adjustment programme with the IMF, the BCEAO commenced the process of transitioning to market-oriented monetary instruments by October 1989. The shift to indirect monetary management involved abolishing credit ceilings, eliminating administrative sectoral credit allocation and liberalising interest rates on deposits and loans. Open market operations in financial securities and minimum reserve requirements were adopted as the main instruments in the Bank's toolkit for conducting monetary policy.[21] Through the open market window, the BCEAO provides refinancing to banking institutions for 7 days or 28 days, subject to a minimum bid rate set by the BCEAO. The Bank also operates standing lending facilities that provide refinancing at the demand of the banks for which it sets a marginal lending rate. This effectively creates an interest rate corridor within which the Bank can steer the interbank and other money market rate, thereby enhancing the transmission of monetary policy. As depicted in Figure 2.8, the interest rate corridor between the minimum cash injection bid rate and the marginal lending rate was kept at 100 basis points for the period up to December 2016 when the marginal lending rate was increased by 100 basis points leaving the minimum bid rate unchanged. The corridor has since then remained at 200 basis points.

With regards reserve requirements as an instrument of monetary policy, the system has been operational since late 1993 but was initially differentiated across member countries on the basis of their specific requirements, as indicated in Table 2.2. However, by December 2010, the coefficient was unified at 7.0 percent for all member states and later reduced to 5.0 percent in March 2012. The BCEAO further reduced the required reserves coefficient to 3.0 percent in March 2017 to ensure optimal levels of liquidity in the banking system, limit access to the BCEAO financing windows, and deepen the interbank market.

Reforms to modernise the institutional framework for monetary policy came into effect in April 2010 that included redefining the primary objective of monetary policy to be price stability. The inflation objective in the union was set at one percentage point above or below the central value of 2 percent over a 24-month horizon. Without prejudice to its price stability objective, the BCEAO also supports the economic policies of WAEMU member countries with a view to promote high and sustainable economic growth. As part of the reforms, in September 2010, a monetary policy committee (MPC) was established chaired by the central bank Governor, with the responsibility for determining the instruments employed to achieve the policy objectives.[22] The MPC meets quarterly, with provision for ad hoc meetings.

[21] The exchange rate peg of the CFA franc at par with the euro, has not served as a daunting constraint to the conduct of a single monetary policy in the union. The existence of significant capital controls provides room for effective independent monetary policy in the context of a fixed exchange rate regime.

[22] The MPC comprises the Governor of the BCEAO, the Deputy Governors, one member nominated by each of the Governments of the member States of the Union and appointed by the Council of Ministers, one member

Figure 2.8: BCEAO – Monetary Policy Rates (percent per annum)

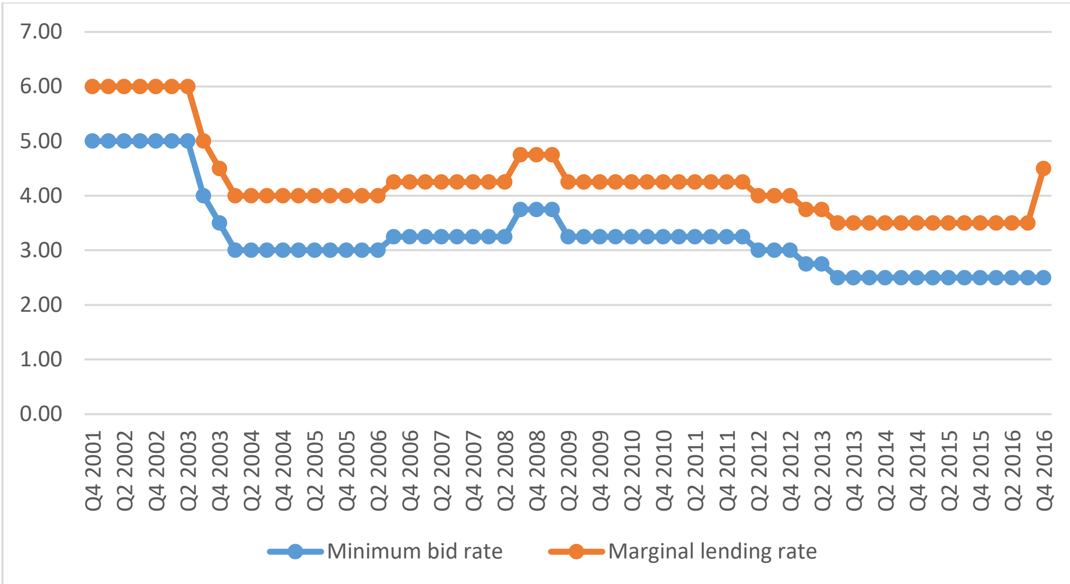


Table 2.2: BCEAO - Reserve requirement ratios applicable to banks (1998 – 2018)

	Up to Nov. 15, 1998	**Nov. 16 - Dec. 15, 1998**	**Dec. 16. 1998 - Aug. 15, 2000**	**Apr. 16 - Aug. 15, 2000**	**Aug. 16 – Sept . 15, 2000**	**Sept. 16, 2000 - Apr. 15, 2002**	**Apr. 16, 2002 - Mar 15, 2004**	**Mar 16, 2004 - June 15, 2005**	**June 16, 2005 - June 15, 2009**	**June 16, 2009 -May 15, 2010**	**May 16 - Dec. 15, 2010**	**Dec. 16, 2010 - Mar 15, 2012**	**Mar 16, 2012 - Mar 15, 2017**	**Mar 16, 2017 - Dec. 2018**
(in percentages)														
Benin	9.0	9.0	3.0	3.0	9.0	9.0	9.0	13.0	15.0	9..0	7.0	7.0	5.0	3.0
Burkina Faso	9.0	9.0	3.0	3.0	3.0	3.0	3.0	3.0	7.0	7.0	7.0	7.0	5.0	3.0
Cote d'Ivoire	9.0	1.5	1.5	3.0	3.0	5.0	5.0	5.0	5.0	5.0	5.0	7.0	5.0	3.0
Guinea Bissau	5.0	5.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0	7.0	5.0	3.0
Mali	9.0	9.0	3.0	3.0	3.0	3.0	9.0	9.0	9.0	7.0	7.0	7.0	5.0	3.0
Niger	5.0	5.0	1.5	3.0	5.0	5.0	5.0	5.0	9.0	7.0	7.0	7.0	5.0	3.0
Senegal	5.0	1.5	1.5	3.0	9.0	9.0	9.0	9.0	9.0	7.0	7.0	7.0	5.0	3.0
Togo	9.0	3.0	1.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0	7.0	5.0	3.0

Source: BCEAO

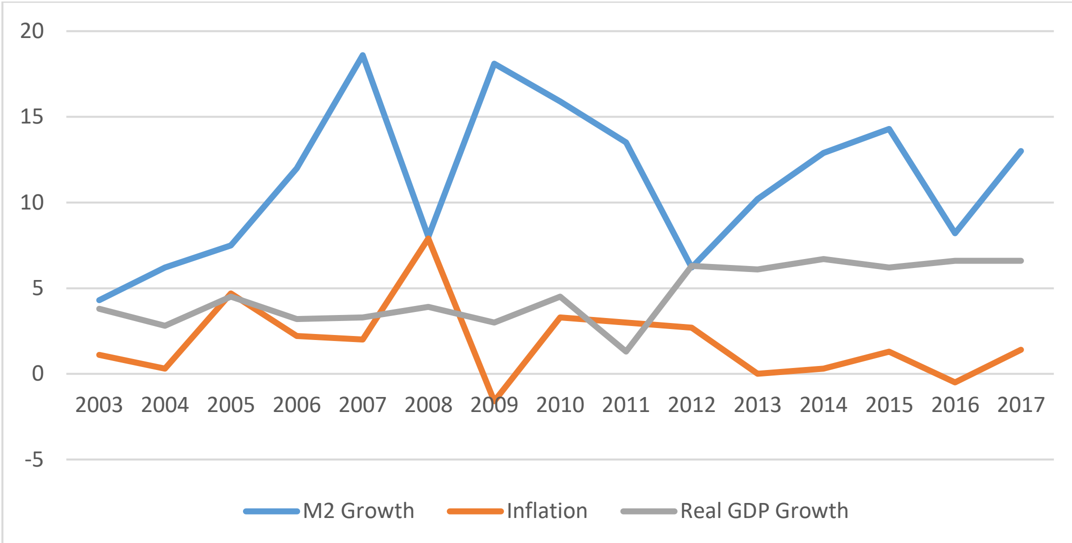
nominated by the State to ensure the convertibility of the common currency, and four other members from WAMU member States, appointed intuitu personae by the Council of Ministers.

In principle, given the fixed exchange rate regime operated by the WAEMU and the peg of the CFA franc to the euro, the BCEAO relinquishes its ability to conduct independent monetary policy in the presence of full capital mobility. This derives from the 'impossible trinity' or the 'trilemma', theorized by Mundell (1963) and Fleming (1962), which precludes the simultaneous pursuance by a central bank of the three policy goals of fixed exchange rate, free capital mobility and an independent monetary policy. Within this context, monetary policy autonomy is possible in a fixed exchange rates arrangement only if controls are imposed on capital account transactions. Allowing free capital mobility undermines the monetary authorities' ability to regulate the money supply as their policy actions in altering the short-term interest rates are offset by capital movements. Capital control measures could include administrative and priced-based restrictions which assume the form of taxes, limits and even bans on cross-border financial activity.

In the WAEMU, the economies are characterised by significant capital controls in respect of capital transactions with non-residents, with prior approval required on almost all outward capital transfers. The restrictions to capital mobility and the differences in credit risk have contributed to altering the expected co-movement between the BCEAO and ECB policy rates. In view of the limited capital mobility and a monetary policy framework with its primary objective of price stability and with the ability to set nominal interest rates independent of developments in the euro rates, the BCEAO possesses the capacity for independent monetary policy (Kireyev, 2015, pp. 8–11).

Figure 2.9 below presents the trend in broad money growth, inflation and real GDP growth over the period 2003 – 2017. Throughout this period, inflation in the WAEMU was within low single digits, with the exception of 2008 when it reached 7.9% which could be attributed to the impact of the 2007-2008 global food and fuel crisis. Since 2009, inflation has been well anchored to that in the euro area on account of the exchange rate peg. Real GDP growth, which up to 2011 remained below 5 percent, has been robust at above 6 percent since 2012. Broad money growth was characterised by severe volatility over the period. It however appears to have served as a leading indicator of the trend in inflation since 2013.

Figure 2.9: WAEMU - Broad money growth, Inflation and Real GDP growth (2003 - 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in the WAEMU has been expanding over recent years and is comprised of diverse institutions, including 122 commercial banks, 142 insurance companies, 702 registered microfinance institutions, and a stock exchange, as at end December 2016 (Table 2.3). The system is predominantly bank-based, with the banking sector accounting for a large percentage of its assets. The banks are heterogeneous, including in terms of their business models and size, and comprise a mix of WAEMU-based local banks, Pan-African banks, and international banking institutions, mostly European. As depicted in Figure 2.10, over the period 2012 – 2016, the banks in the WAEMU were on average highly capitalised, surpassing the statutory capital adequacy threshold of 8 percent. The quality of their credit portfolio has however been a cause for concern. Non-performing loans (NPLs) consistently recorded double digits throughout the period. Profitability of the banking system was on average strong, as reflected in the positive return on assets (ROA) and the return on equity (ROE).

Overall financial sector depth in the WAEMU is low, though it compares favourably against the ECOWAS average in 2016. As shown in Figure 2.11, the ratio of private sector credit to GDP for each member country, with the exception of Guinea Bissau and Niger, exceeded the ECOWAS average, though significantly lagging the average depth for SSA countries. The ratio of broad money to GDP for the WAEMU was slightly above both the ECOWAS and the SSA averages. Mali and Niger reported the lowest scores in respect of this indicator. Both indicators of financial depth were significantly lower than those in advanced economies. Access to finance in WAEMU member countries remains a challenge, with the region lagging both the ECOWAS and SSA averages in terms of key indicators, including commercial bank branches (per 100,000 adults), depositors with commercial banks (per 1,000 adults), and automated teller machines (ATMs) (per 100,000 adults), reported in Figure 2.12. Access to financial services through mobile banking however possesses great potential, as reflected in the high mobile cellular subscriptions in the union outperforming the SSA average.

The WAEMU operates a regional stock market, the BRVM[23], launched in 1998 to promote cross border access to financing, primarily for long-term investment, at reduced cost of transactions from using harmonised issuance procedures. It offers stocks by listed companies and bills and bonds from WAEMU companies and regional institutions. Stock market capitalisation remains low, averaging 24.1 percent of GDP between 2014 to 2016 (Figure 2.13), and transactions have mainly taken the form of short-term financing to governments.

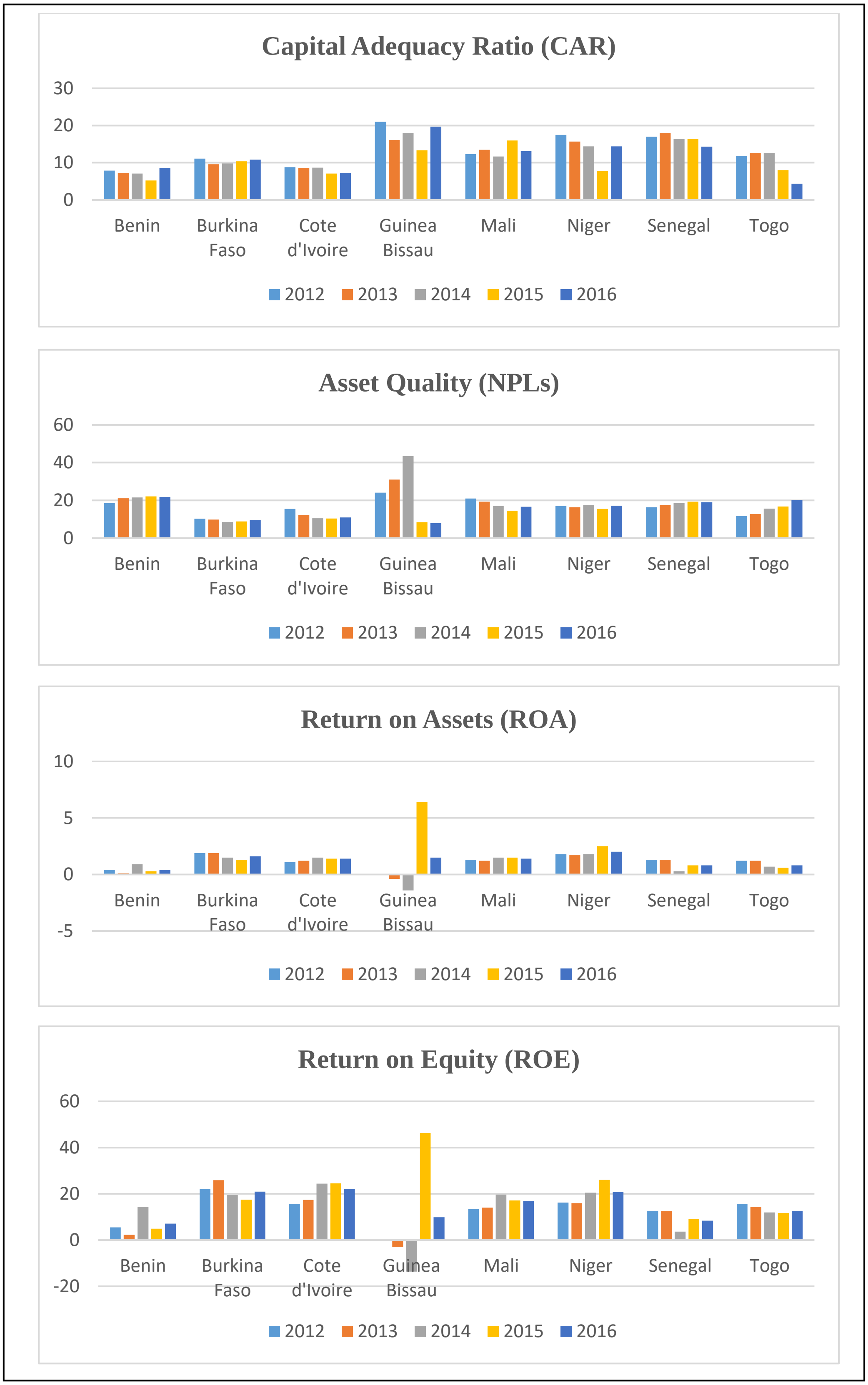
Table 2.3: Overview of Key Financial Institutions in WAEMU

Country	No. of Banks	No. of Insurance companies	No. of Microfinance Institutions	No. of Stock Exchanges
Benin	15	20	81	NA
Burkina Faso	13	10	74	NA
Cote d'Ivoire	27	28	64	1
Guinea Bissau	5	1	18	NA
Mali	13	18	127	NA
Niger	12	20	42	NA
Senegal	24	27	208	NA
Togo	13	18	88	NA
WAEMU	**122**	**142**	**702**	**1**

Source: WAMA 2017

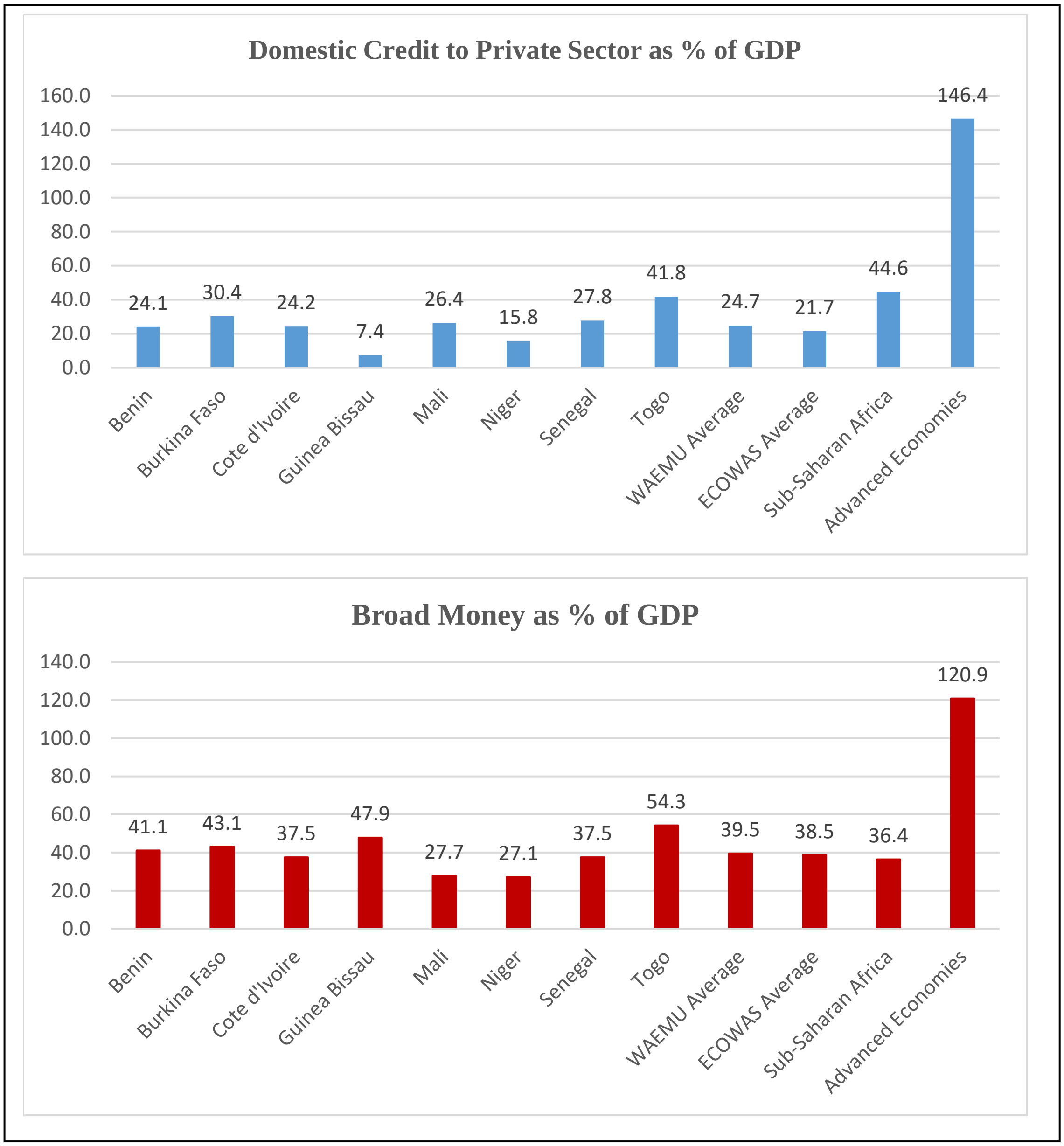
[23] The BRVM is French acronym for Bourse Regionale des Valeurs Mobilieres

Figure 2.10: Key Financial Soundness Indicators for WAEMU (2012 – 2016)



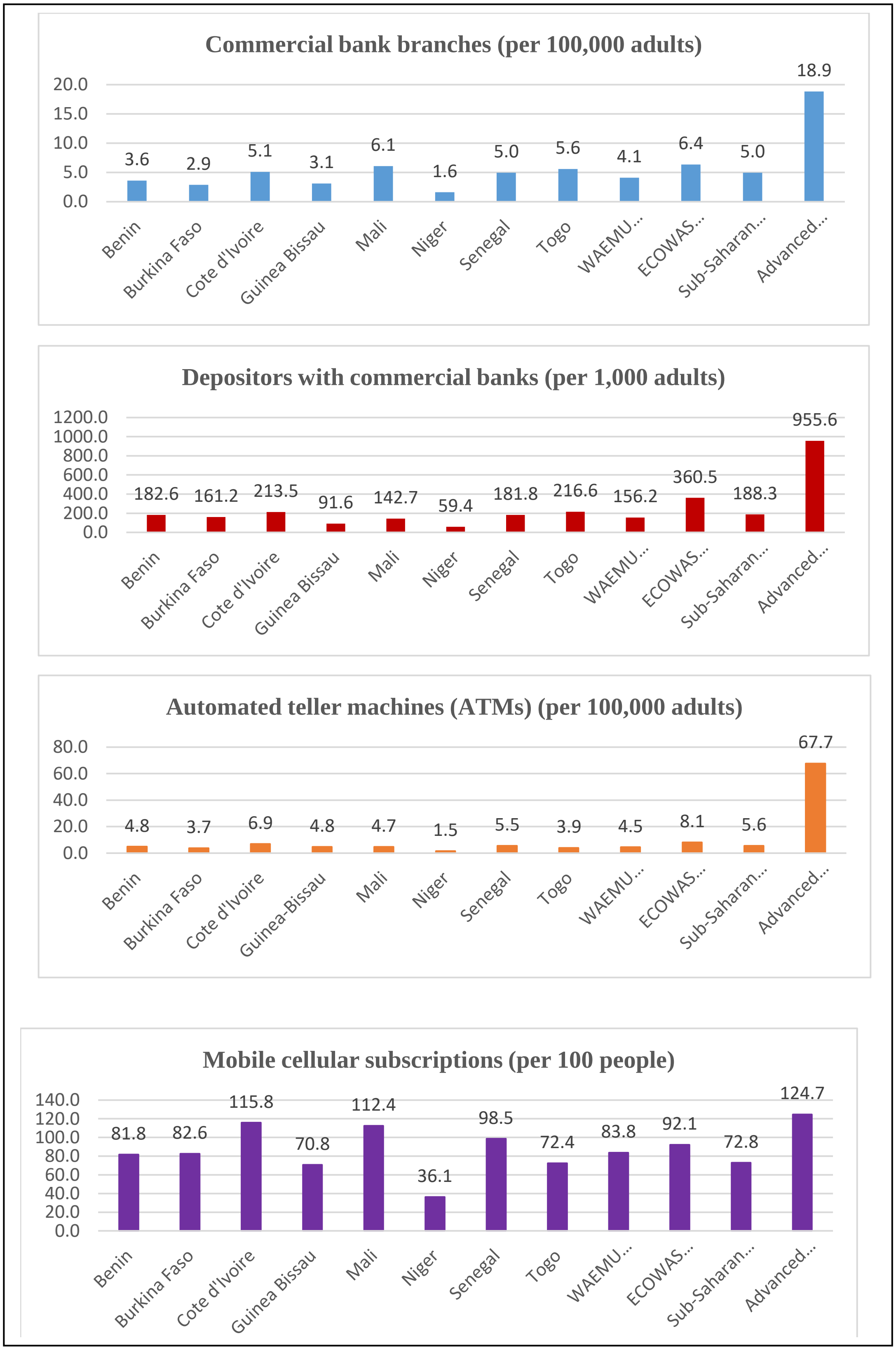
Source: WAMA 2017

Figure 2.11: Indicators of Financial Depth for the WAEMU (2016)



Source: World Development Indicators 2016 (Accessed on June 21, 2019)

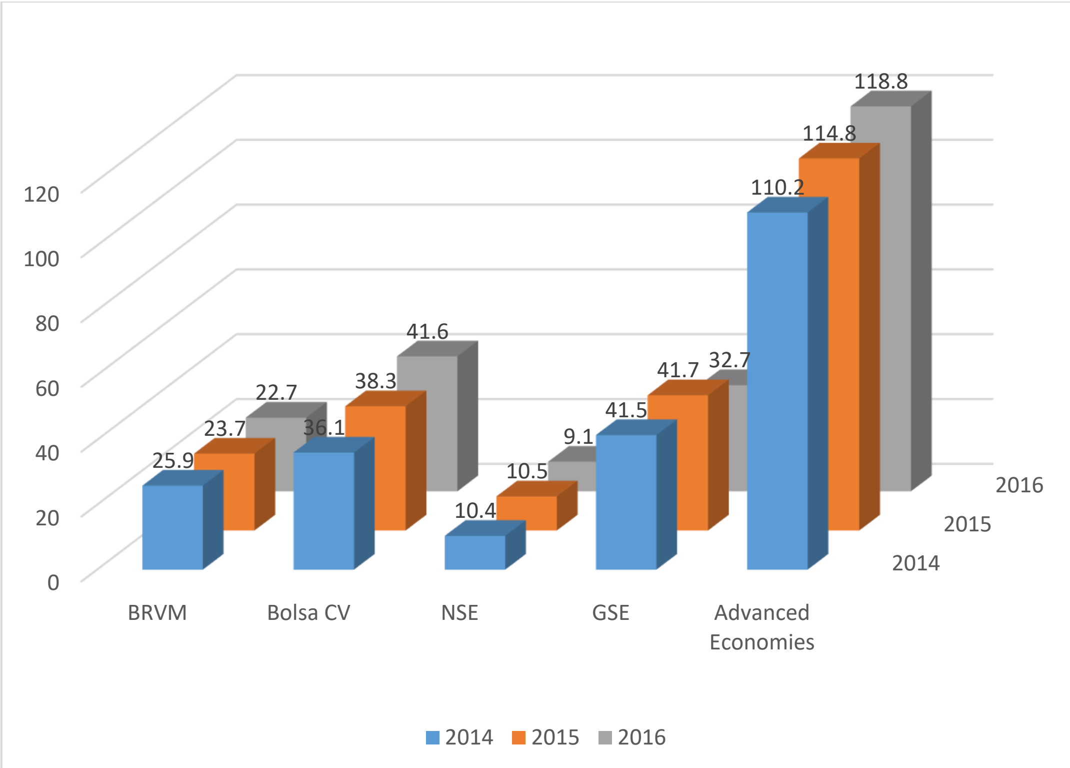
Figure 2.12: Selected Financial Access Indicators for the WAEMU (2016)



Source: World Development Indicators 2016 (Accessed on June 21, 2019)

Note: *Data for advanced economies represent average for the only two OCED countries (Italy and Turkey) recorded for 2016.

Figure 2.13: Stock Market Capitalisation as % of GDP



Source: WAMA 2017

2.4.2 Monetary policy frameworks and financial sector development in the WAMZ

Monetary targeting has been the dominant framework for conducting monetary policy by central banks within the WAMZ. This has involved the use of reserve money as the operational target and a monetary aggregate as intermediate target directly linked to the ultimate goals of price stability, defined in terms of low inflation, and sustainable economic growth. In Liberia, however, the high level of dollarization has meant the adoption of an exchange rate targeting framework, with exchange rate as its intermediate target to influence monetary conditions. Also, Ghana operated a monetary targeting framework up until 2007 when it adopted an inflating targeting regime.

The broad schematic representation of the operational frameworks of monetary policy in the WAMZ is presented in Figure 2.1.4 below, with the various instruments, targets and objectives employed highlighted below each category:

Figure 2.14: Schematic Representation of the Monetary Policy Frameworks in the WAMZ

Monetary Policy Instruments →	**Operating Target(s)** →	**Intermediate Target(s)** →	**Ultimate Objective(s)**
Open market Operations	Reserve Money	Broad Money	Price Stability (*primary objective*)
Lending/Deposit Facilities	Short-term interest rates	Inflation Rate	Economic Growth
Foreign Exchange Operations	Exchange rate	Exchange rate	Financial Stability etc.
Repo and Reverse Repo Transactions			
Reserve Requirements			

Source: Author's construction

2.4.2.1 The Gambia

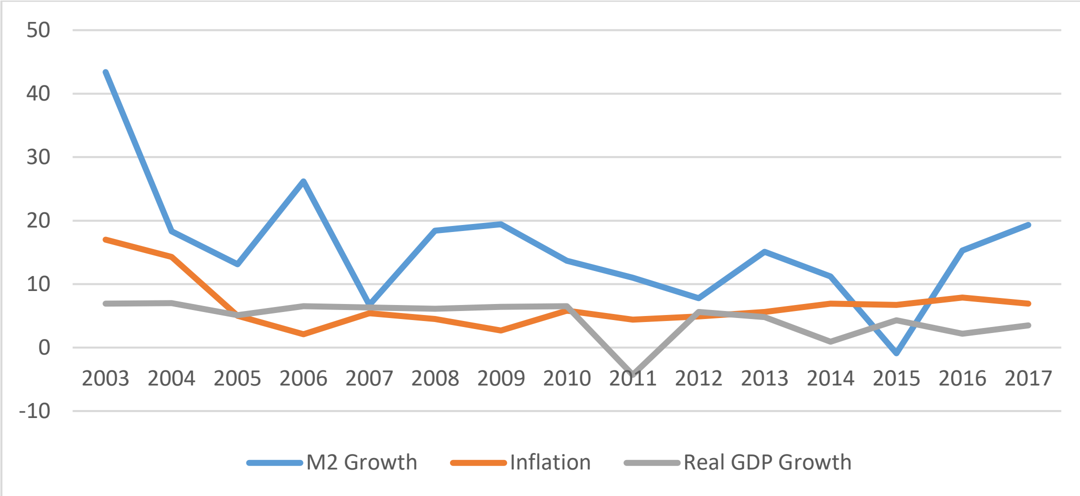
The conduct of monetary policy in The Gambia is defined by the Central Bank of The Gambia (CBG) Act 2005 which stipulates price stability as the overarching objective of monetary policy. The CBG Act 2005 also provides for the pursuance of subsidiary objectives that includes achieving and maintaining exchange rate stability and promoting the development of a sound financial system to support attainment of sustainable economic growth. The inception of this revised statute accorded the CBG greater autonomy or independence in the conduct of monetary policy.

The CBG transitioned from the use of direct monetary tools, including interest rate controls and selective credit allocations, to indirect market-based instruments of monetary policy in 1986 as part of economic and financial sector reforms supported by the IMF. With the introduction of a treasury bills market in 1987, open market operations in government and central bank securities has since constituted the dominant instrument for monetary operations. The primary dealers are the commercial banks through which institutions and individuals participate in the auctions. Secondary market sales and purchases of the securities are undertaken through a special window at the CBG. Other instruments at the disposal of the CBG to regulate liquidity in the banking system include reserve requirements and rediscount window. The Bank intervenes in the foreign exchange market mainly to smoothen short-term fluctuations rather than as an explicit tool for liquidity management.

In implementing the framework of monetary targeting, the CBG regularly monitors the factors which influence liquidity conditions, notably the Central Bank’s net international assets and net foreign assets. The Bank occasionally sterilizes external financial inflows which, in addition to supporting open market operations, helps ease exchange rate volatility and contain inflationary pressures. In August 2018, the Bank introduced standing deposit and lending facilities to establish an effective interest rate corridor, and in October 2018, it launched the central bank bills to help enhance monetary policy implementation (IMF, 2019a). The CBG continues to improve its monetary policy framework, including by strengthening its liquidity forecasting framework to better inform monetary operations.

Figure 2.15 below depicts the trend in broad money growth, inflation and real GDP growth from 2003 to 2017. It reveals that the double-digit rate of inflation in The Gambia in the early 2000s (17 percent and 14.3 percent in 2003 and 2004, respectively), was underpinned by significantly high broad money growth over the period. The rate of inflation has thereafter remained in single digits as the growth rate of broad money has lowered. Real GDP growth which was strong up to 2010, became subdued during the latter part of the review period, averaging 2.7 percent from 2014 to 2017. The Real GDP growth of less than one percent in 2014 could partly be attributed to the secondary effects of the Ebola crisis that hit the region in that year.

Figure 2.15: The Gambia - Broad money growth, Inflation, and Real GDP growth (2013 – 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in The Gambia is liberalised, with market determined interest rates and the absence of exchange controls. It comprises commercial banks, insurance companies, foreign exchange bureaus, microfinance institutions and other non-bank finance institutions. The banking sector consisted of 12 commercial banks as at end December 2016, one of which provides Islamic banking services. The sector is dominated by a small number of banks, with the four largest banks accounting for almost 75 percent of the industry's total assets as at end December 2016. Financial soundness indicators, depicted in Figure 2.22 (and detailed in appendix A.5), reveal that over the period 2012 – 2016 the banking sector was highly capitalized as majority of the banks complied with the minimum capital adequacy requirement. Assets quality remained within satisfactory limits, though the ratio of NPLs to gross loans increased to 9.3 percent in 2016 from 6.5 percent the preceding year. The banking industry continued to be profitable, reflecting positive ROA and ROE over the period. The microfinance sector has expanded steadily as a source of microcredit and is dominated by small savings and credit associations.

Indicators of financial deepening for The Gambia reveal that the financial sector remains shallow. As reflected in Figure 2.23, the ratio of private sector credit to GDP in 2016 was lowest among WAMZ member countries and significantly lagged behind the ECOWAS and SSA averages. However, broad money as a percent of GDP was at par with the ECOWAS average and slightly exceeded the average for SSA countries. Key access to finance indicators in respect of the number of commercial bank branches, depositors with commercial banks, ATMs and mobile phone subscriptions for The Gambia in 2016 outperformed both the ECOWAS and SSA averages (Figure 2.24), enhancing prospects for greater financial inclusion.

The country however lacks a stock exchange which constrains the public and private sector's ability to mobilise medium to long-term resources and support the country's development agenda. The authorities have however established a national task force to develop the requisite legal and regulatory framework for capital market development.

2.4.2.2 Ghana

Monetary policy is conducted in Ghana using an inflation targeting (IT) framework.[24] The Bank of Ghana (BOG) Act (2002) provided the legal framework for the transition to an IT regime, including by guaranteeing the central bank's operational independence in setting the policy interest rate as the principal instrument for signalling its monetary policy stance and also anchoring inflation expectations. The primary objective of the BOG's monetary policy is price stability, though without prejudice to this objective, the Bank supports the general economic policies of Government, including promoting economic growth, employment and effective and efficient operation of banking and credit systems. At present, price stability is defined in terms of a medium-term target of 8 percent with a symmetric band of +/- 2 percent. Inflation targets are set jointly by the Ministry of Finance and the Bank of Ghana and are often clearly spelt out in the annual budget statement. The current horizon for achieving the inflation target is between 18-24 months. In line with the statutory provisions of the BOG Act 2002, a monetary policy committee (MPC)[25] was established in 2002, charged with the responsibility for formulating monetary policy.

The period prior to the commencement of IT in May 2007 could be characterised by two distinct monetary arrangements. First, up to 1992 monetary policy was conducted on the basis of direct monetary management whereby the authorities exerted direct control over domestic credit to regulate the money supply with a view to attain the primary goal of low and stable inflation. To this end, the BOG authorized sectoral allocations and limits on

[24] South Africa is the only other country in sub-Saharan Africa operating an IT framework. The IT regime was adopted in the year 2000.

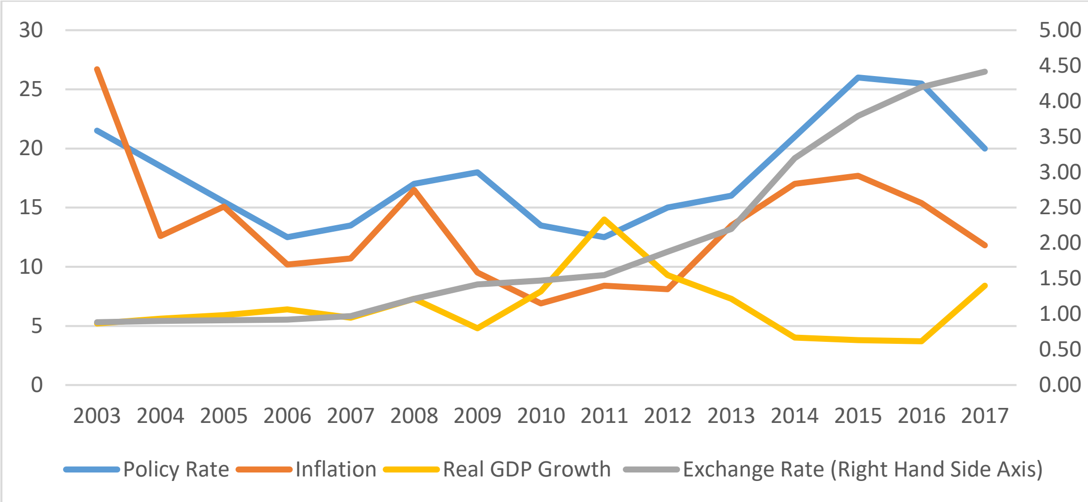
[25] The MPC consists of seven members including the Governor (Chair), the two Deputy Governors, the Director of Monetary Policy Analysis, the Director of Banking Operations, and two external members appointed by the Minister of Finance.

commercial bank lending, and administratively determined interest rates. The second phase which commenced in 1992 witnessed a transition to indirect monetary management in which the monetary targeting framework was predicated on open market operations (OMO) in treasury securities. Within this framework, the conduct of OMO was aimed at achieving the operational target set on reserve money on the central bank's balance sheet, assumed to be directly linked to the money supply through a stable money multiplier. Evident weaknesses in the underlying assumptions of the monetary targeting framework, notably stable money multiplier and money demand relationships, paved way for the adoption of the IT framework.

The introduction of the IT regime witnessed significant efforts by the BOG to develop the requisite institutional, analytical and communications frameworks to support its implementation. In addition to the enhanced policy independence provided by the BOG 2002 Act, the inflation forecasting capacity of the Bank was strengthened by adopting a model-based framework and monetary policy operations deepened to include the use of overnight repo and reverse repo facilities to create an interest rate corridor around the policy rate and exert the BOG's influence on the interbank market and other money market rates. Additionally, the OMO of the BOG to regulate domestic liquidity was divorced from financing of the public sector borrowing requirements.

The IT regime appears to have served the country well thus far, though without challenges of its own. The rate of inflation stabilised at single digits between 2009 and 2012 (Figure 2.16 below) following the adverse effects of the global food and fuel price shocks in 2007-08 and the preceding period of heightened inflationary pressures, which peaked at 26.7 percent in 2003. However, the pass-through of depreciation in the Ghanaian cedi drove the inflation rate into double digits, attaining close to 18 percent in 2015. The BOG responded with a monetary tightening by steadily raising the policy rate which reached at high of 26 percent by 2015. Inflation reverted to a downward trajectory, though it remained in low double digits by the end of the review period as exchange rate pressures persisted. To return and maintain the inflation rate within its stipulated target, the monetary authorities need to better anchor inflation expectations by strengthening policy credibility. Real GDP growth followed a downward trajectory following a high of 14 percent in 2011 but recovered strongly recording 8.4 percent in 2017 as the monetary disturbances appeared to have abated.

Figure 2.16: Ghana – Policy rate, Exchange rate, Inflation, and Real GDP growth (2003 – 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in Ghana is comprised of a range of financial institutions including commercial banks, a host of deposit-taking non-bank financial institutions such as savings and loans companies, finance companies etc. and non-deposit taking financial institutions including leasing and mortgage companies and microfinance companies. The banking industry which consisted of 30 commercial banks with over 1000 branches in 2016 accounted for almost 70 percent of the total assets of the financial sector. The banking sector was adequately capitalized averaging 16.5 percent over the period 2012 to 2016, well above the regulatory minimum of 10 percent and the BOG's recommended level of 13 percent. However, at the individual bank level there was significant heterogeneity, with some banks below the minimum requirement. While the banking industry remained profitable recording strong ROA and ROE over the period, asset quality deteriorated steadily. At 17.4 percent in 2016, the ratio of NPLs to gross loans far exceeded the 10 percent statutory ceiling.

The financial sector in Ghana is characterised by a reasonable level of depth relative to other member countries in the WAMZ. Both the ratio of private sector credit to GDP and the ratio of broad money to GDP exceeded the WAMZ average, though significantly lagged the ECOWAS and SSA averages in 2016 (Figure 2.22). The indicators of financial access are quite favourable, with the number of commercial bank branches, depositors with commercial banks, ATMs and mobile phone subscriptions outperforming both the ECOWAS and SSA averages (Figure 2.23). The country operates a stock exchange, the Ghana Stock Exchange

(GSE), and had a total number of listed companies of almost 40 as at end December 2016. Market capitalisation as a ratio of GDP averaged 38.6 percent over the period 2014 to 2016, as reported in Figure 2.13 above.

2.4.2.3 Guinea

The primary objective of monetary policy as enshrined in the Central Bank of the Republic of Guinea (BCRG) statute of 2014 is price stability, with financial stability and exchange rate stability as secondary objectives. Without prejudice to these objectives, the BCRG supports the Government's overall economic policy agenda of promoting strong and sustainable economic growth. The 2014 statute provides the basis for independence of the BCRG and for the setting up of a Monetary Policy Committee (MPC)[26] charged with the responsibility of formulating monetary policy and defining its policy instruments. A new 2016 BCRG Law was amended in 2017 to strengthen the Bank's financial and operational autonomy, including by prohibiting issuance of guarantees by the BCRG to the private sector (IMF, 2019b, p.67).

The main framework for conducting monetary policy is monetary targeting framework, wherein broad money supply growth serves as intermediate target that is achieved through adjustments to the monetary base. The framework assumes a direct relationship between base money and inflation. Within the context of the structural adjustment program supported by the IMF which commenced in the second half of the 1980s, the Republic of Guinea undertook significant monetary reforms culminating in a transition from direct monetary control to a system based on indirect management in 1990. Open Market Operations (OMO) have been the main policy instruments to regulate liquidity in the banking system and ensure the provision of credit to the economy, consistent with the ultimate objective of price stability. The OMO is conducted using the main repurchase operations rate (OPR) through which the BCRG provides liquidity to the banking system against 7-days treasury securities and the monetary regulation securities (TRMs) by which liquidity is absorbed or injected against securities of up to 91 days. In practice, the TRMs are utilised to absorb excess liquidity and refinancing operations to meet liquidity needs, thereby creating an interest rate corridor. The policy rate represented by the marginal refinancing rate has served as a mere

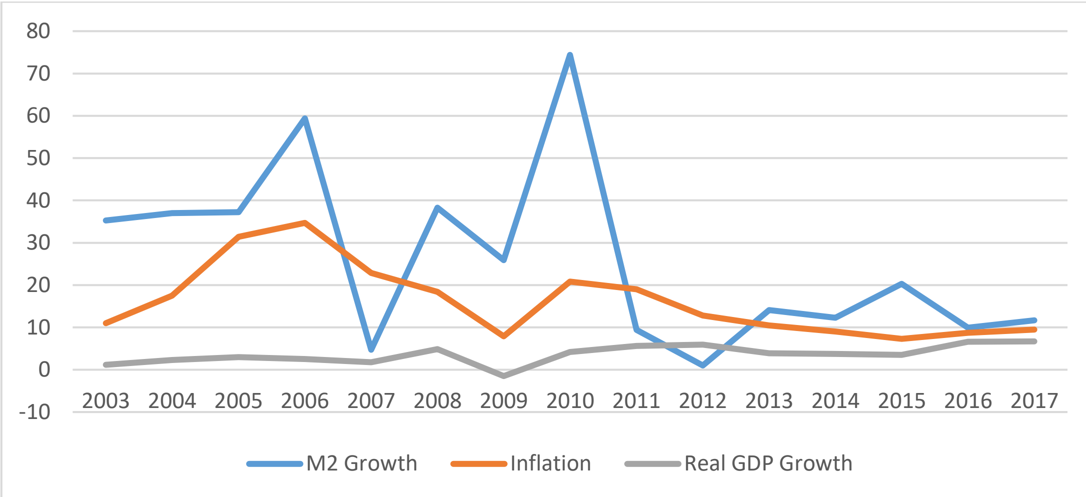
[26] The MPC consists of seven members, three of which are ex officio (The Central Bank Governor and two Deputy Governors) and the remaining four members appointed by the President of the Republic of Guinea.

reference rate. Other policy instruments at the disposal of the BCRG include the required reserves ratio and the exchange rate intervention.

Intervention in the foreign exchange market by the BCRG has been a regular feature of monetary policy employed to absorb excess liquidity in the banking system. The BCRG has sought to fix the exchange rate at levels consistent with the target rate of inflation and price competitiveness of the economy. Towards that end, the BCRG has proceeded by setting a narrow band around a reference exchange rate (weighted average of commercial bank rates) within which the commercial banks are required to buy and sell foreign exchange. As a consequence, a wide margin has obtained between the official and the parallel market rates. The BCRG has therefore worked to improve the operation of the foreign exchange market with a view to unifying the official rate and foreign bureau markets rates and eliminating multiple exchange rates. In December 2015, the BCRG implemented a number of reform measures that have improved the flexibility of the exchange rate and unified the exchange rates. These reforms include the elimination of the band limiting the fluctuations in the official rate and the introduction of a new facility to mop up domestic liquidity and support adjustment in the exchange rate. The authorities are also working on setting up an electronic platform for interbank transactions in domestic and foreign currencies (IMF, 2019b, p. 67).

Inflation in Guinea has been characteristically high at double digits for most of the period up to 2013, peaking at about 35 percent in 2006. Broad money growth exhibited severe volatility, unable to serve as a nominal policy anchor in the context of the monetary targeting regime operated by the BCRG. The relatively subdued rate of growth of broad money since 2011 helped reduce inflationary pressures, with inflation contained within single digits since 2014. The early part of the review period witnessed low real GDP growth rates, averaging about 2 percent between 2003 and 2007. Following the adverse impact of the shock caused by the Ebola crisis, robust growth of above 6.5 percent was recorded in 2016 and 2017, as presented in Figure 2.17 below.

Figure 2.17: Guinea – Broad money growth, Inflation, and Real GDP growth (2003 – 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

In Guinea, the key institutions within the financial sector as of end December 2016 included commercial banks (16), insurance companies (11), microfinance companies (13) and a few money transfer offices and foreign exchange bureaus. The sector is dominated by the banking industry, with three large banks accounting for almost 60 percent of total industry assets. On average, the commercial banks were adequately capitalised over the period 2012 to 2016 at 13.3 percent (Figure 2.22). The quality of the credit portfolio remained with statutory limits within this period, though the NPL ratio deteriorated from 4.8 percent in 2012 to 9.4 percent in 2016. The banking industry was only marginally profitable in terms of the ROA, but the ROE was much stronger over the period.

Guinea's financial sector is quite shallow and is largely focused on the provision of traditional financial intermediation services, mainly savings and short-term credit. Private sector credit was a mere 9.5 percent of GDP in 2016 compared to the SSA average of 28.3 percent, while the ratio of broad money to GDP was 25.1 percent lagging the sub-regional average of 36.4 percent. Access to financial services remains limited, as reflected in the least number of commercial bank branches (per 100,000 adults) and bank depositors (per 1,000 adults) in the WAMZ region and much lower than the SSA average in 2016 (Figure 2.24). The microfinance sector has been expanding over recent years as a channel for accessing finance, though only a small fraction of the demand for credit is fulfilled. However, with mobile phone subscriptions around the WAMZ average and above the SSA average, the sector holds the potential for expanding financial services. The implementation of a National Strategy for Financial Inclusion, adopted in 2014, will further enhance financial inclusion. Guinea lacks a stock exchange, constraining opportunity for mobilising long-term financing.

2.4.2.4 Liberia

By the Central Bank of Liberia (CBL) Act of 1999, the principal objective of monetary policy is to achieve and maintain price stability. In pursuing this objective, the CBL institutes measures aimed at preserving the purchasing power of the national currency and fostering 'monetary, credit and financial conditions conducive to orderly, balanced and sustained economic growth and development'. In view of the high level of dollarization of the Liberian economy, the monetary authorities seek to effectively influence domestic monetary conditions and contain inflationary pressures by working to maintain exchange rate stability.[27] The framework for the conduct of monetary policy has been anchored on the exchange rate as intermediate target and has thus aimed to contain volatility in the exchange rate while at the same time accumulating foreign exchange reserves. Towards this end, monetary operations have involved periodic foreign exchange auctions, in addition to targeting a level of reserve money through open market operations. The CBL is also strongly supportive of the country's development agenda through its promotion of financial inclusion and the provision of selective credit to productive sectors of the economy. Another policy instrument at the disposal of the CBL is the cash reserve requirement, though it has not proven to be effective as an instrument for transmitting monetary policy impulses. This could be attributed to the fact that a significant proportion of currency in circulation is held outside of the banking system and cannot be influenced by adjustments in the reserve requirement ratio.

The CBL has sought to strengthen monetary operations through increased trading in government securities, notably Treasury bills and Treasury bonds, for liquidity management to help sterilize excess liquidity in the banking system, in addition to helping smoothen out government short-term cash flow. While monetary operations have mostly been conducted in the primary markets, efforts are being made to deepen operations in the secondary market. The CBL is also working to extend the issuance of government securities beyond

[27] In Liberia, the US dollar is a legal tender and comprises more than 80 percent of the commercial banks' deposits and 90 percent of bank lending (IMF, 2016, p. 14).

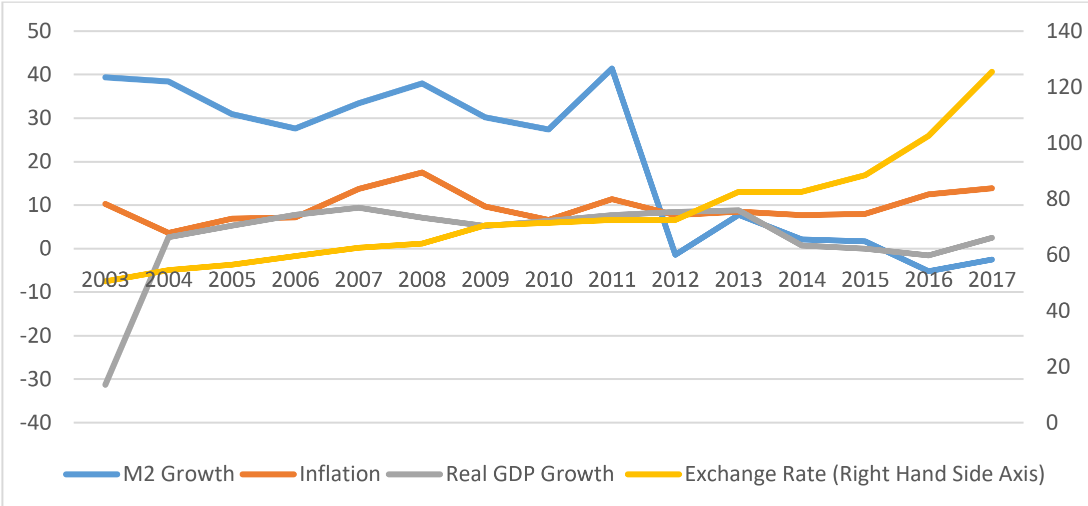
institutional investors, to retail investors with a view to further strengthen the financial markets. In addition, the Bank has transitioned from manual to electronic platform by operationalising some aspects of the Scriptless Security Settlement System (DEPO/X).[28]

The conduct of monetary policy by the CBL is challenged by a number of factors, including the lack of effective operational instruments to manage domestic liquidity in the face of the high dollarization of the Liberian economy and underdeveloped domestic currency and foreign exchange interbank markets; and the weak monetary policy framework that lacks a clear mandate of price stability as its primary objective and an effective communication strategy (IMF, 2018c, p. 40). The ability of the CBL to manage liquidity has also been constrained by statutory legislation enshrined in the 2014 amendment to the CBL Act requiring parliamentary approval for the issuance of currency. As part of the CBL's plans to modernize the monetary policy framework, the Bank 'has abandoned the exchange rate as a policy anchor, and the exchange rate is now a de facto "other managed" float' (IMF, 2018c, p. 13). The Bank intends establishing a Monetary Policy Committee (MPC) and introducing a Monetary Policy Rate (MPR).[29]

Figure 2.18 below reveals that the trend in inflation up to 2011 was driven by monetary developments, in spite of the fact that monetary policy was not predicated on explicit monetary targeting. Movements in the exchange rate have exerted meaningful impact on inflation since 2015 as the marked depreciation in the Liberian dollar translated into double digit inflation, notwithstanding the subdued growth in the money supply. The strong growth in real GDP since 2005 was dampened by the adverse shock from the Ebola epidemic in 2014 resulting in a recession (average growth of -0.3 percent over 2014 – 2016).

[28] The DEPO/X system is a well-organised electronic platform that supports the conduct of the foreign exchange auction and the processing of government securities.
[29] As a first step towards this transition, a Monetary Policy Advisory Committee (MPAC) is being constituted with the responsibility for monetary policy formulation subject to the approval of the Board of Governors (CBL Policy Statement 2019). www.cbl.org .

Figure 2.18: Liberia - Broad money growth, Exchange rate, Inflation and Real GDP growth (2003 – 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in Liberia comprises a range of institutions, including commercial banks, rural community finance institutions, credit unions, insurance companies, microfinance institutions, and a large number of foreign exchange bureaus. The banking industry, consisting of 9 banks with 87 branches in 2016 spread across most regions, was adequately capitalised over the period 2012 to 2016, registering a ratio of regulatory capital to risk-weighted assets averaging of 22.4 percent. However, asset quality remained a challenge as the NPL ratio persisted above the statutory limit of 10 percent. Profitability of the industry was adversely affected, with both the ROA and ROE recording negative outturns over the period.

The financial sector in Liberia is shallow, partly attributed to legacy problems of years of political instability and civil conflict in the 1990s and early 2000s. Both private sector credit as a ratio of GDP and broad money as a ratio of GDP, key indicators of financial deepening, were 13.9 percent and 22.1 percent, much lower than respective ECOWAS and SSA averages of 21.7 percent and 38.5 percent, and those of SSA averaging 44.6 percent and 36.4 percent, respectively. Financial access indicators, notably the number of commercial bank branches (per 100,000 adults), ATMs (per 100,000 adults) and the mobile phone subscriptions (per 100 people), also indicate that the country lagged the ECOWAS and SSA averages in 2016. Mobile money services have however been expanding over the years, supported by the adoption of a Mobile Money Regulation in 2014. Liberia does not have a stock exchange, limiting access to medium to long-term funds for private investment and public sector development programmes. However, the authorities have enacted a Securities Market Bill and a Central Securities Depository Bill which provide the regulatory framework for development of financial and capital markets.

2.4.2.5 Nigeria

As enshrined in the Central Bank of Nigeria (CBN) Act, 2007, the primary objective of monetary policy in Nigeria is to maintain price stability, broadly defined by low and stable inflation. In addition, the CBN Act 2007 emphasizes the need for preserving the stability of the exchange rate, maintaining a favourable balance of payments position, developing a sound financial system, and promoting high and sustainable economic growth. The conduct of monetary policy has evolved since the establishment of the CBN in 1958. For about a decade and half, monetary policy was conducted on the basis of an exchange rate targeting framework that ensured fixed parity between the domestic currency and the British pound sterling, with a view to attaining favourable balance of payments position and inflation control (CBN 2012, p. 18). Since 1973, the conduct of monetary policy in Nigeria has been predicated on a monetary targeting framework, with monetary aggregates serving as a nominal anchor for achieving the ultimate objectives of monetary policy.

Two phases of the monetary targeting framework could be distinguished. The first phase involved direct monetary control to attain the key policy objective of high and sustainable economic growth. This entailed the issuance of credit rationing guidelines to banks, specification of sectoral distribution of credit, and the administrative controls of interest rates, among other direct policy measures. The second phase which commenced in 1993 witnessed a switch from direct to indirect monetary control, within the context of the Structural Adjustment Programme (SAP) introduced in 1986. Here, liquidity management was pursued using market-based indirect policy instruments, notably open market operations, including through the outright sales or purchases of securities in the market, repurchase transactions (REPOs) and reverse repurchase transactions (Reverse REPOs). Other monetary policy instruments at the disposal of the CBN include cash reserve requirements and moral suasion. The minimum rediscount rate (MRR) was employed as an anchor for monetary policy, expected to influence short-term money market interest rates. The MRR was, however, found to be ineffective in transmitting monetary policy impulses on account of the persistent liquidity overhang in the banking system (CBN 2012, p. 19).

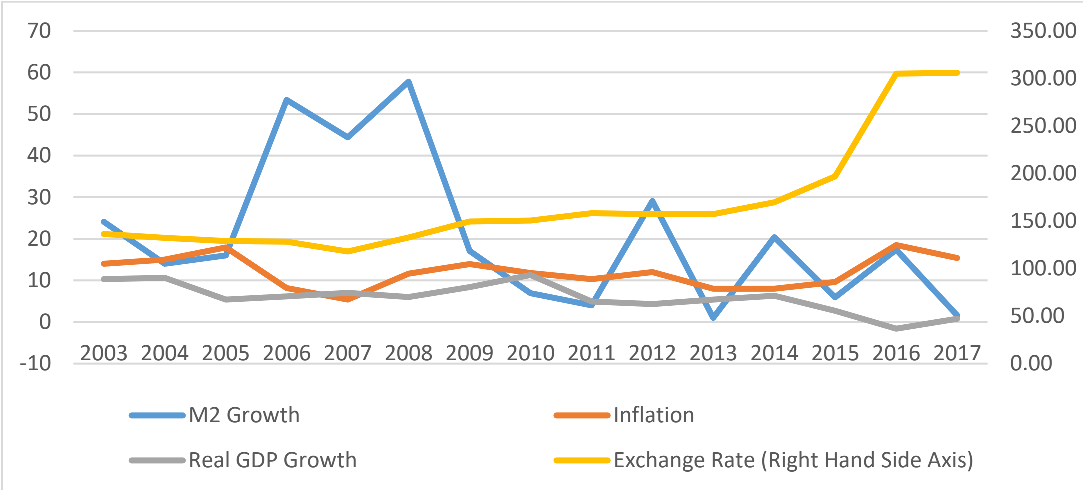
To modernise the monetary policy framework and strengthen monetary policy, a monetary policy rate (MPR) was introduced in 2006 to replace the MRR as the nominal policy anchor that provides indicative guidance for rates in the inter-bank market and the commercial banks. The introduction of the MPR together with the standing lending facility which provides liquidity to banks on an overnight basis and a standing deposit facility that remunerates banks on their deposits at the CBN, allows for the creation of an interest rate corridor within which the inter-bank and other market rates are steered. A Monetary Policy Committee (MPC)[30] constituted in 2007 with the overall responsibility for the formulation and implementation of monetary and credit policies. The MPC meets periodically to formulate monetary policy, including setting of the MPR.

Within this policy framework, the overnight interest rate serves to complement the monetary base as an operating target, while MPR guides money market rates towards the operating target. Monetary growth remains the intermediate target with an implied direct relationship with the ultimate policy variable(s). However, the CBN has continued to rely more on OMOs to contain inflationary pressures and much less on the MPR. This apparent conflicting use of policy instrument(s) and the pursuit of multiple objectives, including managing the exchange rate and promoting economic growth, creates a challenge for the conduct of monetary policy (IMF, 2018d, p. 84).

Figure 2.19 below shows that broad money growth exhibited extreme volatility over the review period and did not appear to have underpinned the trend in inflation. Instead, the inflation rate has been influenced by the pass-through effects of movements in the exchange rate. As an economy that relies significantly on oil exports, the drop in global oil prices since 2014 has adversely impacted fiscal revenues and foreign exchange earnings culminating in steady depreciation of the domestic currency, the Naira. Inflation trended upwards, attaining double digits of 18.5 percent and 15.4 percent in 2016 and 2017, respectively. The country apparently experienced a recession in 2016 as real GDP growth registered -1.6 percent.

[30] The MPC comprises the Governor of the Central Bank (Chairman), the four Deputy Governors of the Bank, two members of the Board of Directors of the Bank, three members appointed by the President, and two members appointed by the Governor.

Figure 2.19: Nigeria - Broad money growth, Exchange rate, Inflation and Real GDP growth (2003 – 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in Nigeria is vast relative to most countries within the ECOWAS, both in terms of the number of financial institutions and asset base. It includes money and capital markets, insurance companies, foreign exchange markets, and development finance institutions. As at end December 2016, it consisted of 22 commercial banks, with a large network of branches, 58 insurance companies, 5 discount houses, 64 finance companies, 825 microfinance companies, 1 stock exchange, and a large number of bureau-de-change operators. The financial system is dominated by the banking industry, accounting for up to 80 percent of total financial sector assets by 2016. The industry has been sound and appears to have benefitted from the bank consolidation exercise implemented in 2005 which culminated in a significant reduction in the number of commercial banks and attracted substantial investment in the sector. The industry has been adequately capitalised, with the ratio of bank capital to risk-weighted assets exceeding the statutory requirement over the period 2012 to 2016 (Figure 2.22). Asset quality was relatively good, as the NPL ratio averaged 5.9 percent, though by 2016 it breached the 10 percent threshold by 4 percentage points. Overall, the industry continued to be profitable, reflected in positive ROA and ROE throughout the period.

The financial sector remains shallow, as key indicators of financial deepening lag both the ECOWAS and SSA averages as at end 2016 (Figure 2.23). Private sector credit as a percentage of GDP at 15.7 percent records the highest score among WAMZ countries, while, on the other hand, the ratio of broad money to GDP was the lowest in the zone (20.4 percent) as at end-2016. Key indicators of access to short-term finance depicted in Figure 2.24 show that the country in most cases outperformed the ECOWAS and SSA averages in 2016, reflecting a generally higher level of financial inclusion. Nigeria operates a stock exchange, the Nigeria Stock Exchange (NSE), which offers a range of services, including listing and trading services, creating opportunities for access to medium to long-term financing for businesses and the public sector. Compared to other stock exchanges in the ECOWAS, the market capitalisation of the NSE was nonetheless the lowest relative to GDP, averaging 10 percent over the period 2014 to 2016 (Figure 2.12 above).

2.4.2.6 Sierra Leone

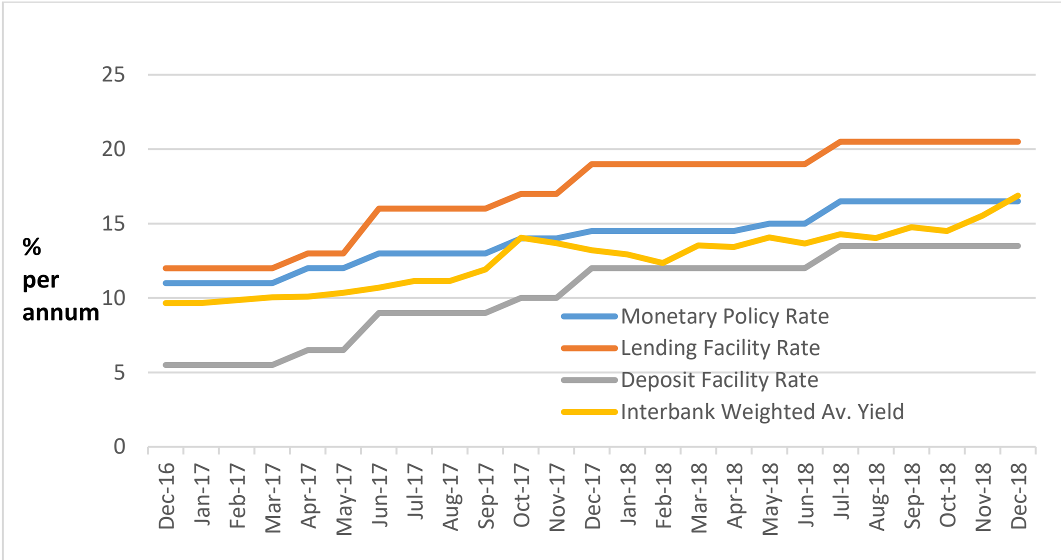
The primary objective of monetary policy, as stipulated in the Bank of Sierra Leone (BSL) Act 2011, is the attainment and maintenance of price stability, without prejudice to the BSL's responsibility for formulating and implementing financial regulation and prudential standards, and foreign exchange and reserves management policies. Like most countries within the WAMZ, Sierra Leone operates a monetary targeting regime with reserve money the operating target linked through the intermediate target of broad money to the ultimate goals of low inflation and sustainable economic growth. To this end, the BSL sets quarterly targets on reserve money consistent with programme targets on inflation and economic growth under the Extended Credit Facility (ECF) programme supported by the IMF. Similarly, the conduct of monetary policy has evolved over the years. Prior to the 1990s, monetary policy was pursued using direct instruments of monetary management, with administrative ceilings on interest rates, sectoral allocation of credit, and several other restrictions on financial market activities. The system of direct monetary management often required commercial banks to maintain an explicit credit ceiling with a view to achieving a stipulated money supply target.

In line with the deregulation of the financial system within the context of implementation of an IMF Structural Adjustment Program (SAP), the BSL in 1990 shifted away from direct monetary controls considered financially repressive to an indirect system of monetary management. Consistent with this framework was the liberalization of trading in government securities through an auction system, with market determined interest rates on Treasury Bills and Treasury Bearer Bonds. Open market operations have since been the main instrument of monetary policy, though operations were mostly concentrated in the primary market for government securities, with limited trading in the interbank market. The cash reserve requirement (CRR) is another monetary policy instrument at the disposal of the BSL but has been seldom employed to manage domestic liquidity. In fact, the CRR ratio has remained at 12% since 2004. The BSL's ability to conduct monetary policy has over the years been constrained by the limited array of monetary policy instruments.

To enhance the efficacy of monetary policy, the BSL has over recent years implemented a series of policy measures, including developing a liquidity forecasting and management framework to guide monetary operations, preparing a Master Repurchase Agreement (MRA) that formed the basis for commencement of repurchase agreements (repos) and reverse repurchase agreements (reverse repos), and introducing a monetary policy rate (MPR) to effectively signal the stance of monetary policy. Standing lending and deposit facilities have also been established to enhance management of domestic liquidity. A monetary policy committee (MPC)[31] has been constituted with the responsibility for formulating monetary policy, as enshrined in the BSL Act 2011. The MPC meets quarterly to deliberate on economic developments influencing monetary policy and to set the MPR and the interest rates on the Bank's repurchase transactions and standing facilities. The effectiveness of the MPR in steering market interest rates and signalling the stance of monetary policy has been challenged by the persistent structural liquidity surplus in the banking system and the weak liquidity management. However, recent trends in the policy interest rates, depicted in Figure 2.20 below, reveal that the MPR has been successful in steering the interbank rate within the interest rate corridor bounded on the upper end by the standing lending facility and on the lower end by the standing deposit facility.

[31] The MPC consists of the Governor, the Deputy Governor, three persons appointed by the Governor, and two other persons with relevant knowledge and expertise appointed by the Minister of Finance.

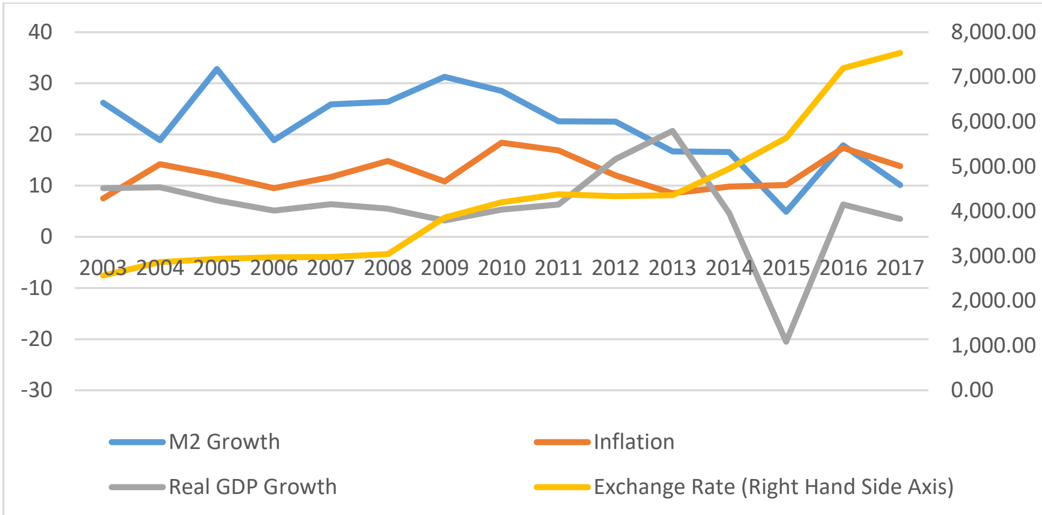
Figure 2.20: Sierra Leone - Policy interest rates corridor



Source: Bank of Sierra Leone

From Figure 2.21 below, it is evident that inflation, which recorded double digits for most of the period up to 2012 was driven by the high growth rate of monetary aggregates. The steady depreciation of the exchange rate since 2013 has adversely impacted consumer prices, given the high pass-through of import prices. Following the global food and fuel crisis in 2007/2008, real GDP growth was robust and by 2013 Sierra Leone became one of the fastest growing economies in the world with a growth rate of over 20 percent, as the country commenced large-scale mining operations in an atmosphere of favourable global commodity prices. However, adverse twin shocks on the economy triggered by the Ebola crisis and global commodity price collapse, resulted in a significant output contraction of 20.5 percent in 2015.

Figure 2.21: Sierra Leone - Broad money growth, Exchange rate, Inflation and Real GDP growth (2003 – 2017)



Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in Sierra Leone is liberalised and competitive, comprising a diverse range of financial institutions, including commercial banks (13), insurance companies (12), community banks (17), an apex bank, a stock exchange and several microfinance institutions and foreign exchange bureaus, as at end 2016. The system is dominated by the banking sector, accounting for a large percentage of total assets. Over the period 2012 to 2016, the banking sector was relatively stable and adequately capitalised, averaging 35.6 percent (Figure 2.23). The industry was profitable throughout the period, recording a ROA of 2.6 percent and a ROE of 14.2 percent. Asset quality remained a challenge for most banks and the industry average of NPLs to gross loans at 26.5 percent, far exceeds the regulatory ceiling of 10 percent. The effective functioning of the country's credit reference bureau may help reduce the huge portfolio of NPLs by addressing the problem of asymmetric information in the credit market that has led to adverse selection and moral hazards.

The financial sector in Sierra Leone remains shallow, with private sector credit as a percent of GDP at 5.8 percent in 2016, compared to the ECOWAS average of 21.7 percent and the SSA average of 44.6 percent in 2016. The ratio of broad money to GDP also lagged the ECOWAS and the SSA averages (Figure 2.24). Access to financial services, as reflected in the number of commercial bank branches, ATMs and depositors with commercial banks, is also limited relative to most ECOWAS counterparts and sub-regional peers. The microfinance sector has however been expanding as a source of financing for low-income earners and small and medium-sized businesses, with microfinance institutions and financial services associations totalling 13 and 51, respectively, by end 2016. Mobile phone subscriptions have increased significantly and exceeded the SSA average by 2016, creating an opportunity for greater financial inclusion through mobile services. Sierra Leone operates a stock exchange but has been largely inactive with a low market capitalisation and only three listed companies since inception in 2007 up to end 2016.[32] A Securities and Exchange Bill is awaiting enactment that would lead to the establishment of an effective Securities and Exchange Commission.

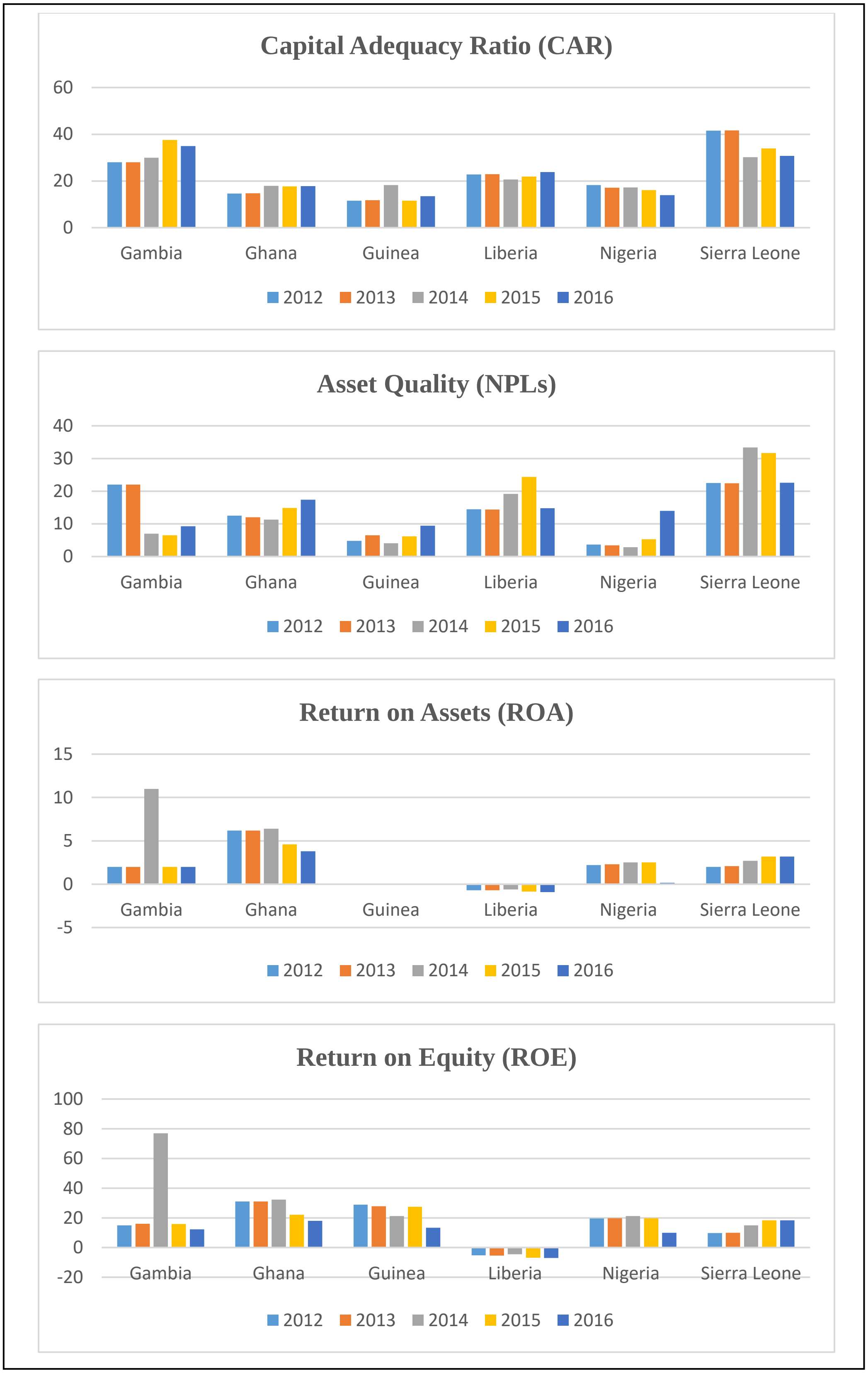
Table 2.4: Overview of Key Financial Institutions in the WAMZ

Country	No. of Banks	No. of Insurance companies	No. of Microfinance Institutions	No. of Stock Exchanges
Gambia	12	13	71	NA
Ghana	30	50	65	1
Guinea	16	11	20	NA
Liberia	9	20	122	NA
Nigeria	22	58	825	1
Sierra Leone	13	12	13	1
WAMZ	**102**	**164**	**1116**	**3**

Source: WAMA 2017

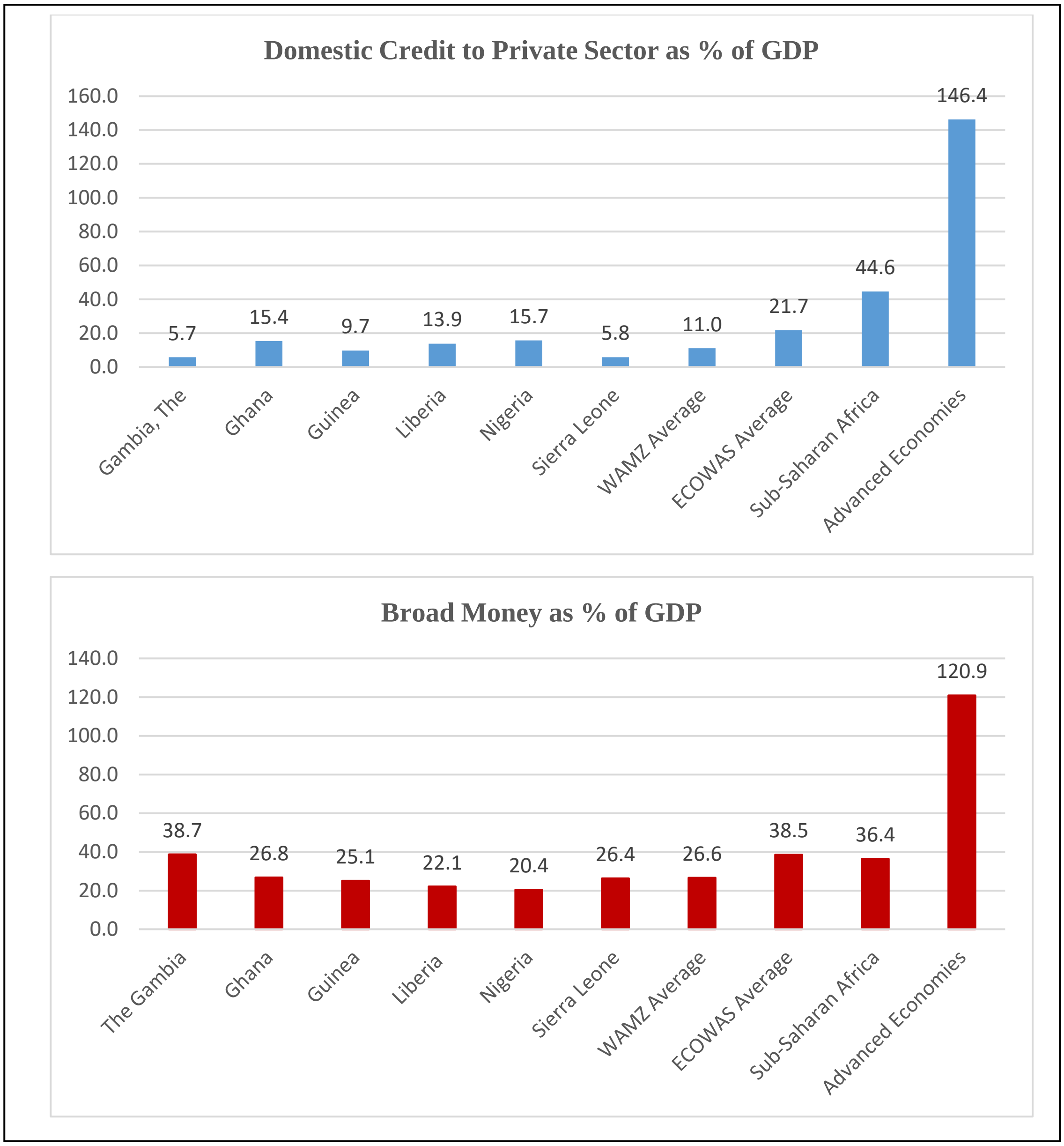
[32] Rokel Commercial Bank, First Discount House, and the Commerce and Mortgage Bank.

Figure 2.22: Key Financial Soundness Indicators for the WAMZ (2012 – 2016)



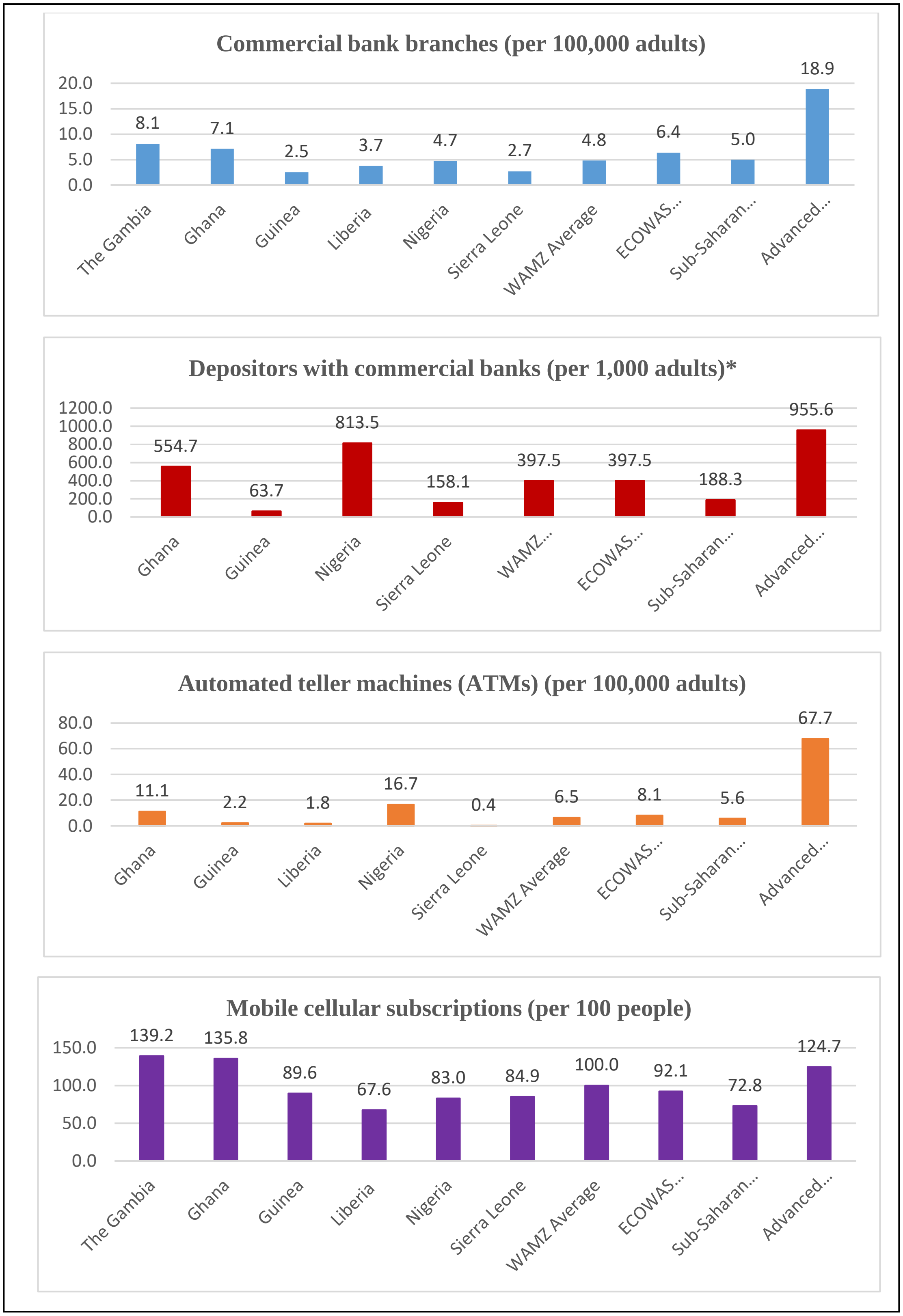
Source: WAMA 2017

Figure 2.23: Indicators of Financial Depth for the WAMZ (2016)



Source: World Development Indicators 2016 (Accessed on June 21, 2019)

Figure 2.24: Selected Financial Access Indicators for the WAMZ (2016)



Source: World Development Indicators 2016 (Accessed on June 21, 2019)

Note: *Data for advanced economies represent average for the only two OCED countries (Italy and Turkey) recorded for 2016.

2.4.3 Monetary policy framework and financial sector development in Cabo Verde

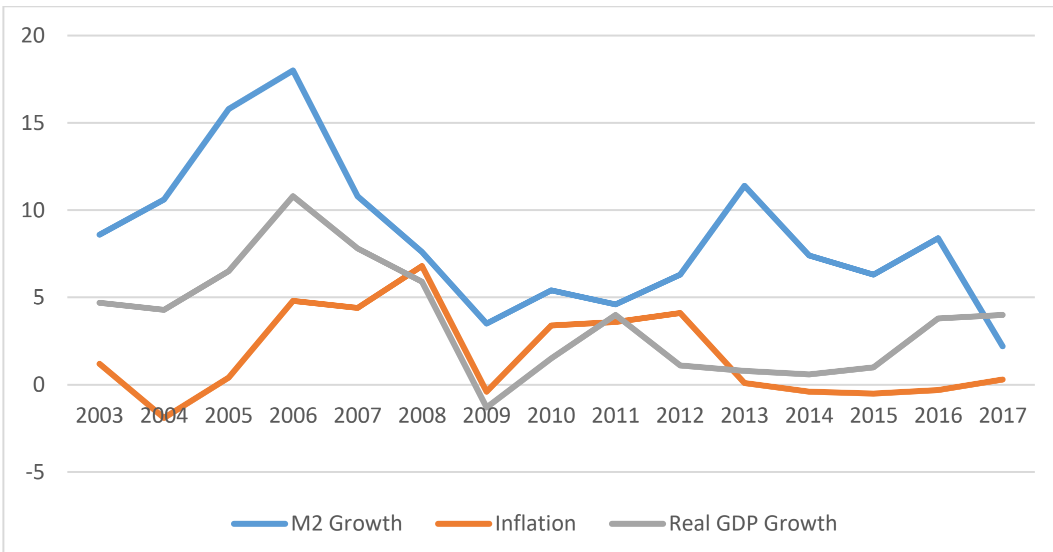
Responsibility for the conduct of monetary policy rests with the central bank of Cape Verde (BCV), as stipulated in the country's Organic Law No.10/V/2002. The primary objective of monetary policy is the maintenance of price stability, considered crucial for achieving macroeconomic stability, promoting economic growth and fostering job creation. The Cabo Verdean currency, the Escudo, has maintained a unilateral peg to the euro since 1998 which ensures currency convertibility and supports the BCV's price stability objective. Within this context, anchoring national inflation to inflation expectations in the Euro area warrants accumulation of international reserves adequate to cover the country's short-term contractual and contingent liabilities and preserve the exchange rate peg.

In Cabo Verde, the limited capital controls allow for independent monetary policy in spite of the theoretical loss of monetary sovereignty presupposed by the exchange rate peg to the euro. Like most countries in the ECOWAS region, prior to the early 1990s Cabo Verde conducted monetary policy through direct monetary controls, including the use of credit ceiling, sectoral credit allocation and administered interest rates. In 1993, the country transitioned to an indirect system of monetary management that involves implementation of monetary policy through monetary instruments such as open market operations, minimum reserves requirement, and standing facilities. Open market operations to stabilize liquidity in the banking system are conducted on a weekly basis through the issuance of monetary regularization securities and monetary intervention securities. Two types of standing facilities are operated by the BCV to address temporary liquidity imbalances in the banking system: the deposit facility which allows banks to place overnight deposits with the BCV and the lending facility that provides a window for banks to obtain overnight liquidity from the BCV against eligible assets.

The BCV established a Monetary Policy Committee in October 2004 charged with the responsibility for periodic review of monetary developments in the economy to support the decision-making process of the BCV's Board of Directors. The MPC meets on a monthly basis, with provision for ad hoc extraordinary sessions as the situation demands. The current operational framework for monetary policy employs interest rates as an operational target and exchange rate stability as the intermediate target to attain the ultimate objective of price stability.

In Cabo Verde, inflation was maintained in single digits throughout the review period, which could be partly attributed to the anchoring of inflation expectations to those in the euro area. In fact, a period of deflation was recorded between 2014 and 2016. That said, it is also clear from Figure 2.25 below that broad money growth has trended with the rate of inflation for most of the period, consistent with steadfast implementation of an IMF-supported monetary program by the BCV authorities. Real GDP growth which was strong in the early part of the review period became generally subdued after 2008, though indications at the end of the period point to a rebound.

Figure 2.25: Cabo Verde - Broad money growth, Inflation and Real GDP growth (2003 – 2017)

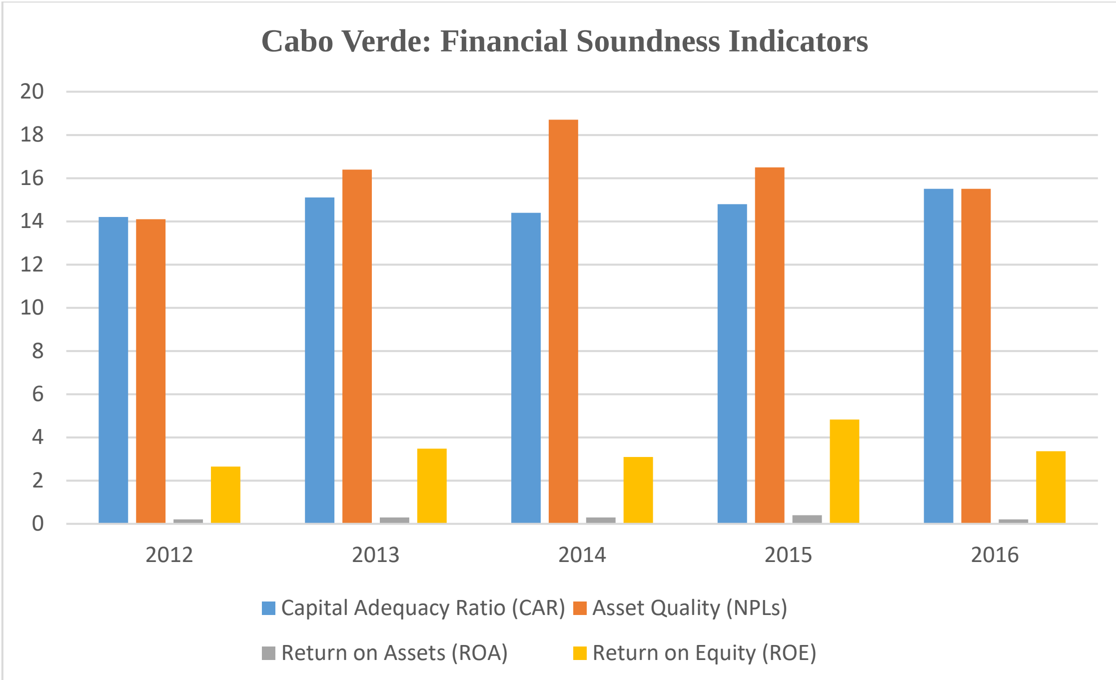


Source: IMF Regional Economic Outlook for Sub-Saharan Africa (April 2018b and October 2009)

The financial system in Cabo Verde is expansive relative to the country's level of economic development and compares favourably to most countries within the ECOWAS region in terms of depth. As at end 2016, it comprised 8 registered commercial banks, 2 insurance companies, and an active stock exchange. Growth of the system has particularly been rapid over the past decade and by end-2016 assets of the financial sector totalled 139 percent of the GDP. The financial sector is dominated by the banking system which accounted for more than 85 percent of the total assets of the financial sector. The banking industry has been adequately capitalised, averaging 14.8 percent over the period 2012 to 2016, though a few banks encountered difficulties meeting the statutory requirement. Asset quality was challenging for the banking system, with NPLs to total loans averaging 16.2 percent over the period, well above the 10 percent threshold. The weak asset quality undermined the industry's profitability as the ROA was marginally positive at 0.3 percent, while the ROE averaged 3.5 percent over the period (Figure 2.26).

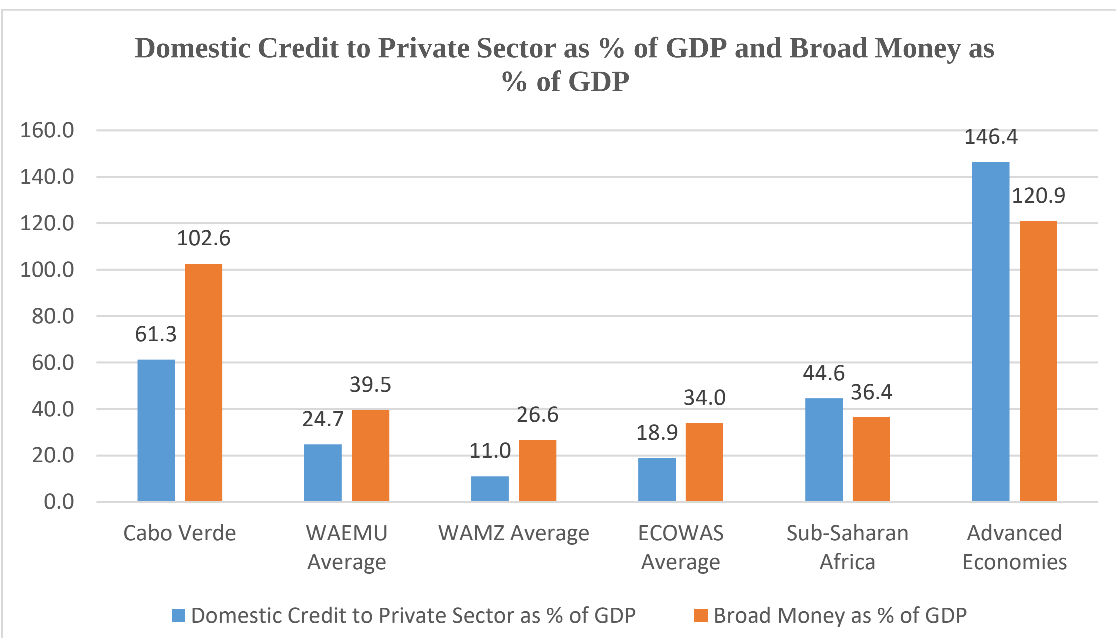
Key indicators of financial deepening indicate that Cabo Verde's financial sector outperforms counterparts in the ECOWAS and even the SSA average. As shown in Figure 2.27, private sector credit as a percentage of GDP was 61.3 percent by end-2016, surpassing the averages for WAEMU (24.7 percent), WAMZ (11.0 percent), ECOWAS (18.9 percent) and SSA (44.6 percent). The ratio of broad money to GDP was 102.6 percent, compared to 39.5 percent, 26.6 percent, 34.0 percent and 36.4 percent for WAEMU, WAMZ, ECOWAS and SSA, respectively. Access to finance remained challenging for micro and small-scale enterprises, in spite of progress over the years. Notwithstanding, the country compares favourably with most ECOWAS and SSA countries in respect of indicators such as the number of commercial bank branches (per 100,000 adults), depositors with commercial banks (per 1,000 adults), ATMs (per 100,000 adults) and mobile cellular subscriptions (per 100 people) (see figure 2.28). The stock exchange in Cabo Verde, Bolsa de Valores de Cabo Verde (BVC), has expanded steadily with 230 listed securities among stocks, corporate bonds and treasury securities offered by various firms and companies (ASEA, 2016). Market capitalisation increased from 36.1 percent of GDP in 2014 to 41.6 percent in 2016, the highest compared to other stock exchanges in the ECOWAS (Figure 2.12 above).

Figure 2.26: Cabo Verde – Key Financial Soundness Indicators (2012 – 2016)



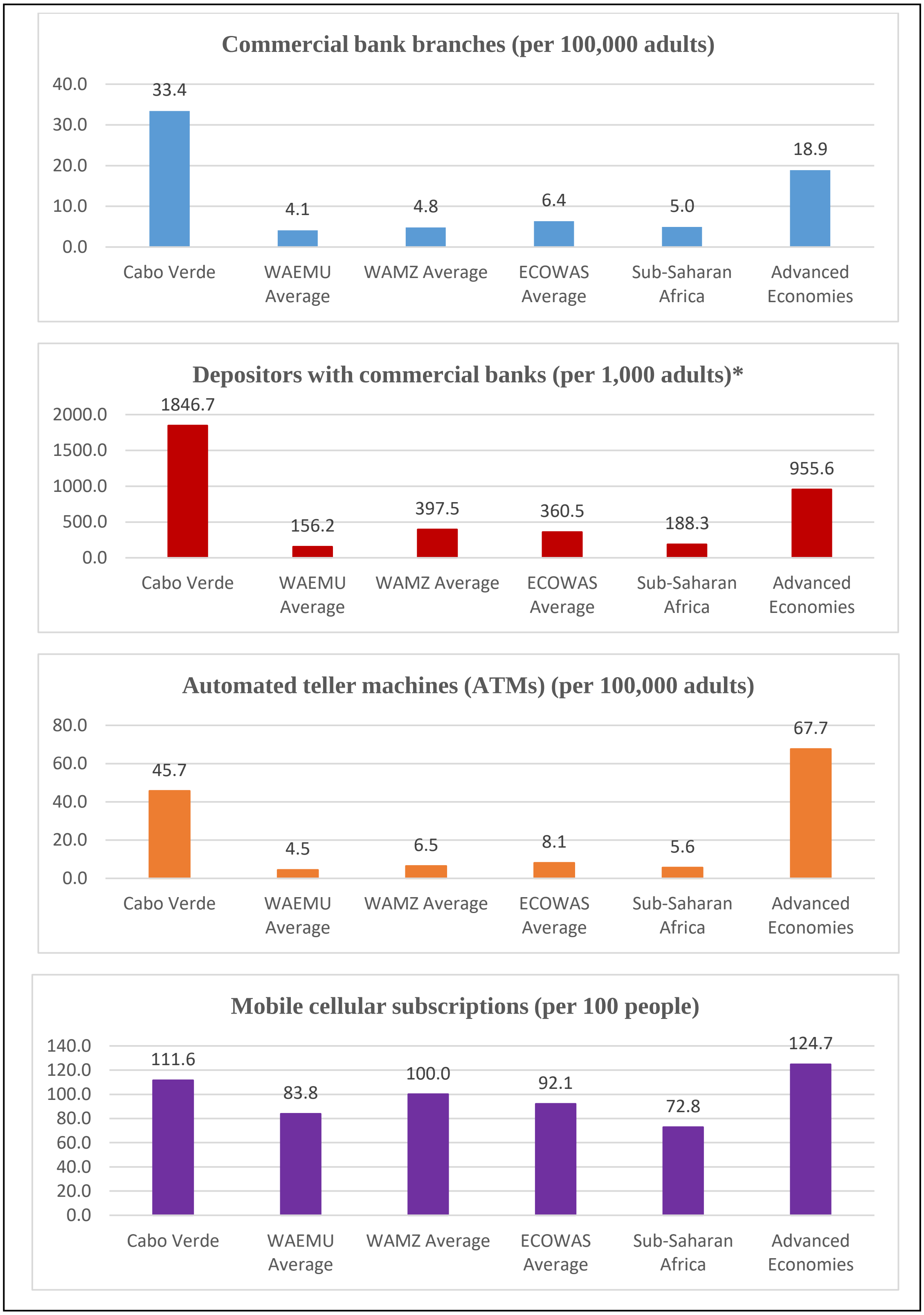
Source: WAMA 2017

Figure 2.27: Cabo Verde – Indicators of Financial Depth (2016)



Source: World Development Indicators 2016 (Accessed on June 21, 2019)

Figure 2.28: Selected Financial Access Indicators for Cabo Verde (2016)



Source: World Development Indicators 2016 (Accessed on June 21, 2019)

Note: *Data for advanced economies represent average for the only two OCED countries (Italy and Turkey) recorded for 2016.

Chapter 3: Assessing the stability of the money multiplier and monetary targeting as a viable policy framework for the proposed common central bank in West Africa.

3.1 Introduction

This chapter presents an assessment of the stability of the conventional money multiplier, a key assumption underlying the monetary targeting framework that has been adopted by several ECOWAS countries. It also examines the alternative theoretical perspective of the money creation process espoused by the endogenous money theory. Testable hypotheses in respect of the money multiplier are investigated using a range of panel unit root tests and both the Pedroni (2004) residual-based panel cointegration test and the Westerlund (2007) error-correction-based panel cointegration procedure. Robustness check of the results is undertaken by employing the Westerlund and Edgerton (2008) panel cointegration test, which is robust to structural breaks and cross-sectional dependence. With respect to the postulates of the endogenous money theory, the Dumitrescu and Hurlin (2012) panel Granger non-causality test is applied to the related testable hypotheses.

3.1.1 Background

Over recent years, the relevance of the conventional money multiplier concept as foundation for a viable framework for policy formulation and implementation has come under immense scrutiny, both in academia and the policy arena (Goodhart, 2017; Jakab and Kumlof, 2015; McLeay et al., 2014; Sheard 2013; Carpenter and Demiralp, 2012). The motivation mostly derives from experiences following the 2008/09 global financial and economic crisis whereby, in spite of the massive injection of liquidity through quantitative easing in some advanced economies—notably, United States, United Kingdom, Euro Area, and Japan—the recorded expansion in bank reserves did not translate into equivalent monetary expansion.[33] Such developments contradict the orthodox monetarist theoretical postulation which underpins the money multiplier, thereby reinforcing doubts about the operability and viability of the concept. As Goodhart (2017, p.7) categorically puts it, 'the monetary base multiplier almost never operated in practice; now it is defunct even in theory and in principle'.

[33] In the United States, reserve balances increased by a factor of more than 50 from $15 billion in July 2007 to $788 billion in December 2008, whereas broad money expanded by a mere 8.5 percent (Carpenter and Demiralp, 2012).

In fact, a growing theoretical perspective, in line with the Post-Keynesian school of thought, which has gravitated to the centre of policy discourse for the past two decades is that the direction of causation between monetary reserves and bank credit runs in the reverse direction.

For advanced countries and most emerging market economies the shift away from the monetary targeting framework which is built on the conventional money multiplier concept took hold a few decades back as the pace of financial innovation accelerated and financial markets deepened, rendering the relationships underlying the monetary targeting framework unstable and unreliable. Much of these economies now rely on short-term policy interest rates to signal their monetary policy stance and guide attainment of policy objectives. In developing countries, particularly in sub-Saharan Africa (SSA), the transition has been gradual, with only a handful of countries abandoning monetary targeting or relying much less on monetary aggregates as a policy anchor.[34]

The continued targeting of monetary aggregates by most central banks in the region is also motivated by their perception of a direct relationship between monetary aggregates and inflation, whereby excessive money growth will result ultimately in inflation. The monetary policymakers are thus of the view that exercising control over monetary aggregates would help keep inflation in check or at levels consistent with their overall macroeconomic objectives. Moreover, monetary targeting was said to help anchor inflation expectations given that monetary targets send immediate signals to market agents on the stance of monetary policy. It is also argued that monetary targeting provides immediate accountability for policymakers to keep inflation low and prevents them from falling into a time-inconsistency trap. However, for the policy regime to be effective in achieving its goals, certain prerequisites need to be fulfilled. These include appreciable central bank control over the target monetary aggregate, a stable money demand function, and a strong and reliable relationship between the objective variable, inflation, and the intermediate target variable, the money supply. It is also assumed that the monetary base, also referred to as reserve money, under the direct operational control of the central bank has a stable and predictable relationship with the money supply. The money multiplier, which serves as a direct link between the monetary base and the money supply, is thus an important building block of the

[34] Only South Africa and Ghana in the sub region have instituted full-fledged inflation targeting regimes.

monetary targeting framework and its stability is crucial for the monetary authorities' efforts in attaining their ultimate policy objective.

While the money multiplier has underpinned orthodox monetary theory and served as a widely-used measure for assessing the viability of the monetary targeting regime, an emerging theoretical paradigm for monetary analyses and policy guidance is the endogenous money theory, espoused by the Post-Keynesian school of economics. The theory of money endogeneity considers money an endogenous creation of the economy's production and places emphasis on the role of the banking system in money creation driven by private sector demand for credit. The central bank accommodates demand for reserves by commercial banks and employs the short-term interest rate as its main policy instrument. The causal relationships between bank credit and monetary aggregates underpinning this money theory provide useful insights into the appropriateness of a monetary policy regime. Moreover, the money multiplier is rendered ineffective as a leading indicator for monetary policy when the money supply is endogenous or partly endogenously determined (Nell 1999, p. 2).

In West Africa, the challenge of monetary policy formulation and implementation continues to be daunting given the dearth of policy instruments, underdeveloped financial markets, and fiscal dominance by central government, to name but a few. Also, with progress in instituting structural monetary and financial market reforms, the stability of underlying monetary relationships has become questionable. At present, monetary policy is conducted in the region mostly through the market mechanism using indirect policy instruments including open market operations and reserve requirements, on the basis of different different monetary policy frameworks ranging from monetary targeting and exchange rate targeting to more recently, inflation targeting. The commencement of a monetary union will witness the adoption of a unified monetary policy framework. To this end, building consensus on an appropriate policy framework to effectively conduct the common monetary policy is pivotal. Part of this consideration includes determining whether the monetary targeting framework on which basis monetary policy has been conducted by several member countries is a viable option.

3.1.2 Research Objectives

Against the above backdrop, this chapter investigates empirically the viability of monetary targeting as an operational policy framework for a common monetary policy in the proposed monetary union in West Africa. The objective is therefore two-fold:

First, to assess the stability of the money multiplier in the ECOWAS region in line with the orthodox monetarist perspective. In this regard, the study seeks to determine whether the proposed monetary union should rely on monetary aggregates as nominal anchor for achieving its primary policy objective(s).

Second, to examine whether the money creation process as espoused by the endogenous money theory lends support to the adoption of monetary targeting as a framework for the common monetary policy. Towards this end, the underlying theoretical relationships are assessed by investigating the direction of causation between commercial bank credit to the private sector and key monetary aggregates.

3.1.3 Research Contributions

The decision on the monetary policy framework on which the common monetary policy under the proposed ECOWAS monetary union is to be predicated—monetary targeting, inflation targeting or a 'hybrid' regime[35]—has to be informed by rigorous empirical research. The main contribution of this study therefore is to help to fill this gap by empirically assessing the stability of the conventional money multiplier—a key assumption underlying the monetary targeting framework—and examining the causal relationships among key credit and monetary variables underpinning the endogenous money theory with a view to informing the decision on an appropriate operational monetary policy framework.

The specific research contributions include:

i. Assessing the stability of the conventional money multiplier in the ECOWAS region within a panel framework. Separate investigations are conducted for the WAEMU countries and the Non-WAEMU[36] countries to provide further insight into stability at the level of the sub-monetary grouping. The empirical studies on the money multiplier in the region are quite few and predominantly country-specific. In general, the subject is under-researched, with

[35] Some countries in the sub-region, including Kenya and Uganda, have adopted policy regimes that target inflation while, at the same time, actively monitoring developments in monetary aggregates.
[36] The Non-WAEMU countries cover WAMZ member countries and Cabo Verde.

only limited studies even in advanced economies. Moreover, recent advancements in panel data modelling techniques have not been effectively explored in investigating the relevance of monetary aggregates in the conduct of monetary policy, including in the context of monetary unions. This research adds to the body of existing studies on the subject matter, by applying a range of more advanced empirical techniques that ensure attainment of more credible results. Towards this end, the study employs both the conventional or first-generation panel unit root tests—developed by Levin et al. (2002), Im et al. (2003), Maddala and Wu (1999) and Choi (2001)—together with a second generation test—proposed by Pesaran (2007)—in ascertaining the stationarity of the money multiplier and the other relevant data series, i.e. the broad money supply and the monetary base. The second-generation unit root tests account for the potential cross-sectional dependencies among the member countries. To determine the existence of cross section correlation among the countries in the region, a range of panel tests—the Breuch-Pagan Lagrange Multiplier (LM) test, the Pesaran Scaled LM test, the Bia Corrected LM test, and the Pesaran CD test—are performed.[37]

The study also assesses the stability of the money multiplier by examining the long-run association between the two key components of the money multiplier using two advanced panel cointegration techniques—the Pedroni (2004) residual-based test and the Westerlund (2007) error-correction-based approach. While the Pedroni (2004) test could only account for simple cross-sectional dependence, the Westerlund (2007) test is a second-generation technique that fully accommodates cross-sectional dependence and heterogeneity. The latter procedure provides an opportunity to empirically determine whether the potential existence of cross section correlation among countries in the region influences the long-run co-movement between the money supply and the monetary base for the region as a whole. To test the robustness of the results to potential structural breaks in the data series, the Westerlund and Edgerton (2008) panel cointegration test is employed.

ii. Examining the long-run causal relationships between the key monetary aggregates—broad money and the monetary base—and commercial bank credit to the private sector to determine the direction of causation. This would provide useful insights into whether monetary aggregates could serve as an effective anchor for the common monetary policy.

[37] Details on the cross-sectional dependence tests in section 3.4.2 below

There are no such studies on the ECOWAS region as a bloc. Moreover, the few studies that have investigated the postulations of the endogenous money theory, in the context of a monetary union or a multi-country framework, eg. Panagopoulus and Spiliotis (2008) on the euro area and Lopreite (2014) on G7 countries, have adopted time series empirical methodology. This study seeks to make an empirical contribution by examining the endogenous money theory within a panel framework, applying recent panel causality techniques. In this regard, the Dumitrescu and Hurlin (2012) panel non-causality test which is robust to the presence of cross-sectional dependence is applied.

3.2 Review of the relevant theories of money supply determination

Several theories have been postulated to explain the process of money supply determination (Goodhart, 2017), but the two that appear to have dominated the academic and policy discourse are the traditional monetary base multiplier model and the more recent endogenous money theory. This review focuses on these two theories with a view to developing the research hypotheses for the empirical investigation.

3.2.1 Conventional monetary base multiplier model

The traditional money multiplier approach to the money supply is traced back to the work of Phillips (1920) and Keynes (1930) who sought to explain fluctuations in the aggregate money supply, though it is often credited to the work of Brunner (1961) and Brunner and Meltzer (1964)[38]. The model, which has dominated academic and policy discourse in macroeconomics, is developed within a fractional reserve banking framework wherein commercial banks utilize their deposits to give out loans, maintaining only a fraction of these deposits as reserve either in compliance with statutory reserve requirements and/or for precautionary purposes.

The widely-used stylized derivation presents the conventional money multiplier as a function of the public's desire to hold cash and the banks' decision to maintain excess reserves. It establishes a relationship between the money supply and the monetary base as reflected in the following equation:

$$M = m \times MB \qquad (1)$$

[38] See Goodhart (2017).

where M is the nominal stock of money, MB is the monetary base (also known as reserve money or high-powered money), and m is the money multiplier.

The nominal money balances, M, in equation 1 above, is defined in terms of portfolio allocation by households and firms which decide to hold balances in the form of currency or as deposits with commercial. Thus,

$$M = D + C \tag{2}$$

where D is the deposits of commercial banks and C is currency in the hands of the non-bank public, also referred to as currency in circulation.

The monetary base, MB, on the other hand, is defined with respect to demand by the public to use currency (C) and demand by banks to hold reserves. As such,

$$MB = C + R \tag{3}$$

Reserves, R, as noted above, could be separated into statutory requirement imposed by the central bank and any excess above this threshold held voluntarily by banks for precautionary purposes. In this regard, equation (3) is rewritten as

$$MB = C + RR + ER \tag{4}$$

where RR is the required reserves and ER represents excess reserves of commercial banks.

Combining equations (3) and (4) establishes a formal relationship between the money supply (M) and the monetary base (MB) as follows:

$$\frac{M}{MB} = \frac{D + C}{C + RR + ER} \tag{5}$$

Expressing the elements in equation (5) as a ratio of the deposits of the commercial banks (D), we obtain

$$\frac{M}{MB} = \frac{1 + c}{c + rr + er} \tag{6}$$

where the ratios are expressed in small letters, with C/D represented by c the currency deposit ratio; RR/D denoted by rr the required reserves ratio; and ER/D represented by er the excess reserves ratio.

Rearranging the expression above, a formal relationship between the money supply and the monetary base is attained as follows:

$$M = \frac{1+c}{c+rr+er} MB \tag{7}$$

where the money multiplier $m = \dfrac{1+c}{c+rr+er}$

From the above expression, the money multiplier is inversely related to the currency deposit ratio, the required reserves ratio and the excess reserves ratio, and is thus influenced by the actions of the monetary authorities, the commercial banks, and the non-bank public. The monetary authorities, or central bank, has responsibility for setting the reserve requirements, while the commercial banks decide on the volume of excess reserves to hold for precautionary purposes. The non-bank public makes the portfolio choice between currency they hold and deposits, and the proportion of demand deposits relative to total deposits. The theory assumes the money multiplier to be fairly stable, allowing the central bank to regulate the monetary base using its monetary policy instruments, including open market operations, discount rate policy and reserve requirement, in order to achieve its stipulated money supply target. In the process, the ability of the commercial banks to advance credit is influenced by changes in the monetary base.

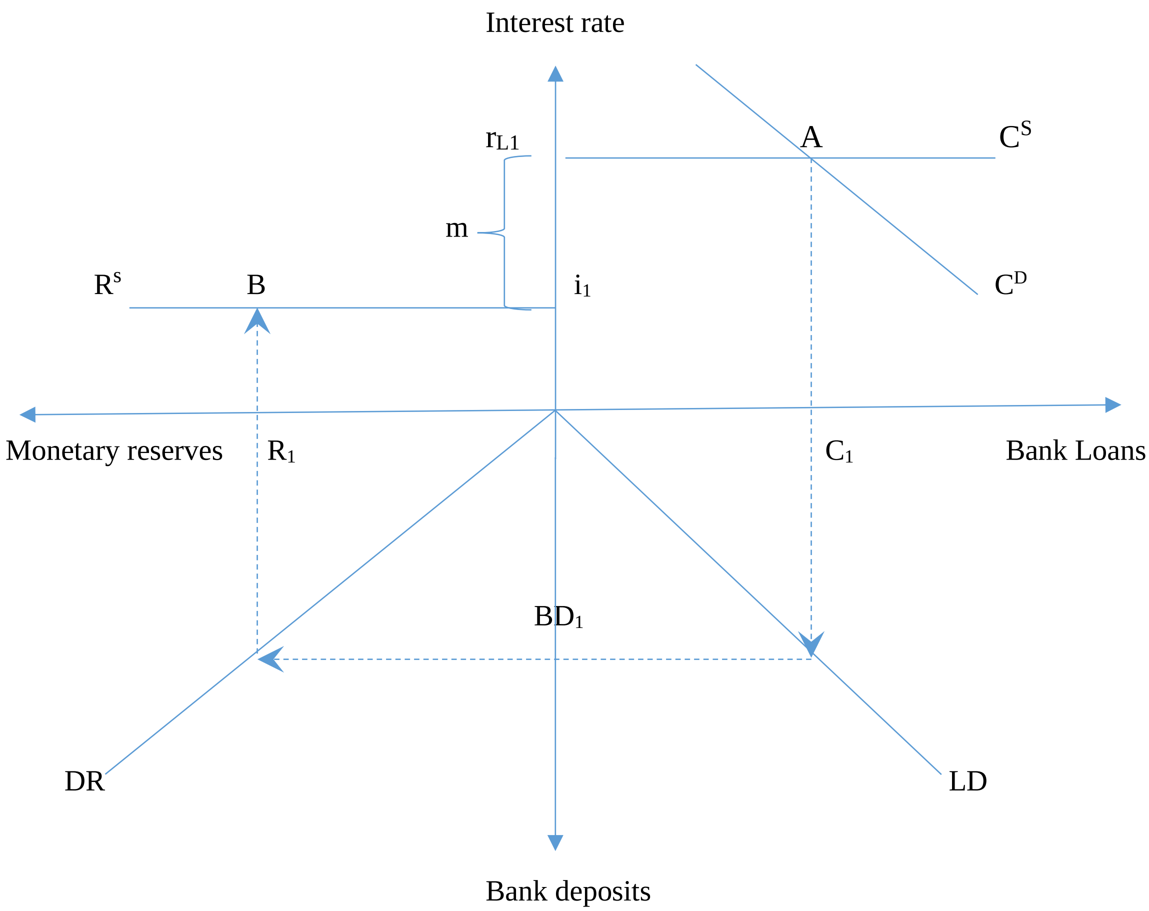
3.2.2 Endogenous money theory

The theory of endogenous money espoused in Post Keynesian economics presents a contrary narrative to the neo-classical theoretical perspective discussed above which considers money an exogenous creation of the central bank and under its direct control. According to the endogenous money theory, the supply of money in the economy is determined by the portfolio decision of commercial banks in their response to demand for credit by economic agents, notably, households and firms. As Fontana (2003,) puts it:

> "*The essence of endogenous money theory is that the stock of money in a country is determined by the demand for bank credit, and the latter is causally dependent upon the economic variables that affect the level of output*" p.29.

The main postulate of the endogenous money theory is illustrated graphically in the four-quadrant diagram in Figure 3.1 below.

Figure 3.1: The Endogenous Money Supply Process



Source: Fontana and Setterfield (2008, p. 147)

From the above framework, the central bank sets the short-term (overnight) interest rate at i_1, the rate at which it supplies monetary reserves to the commercial banks. The demand for loans by creditworthy non-bank private sector borrowers is fully accommodated by the commercial banks, at an interest rate r_{L1} (a mark-up, *m*, over the central bank reference rate). The loan market in the north-east quadrant of the Cartesian plane reflects the horizontal credit supply function, C^s, and the positively sloping demand for credit schedule, C^d. At equilibrium point, A, in the loan market, the quantity of credit created is C_1 which gives rise to the supply of new bank deposits, BD_1, via the loan-deposit (LD) schedule in the South-East quadrant. Commercial banks thus demand monetary reserves from the central bank in proportion to the deposits (captured by the DR schedule). In view of its crucial role of ensuring financial stability, the central bank accommodates the commercial banks' demand for monetary reserves at the prevailing short-term interest rate. The market for monetary reserves is at equilibrium at point B in the north-east quadrant, with the quantity of reserves supplied of R_1. The intuition here in terms of money endogeneity is that the demand for bank loans creates bank deposits which in turn initiates a supply of monetary reserves by the central bank to match the deposits.

Figure 3.1 above illustrates the key tenet of Post Keynesian endogenous money theory that money supply creation is driven by the non-bank private sector's demand for credit and not exogenously determined by the central bank as assumed by orthodox monetary theory. The demand for bank credit creates bank deposits which are in turn accommodated by the supply of monetary reserves. While this relationship underpins the endogenous money theory, two schools of thought on money creation could be distinguished within the realm of Post Keynesian economics: Accommodationism and Structuralism. The main postulates of the two approaches are discussed below.

From the accommodationist viewpoint, the main proposition is that the supply of credit money is infinitely interest elastic, implying that the monetary authorities always supply the quantity of monetary reserves requested by the banking sector to meet the credit demand. In this regard, the supply of reserves is considered an endogenous response to the demand for credit by non-bank private agents, mostly firms, to maintain a production process or establish new businesses, and the central bank fully accommodates the corresponding demand for reserves by banks. The central bank's obligation to provide reserves on demand through the discount window stems from its pivotal role to maintain the liquidity of the financial system and to serve as lender of last resort for financial institutions. In this context, the central bank has authority for setting the short-term interest rate at which reserves are supplied, though with limited ability to directly control the money supply. As depicted in the north-east quadrant of Figure 3.1 above, the credit-money supply function is a horizontal line at the prevailing interest rate. The accommodationists' proposition runs contrary to the traditional view of the money supply process, and as espoused in the classical loanable funds theory which emphasizes the need for additional resources to support provision of additional credit (Mckinnon, 1973). Money is instead viewed not as a commodity on its own but rather generated through bank credit for the production and exchange of commodities. The chief proponents of this theoretical perspective include Kaldor (1970), Weintraub (1978), Lavoie (1992) and Moore (1988).

The structuralists, on the other hand, while subscribing to the notion that the demand for bank credit creates bank deposits which generates reserves, argue that the proposition of full accommodation of the demand for monetary reserves is unrealistic in the real world. In executing its responsibility of preserving financial stability, the central bank has to contend with a number of constraints in attaining its policy targets and objectives which limit its ability to fully accommodate demand for monetary reserves by commercial banks. To this end, the central bank has the discretion to accommodate or not to accommodate the reserves needs of the commercial banks consistent with its prevailing policy stance. Therefore, unlike the accommodationist/horizontalist approach whereby the credit supply function is horizontal, the money supply curve could be upward sloping. Structuralists acknowledge the vital role played by the non-bank private sector (individual economic agents and firms) in the economy as their economic decisions drive overall investment and production, but also ascribe a significant role to the central bank in view of its ability to regulate credit expansion by using its discretion to accommodate or not to accommodate reserves demand by the banks. Proponents of this approach to money endogeneity include Minsky (1982), Palley (1996), Sawyer (1996), and Arestis (1997).

Contrary to the accommodationist's perspective that the only policy instrument at the disposal of the central bank is the interest rate, structuralists argue that the central bank could also target the money supply or some other policy variables. As pointed out by Palley (1996), the increased demand for reserves as bank lending increases is only partially accommodated given the accompanying rise in the federal funds rate. This process may require the central bank

> "*raising the discount rate, restricting discount window borrowing, or draining non-borrowed reserves from the federal funds market to offset any increase in borrowed reserves*" p.589.

Structuralists consider the establishment of a generalized theory of liquidity preference as essential for a modern endogenous money theory, as it helps explain the relationship between lenders and borrowers in terms of their portfolio decisions (Fontana 2003, pp. 297-298). The structuralist perspective runs in contrast to the accommodationist view that there cannot exist excess credit money as demand for reserves driven by credit demand is fully accommodated by the central bank. Instead, there exists an active independent money demand function (Howells, 1995, p. 91).

3.2.3 Summary and Testable Hypotheses

The above theoretical literature review has presented two contrasting schools of thought in respect of the determination of the money supply.

The conventional money multiplier theory considers money to be exogenously supplied by the central bank and is grounded in orthodox monetary theory. It assumes a stable relationship between the monetary base and the money supply on account of a stable and predictable money multiplier which allows any changes in the monetary base by the central bank to be matched by changes in the money supply.

From equation 1 above, a stable money multiplier presupposes stationarity of the ratio between the money supply and the monetary base. Through logarithmic transformation of this equation, the following formulation is obtained:

$$\log (M) = \log (m) + \log (MB) \tag{8}$$

where M is the broad money supply, m is the money multiplier and MB is the monetary base.

From equation (8), the long-run stability of the money multiplier is established using two approaches: (i) determining the stationarity of log (m) which would imply that the log of the ratio of broad money supply (M) to the monetary base (MB) is stationary, and (ii) investigating whether log (M) and log (MB) possess a long-run cointegrating relationship. Inferring from these two conditions, the first testable hypothesis is that the money multiplier is stable. Thus, the first testable hypothesis is that the money multiplier is stable. The second testable hypothesis which is also within the context of Orthodox monetary theory involves examining the relationship between the monetary base and bank credit to ascertain whether the direction of causation runs from the monetary base to bank credit in a unidirectional fashion.

As discussed in section 3.2.2 above, two schools of thought exist in respect of the Post Keynesian endogenous money theory. The accommodationist approach is built on an infinitely elastic credit supply curve whereby the central bank always fully accommodates reserves demand from the commercial banks, whereas the structuralist view asserts that the central bank is constrained in accommodating demand for monetary reserves by commercial banks. Both perspectives nonetheless broadly agree that the direction of causation between monetary aggregates and bank credit runs in the reverse direction.

Drawing from the postulations of these two schools of economic thought, three sets of testable hypotheses are developed. First, that bank credit causes monetary base in a unidirectional manner, i.e. Ho[3]. This hypothesis is derived from the accommodationist perspective which maintains that the central bank is compelled to fulfil the demand of commercial banks for monetary reserves in order to preserve the solvency of the banking system and thus the stability of the broader financial system. The monetary authorities thus fully accommodate a predetermined level of reserves based on the previous period's volume of bank credit. The second hypothesis, Ho[4], establishes a bidirectional causality between bank credit and the money supply, reflective of the Liquidity Preference perspective of structuralism. To start with, given the assumption that money is endogenously determined, causality runs from bank credit to monetary aggregates. On the other hand, the existence of an independent demand for money underpins the reverse causation from monetary aggregates to bank credit.

The third and final hypothesis is that there exists a bidirectional causality between bank credit and the money multiplier, i.e. Ho[5]. The structuralist view of the money creation process presupposes a feedback relationship between bank credit and the money multiplier. The rise in the short-term interest rate induced the central bank's partial accommodation of the demand for reserves could affect some component ratios of the money multiplier and thus the volume of bank credit created. The resulting instability of the credit multiplier culminates in feedback effects between the multiplier and bank credit. The testable hypotheses discussed above are summarised in Table 3.1 below:

Table 3.1: Summary of Testable Hypotheses

Theoretical perspective	Testable hypothesis	Money Theory
Orthodox	Ho [1]: The broad money multiplier is stable	Traditional/Neoclassical
	Ho [2]: Unidirectional causality from monetary base to bank credit	Traditional/Neoclassical
Heterodox (Endogenous money)	Ho [3]: Unidirectional causality from bank credit to monetary base	Accommodationism
	Ho [4]: Bidirectional causality between bank credit and broad money supply	Structuralism (Liquidity preference)
	Ho [5]: Bidirectional causality between bank credit and broad money multiplier	Structuralism

Source: Author's construction

3.3 Review of relevant empirical literature

The empirical techniques employed in investigating the money creation process have largely depended on the theoretical perspective. Studies on the conventional multiplier theory have applied tests of stationarity and cointegration and forecasting techniques to determine the stability and predictability of the money multiplier, while research on the endogenous money theory has mostly utilized causality techniques, notably the granger causality grounded in error correction formulations. A proportion of the more recent research studies following the 2007/08 global financial and economic crisis has been analytical, based on monetary trends and balance sheet identities (Goodhart, 2017; Sheard, 2013). This section systematically reviews studies that have examined the money supply determination process, starting with the conventional money multiplier followed by the endogenous money theory. A summary of these research studies is reported in Appendix A.7.

3.3.1 Empirical literature on the conventional money multiplier

Early empirical research on the conventional money multiplier could be traced back to the work of Friedman and Schwartz (1963), Brunner and Metzler (1964) and Cagan (1965) all of which applied basic regression techniques, including ordinary least squares estimation, to examine exogenous injection of money and its impact on aggregate economic activities.

Subsequent studies have employed more advanced empirical methods. Most of the earlier studies focussed on developed economies. Ford and Morris (1996) examined the money multiplier in the United Kingdom by investigating the existence of cointegrating relationship between monetary aggregates compiled based on simple sum, divisia, and innovation-divisia, on the one hand, and high-powered money on the other. Using Engle and Granger (1987) cointegration technique and error-correction modelling, it uncovered cointegrating relationships between the various aggregates and high-powered money, though there were no discernible differences among the aggregates in terms of their predictive powers.

On the United States, Baghestani and Mott (1997) examined the money supply process covering three different operating procedures of the Federal Reserve from 1971 to 1990. The study also employed the Engle and Granger (1987) cointegration error-correction modelling to investigate the existence of long-run equilibrium and short-run dynamic relations between the money supply, monetary base, and a measure of market interest rates. A long-run equilibrium relationship was established among narrow money (M1), monetary base and the measure of interest rate differential. Over the short-run, adjustments toward the equilibrium relation were found to be the result of movements in M1 and the interest rate differential.

Chu (2006) examined the Canadian experience with money multiplier volatility and predictability following removal of reserve requirements as a policy instrument. The study focussed on the period 1970 - 2004, part of which witnessed zero reserve requirement. The Holt-Winters exponential smoothing technique was employed to forecast the different money multiplier aggregates. The study found that the introduction of a zero-reserve requirement in Canada in 1994 did not increase the volatility of the money multipliers.

Monetary developments during the 2007-08 global financial and economic crisis as reflected in divergent movements between the expanded bank reserves base occasioned by quantitative easing and the resultant money supply, ushered in renewed research interest in the policy relevance or otherwise of the conventional money supply concept. These studies have been conducted predominantly in the context of advanced economies. To start with, Carpenter and Demiralp (2012) examined the validity of the standard money multiplier by reassessing the link from bank reserves to money and to the bank lending channel of monetary policy transmission in the United States. The study employed the VAR technique to investigate the response of reservable deposits and bank loans to a policy shock, by extending the model of Bernanke and Blinder (1992) to cover the period January 1990 to

June 2007. The results reveal that contrary to the money multiplier postulation, bank loans did not contract following a decline in reservable deposits initiated by monetary tightening, as banks resorted to external funding to finance loan demand. The study concluded that banks' access to non-deposit funding which are non-reservable undermines any direct link between broad money and bank lending, and that the implied standard money multiplier link between demand deposits and loan creation is questionable.

Sheard (2013) undertook balance sheet analyses of the central bank and the banking system to argue that 'banks cannot and do not lend out reserves' and thus the standard textbook money multiplier theory is not plausible. Inferring from the established identity between the assets side of the central bank balance sheet and its liabilities, comprising bank reserves, currency in circulation and government deposits, it argued that commercial banks cannot influence the amount of reserves through lending as bank lending does not directly enter the identity. Credit creation by banks occurs through the simultaneously creation of a loan asset and a deposit liability on banks' balance sheet, with the central bank obliged to fully fulfil the reserves demand of commercial banks. The study reveals that while quantitative easing significantly increased excess reserves at the central bank and helped ease financial conditions through 'portfolio rebalancing effects', the expansion did not translate into a corresponding increase in bank lending. Using data on the broad money multiplier and its components for the US, the money multiplier is shown to have decreased dramatically in the advent of the financial crisis.

The line of thinking expressed by Sheard (2013) above is shared by a number of recent publications at the Bank of England. McLeay et al. (2014) addressed what is described as common misconceptions about the money creation process, particularly that the central bank determines the quantity of loans and deposits in the economy through its control of the quantity of base money in line with dictates of the traditional multiplier concept. Using balance sheet analyses, the study debunks the money multiplier narrative, instead ascribes a dominant role to banks in money creation through their issuance of loans to the private sector. The causal relationship from deposits to loans which underpins the money multiplier story is essentially reversed. The central bank's monetary policy is however considered the ultimate constraint on money creation, as it affects the borrowing decisions of households and firms through the policy interest rates in normal times and through quantitative easing when rates are at or around the zero-lower bound.

Jakab and Kumhof (2015), for their part, presented their alternative view of the money creation process in the context of a DSGE model. By incorporating the traditional intermediation of loanable funds (ILF) model of banking and the more nuanced financing through money creation (FMC) model of banking into the DSGE framework, they found that:

> "*FMC models predict changes in the size of bank balance sheets that are far larger, happens much faster, and have much greater effects on the real economy, while the adjustment process depends far less on changes in lending spreads, the dominant adjustment channel in ILF models*" p. 39.

The study concluded that the relationship espoused by the deposit multiplier works in reverse with the quantity of central bank reserves a consequence and not a cause of bank lending and money creation.

Goodhart (2017) reinforces the broad views of the money creation process presented above and considers the standard money multiplier defunct, both in theory and principle. Drawing from trends in the broad money multiplier in the US, Japan, United Kingdom and the Eurozone following the global financial crisis, he concluded that the money multiplier concept has collapsed, as broad money remained stagnated in spite of the massive expansion in the monetary base. He notes, however, that while there are some merits in the emerging view that 'bank loans create deposits', the failure of this theoretical perspective to present a complete picture of the money creation process means that there is still need for a 'new, revised paradigm to explain the determination of the supply of money' (p. 3).

On developing countries, the studies on the conventional money multiplier have mostly been undertaken in the context of the viability of the monetary targeting framework on which policy has often been predicated. Downes et al. (2006) employed the use of unit root tests to examine the impact of financial liberalisation on the stationarity of the money multiplier in six Caribbean countries—Barbados, Belige, The Bahamas, Trinidad and Tobago, Jamaica, and Guyana. The study found out that using standard tests that do not allow for a structural break, the money multiplier was found to contain stochastic trend. However, the unit root hypothesis is rejected when the Perron mean switching unit root test (Perron 1990) and the Perron and Vogelsang (1992) PV break test are applied.

Zaki (1995) examined the controllability of the money supply and predictability of the money multiplier in Egypt over the period 1952-1993. Analyses of the monetary base and its analytical sources—net foreign assets, net claims on government and claims on private sector—reveal that up until the early 1990s before the adoption of market-determined indirect monetary management, credit to central government exerted the most expansionary influence on the monetary base implying limited central bank control over the monetary base. On predictability of the monetary base, the study employed the Box-Jenkins one-step–ahead ARIMA modelling approach. It found the monetary base predictable with the aggregate forecast method producing satisfactory results. The component forecast approach—that involves forecasting each component i.e. currency ratio, deposit ratio and reserve ratio individually—was found to be unsatisfactory.

Ndaushau (2005) investigated the behaviour and stability of the money multiplier in Tanzania over the period 1986 – 2005 by estimating narrow money (M1) and broad money (M2) supply functions that include the monetary base, the statutory reserve ratio, and the central bank discount rate as explanatory variables. The monetary base and the currency ratio were found to be the key determinants of the money multiplier, while the proxies for short-term interest rates were statistically insignificant. Stability test using Chow's break point and CUSUM tests reveal that the estimated money supply functions were unstable prior to the adoption of a market-determined monetary management regime, but somewhat stable afterwards, providing the Bank of Tanzania some leverage in regulating the monetary base to control the money supply.

Also, on Tanzania, Adam and Kessy (2010) investigated the stability and predictability of the money multiplier in Tanzania. The study applied the Johansen cointegration test and unearthed strong evidence of the existence of a stable long-run relationship between money base and broad money supply. The short-run dynamics was found to be complicated with signs of incomplete pass-through from base money to broad money. Using standard and seasonal ARIMA forecasting models, accurate forecast of the future path of the M2 multiplier and its components were established.

Hauner and Di Bella (2005) employed Rwanda as a case study to examine the money multiplier (and the demand for money) in the context of low-income countries. Using monthly data covering the period 1995 to 2003, the forecast accuracy of the multipliers and their component ratios is assessed using autoregressive integrated moving average (ARIMA) models and structural models. The analyses based on the ARIMA models found the aggregate approach to produce more reliable forecasts of multiplier relative to the component approach. Forecasts based on structural models yielded unreliable results, mainly on account of the behaviour of the currency ratio and the time deposit ratio contrary to established economic theory. Rusuhuzwa (2015) also assessed the stability of the money multiplier in Rwanda, but unlike most previous studies applied the Gregory and Hansen (1996a) cointegration procedure which accounts for potential structural breaks both in the intercept and the slope coefficients. The study finds the money multiplier to be stable over the long run.

Within the ECOWAS, published empirical research on the traditional money multiplier is quite limited. This could be attributed to the fact that the operational monetary policy frameworks in member countries are generally predicated on the assumption or broad acceptance of a stable money multiplier relationship and the prevalent use of monetary aggregates as nominal policy anchor. The study by Tule and Ajilore (2016) on Nigeria represents a recent attempt to investigate the money creation process by examining the existence of a stable relationship between broad money (M2) and the monetary base. Employing the Gregory and Hansen (1996a) cointegration technique on hypothesized regime shifts in the conduct of monetary policy on account of changes in banking system liquidity, the study uncovered the existence of a stable long-run money multiplier relationship.

3.3.2 Empirical literature on the endogenous money theory

A growing body of research papers has investigated the endogeneity of the money supply as espoused by Post Keynesian theory. The early studies are traced back to the 1980s, with the works of Kaldor (1982) and Moore (1983). These studies employed the OLS technique to examine the determinants of bank lending in the United Kingdom and the United States, respectively. Moore (1983) examined the forces driving the demand for bank loans to commercial and industrial corporations, and found that the funding of working capital finance, mostly driven by money wage rates, to be the most important determinant of bank lending to companies. It concluded that the supply of money is horizontal as the central bank allows the money stock to accommodate increases in demand for bank credit. The central bank only determines the short-term interest rate at which that liquidity is supplied. Both studies provide support for the endogenous money theory.

Subsequent research papers have utilised more advanced empirical methodologies, notably cointegration and Granger causality, to test the validity of the endogenous money theory, and a significant proportion of these studies has been conducted on advanced economies. Panagopoulus and Spiliotis (1998) applied Engle and Granger (1987) and Johansen (1992) cointegration techniques and error-correction modelling to examine bank lending behaviour in Greece over the period 1971 to 1993. The study did not find any statistically significant effect of lending rates on bank credit but established that the banking system's response to the demand for loans was the primary determinant of credit money. It concluded that the credit-money supply process in modern economies is endogenous, consistent with the Post Keynesian postulation on the endogeneity of money.

Extending their work to the G7 countries—Italy, Germany, United States, Canada, Japan, France, and the United Kingdom—Panagopoulus and Spiliotis (2008) examined the money-generation process to unravel the underlying postulates of the competing schools of monetary thought. Abstracting from the bivariate relationships of the various schools, causality tests within the VAR framework were applied to investigate the money-multiplier and money-income relationships. The study's findings reveal, among others, that 'with some sporadic exemptions, the "multipliers" are not operative in the G7 economies' (pp. 619).

Lopreite (2014) investigated the validity of the endogenous money hypothesis in the Euro area since its inception up to 2010. VAR causality tests and vector error-correction modelling (VECM) procedure were employed, on the basis of the cointegration properties of the data series in the models. Among its findings, it observed that loans influence broad money (M2) in the short run, but not in the long run, implying that the Post Keynesian view may not hold for M2 in the Euro area. The study however concluded that the existence of unidirectional causality from loans to M3 in the short run indicates that the Euro area money supply may be somewhat endogenous.

Lovrero and Deleidi (2017) examined the money creation process in the United States from 1959 – 2016 in an effort to determine which of the two main theories—conventional money multiplier and endogenous money—best fits the data. Causality tests were applied within the VAR and VECM econometric frameworks to ascertain the direction of causation among the monetary base, bank deposits and bank loans. Controlling for potential breakpoints in monetary management over the period, the study finds causality running mostly from bank loans to bank deposits and then to the monetary base, in line with Post-Keynesian postulation on the money supply process. It concludes that the money supply is endogenously created by commercial banks through their lending activities.

Unlike the studies reviewed above which adopted country-specific estimation procedures, Nayan et al. (2013) employed a panel data estimation technique to investigate the theory of money supply endogeneity. Using a panel dataset of 177 countries, the study applied the system generalised methods of moment (GMM) approach to estimate the money supply model. The results, which are supportive of the endogenous money theory, show that real GDP per capita and bank lending are the dominant determinants of the money supply. The study considers its findings as justification for the use of interest rate targeting to undertake monetary policy management.

Research on the endogenous money theory in the context of developing countries has been limited. Among the notable papers, Nell (1999) examined the money supply process in South Africa through the period of direct monetary control (1966 – 1979) and that of indirect monetary management (1980 – 1997). With the help of Granger causality type tests and the auto regressive distributed lag (ARDL) procedure, the study found unidirectional causality from bank credit to the money multiplier but not the reverse under the two periods of monetary management. The money supply was assessed to be endogenously determined, implying its ineffectiveness as a leading indicator of monetary policy.

Ahmad and Ahmed (2006) investigated money supply endogeneity in Pakistan for the period 1980-2003 and employed the Grange causality technique. Their findings point to the endogenous determination of the money supply in Pakistan in the short run, supportive of the Structuralist school of thought. In the long run, however, the results indicate that it is base money that primarily determines the total bank advances. The policy implication here is that the central bank of Pakistan exerts considerable influence on the money supply in the long run.

In summary, it is evident that the empirical methodologies employed in uncovering the policy relevance of the money multiplier have varied as the theoretical perspectives have evolved over the past decades. Importantly, the empirical techniques have been broadly determined on the basis of the underlying theory or school of thought investigated – conventional money multiplier theory or the endogenous money theory. Studies examining the conventional theory have focused mainly on the stability and predictability of the multiplier and have applied tests of stationarity and cointegration and forecasting techniques.

On the other hand, the empirical work on the endogenous money theory has sought to investigate the direction of causation between monetary aggregates (money supply, monetary base, and the money multiplier) and credit aggregates (bank credit, bank deposits). To this end, techniques of causality have been the predominant method employed, notably the granger causality grounded in the error correction formulations. A few studies have undertaken multi-country single-equation investigations (Downes 2006; Panagopoulus and Spiliotis, 2008; Lopreite, 2014; and Goodhart, 2017). However, the use of panel data methods has been limited. In fact, only Nayan et al. (2013) has been found to employ panel data methods to investigate the endogenous money theory.

3.4 Data, Diagnostics and Empirical Methodology

3.4.1 Data

The variables used in the empirical estimations to investigate the research hypotheses are broad money (M2), the monetary base (MB), bank credit to the private sector (BC) and the broad money multiplier (MM). M2 is the sum of narrow money (M1) plus quasi-money (mainly comprising savings and time deposits), where M1 is currency in the hands of the non-bank public and demand deposits. The choice of M2 is justified by the fact that it has served as the nominal policy anchor for member countries in the ECOWAS region that have adopted a monetary targeting regime. MB, also referred to as reserve money, comprises mainly commercial banks' reserves at the central bank plus currency in circulation. BC represents commercial banks credit to the private sector. MM is obtained by taking the ratio of M2 to MB. The variables are presented in their logarithmic form.

The data series are annual frequencies spanning the period 1980 – 2016. The panel is balanced, motivated by the empirical methodologies applied in the study.[39] As a result, the overall panel includes twelve-member countries of the ECOWAS region—Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo—for which the data could be assembled.[40] The two sub-groupings are the WAEMU comprising seven countries—Benin, Burkina Faso, Cote d'Ivoire, Mali, Niger, Senegal, and Togo—and the Non-WAEMU that includes 5 countries—Capo Verde, The

[39] The Dumitrescu and Hurlin (2012) panel Granger non-causality test that is applied requires balanced panel.
[40] Guinea Bissau (WAEMU), Liberia and Guinea (Non-WAEMU) are omitted from the estimation sample due to lack of consistent time series data.

Gambia, Ghana, Nigeria, and Sierra Leone. The total number of observations for the study are 455, 245 and 210, for the ECOWAS, WAEMU, and Non-WAEMU, respectively.

The data is mainly obtained from the International Financial Statistics (IFS) published by the IMF.[41] Appendix A.10 presents details on the data definitions and sources, which are similar across countries in the sample.

3.4.2 Preliminary Diagnostic Tests

The important first step is to conduct cross-sectional dependence tests to investigate the existence of correlation among the cross-sectional units, which meaningfully informs the empirical tests and estimation techniques adopted in this study. The statistical properties of the data are investigated through visual examination of the trends in the data series and empirically by performing panel unit root tests to determine the stationarity or non-stationarity of each panel series.

3.4.2.1 Testing for cross-sectional dependence

The existence of cross-sectional dependence—the interdependencies between cross-sectional units—has been, in part, driven by unobservable common factors or common shocks occasioned by the growing economic and financial integration of countries and other entities. The issue has occupied center-stage in panel data modelling over recent years, as ignoring cross-sectional dependence in the estimation of panels that exhibit this characteristic gives rise to severe consequences including the loss of estimator efficiency and the invalidation of conventional t-tests and F-tests which use standard variance-covariance estimators (Baltagi et al. 2012). Similarly, the size of the panel unit root tests becomes distorted in the presence of cross-sectional dependence (Pesaran, 2007).

With countries in the ECOWAS region sharing some similar characteristics, including in terms of the structural features of their economies and macroeconomic policy frameworks, there possibly exists unobserved common effects that are invariant across member countries or are exposed to common shocks that result in contemporaneous correlations among them. While several estimators have recently been proposed to mitigate its adverse impacts (eg.

[41] The data are available online at the following address: https://www.imf.org/data (accessed on June 1, 2018). Data on The Gambia for 2015 and 2016 were obtained from the IMF Staff Report on The Gambia:2nd Review under the SMP (Country Report No. 18/197), June 28, 2018 (IMF. 2018e).

Pesaran, 2006; Chudik and Pesaran, 2015), it is but critical, as a first step, to test the existence of cross-sectional dependence in the panel series.

Toward this end, assume our panel-data model of the following form:

$$y_{it} = \beta_{it}' x_{it} + u_{it} \qquad \text{for } i = 1, \ldots, N \quad t = 1, \ldots, T \tag{9}$$

where x_{it} is a *k*-dimensional column vector of regressors and the β_i s are the corresponding cross-section specific vectors of parameters to be estimated.

From a general perspective, under the null hypothesis, u_{it} is assumed to be i.i.d over time and across cross-sectional units, while under the alternative hypothesis u_{it} may be correlated across cross sections. In other words, the null hypothesis is the absence of cross-section dependence, whereas the alternative confirms the existence of cross-section dependence. These hypotheses are presented in terms of correlations between the disturbances in the different cross-sectional units as follows:

$$H_0 : \rho_{ij} = \rho_{ji} = cor(u_{it,} u_{jt}) = 0 \quad \text{for } i \neq j$$

against $H_1 : \rho_{ij} = \rho_{ji} \neq 0$ for some $i \neq j$

where ρ_{ij} is the product moment correlation coefficient of the residuals, presented as

$$\rho_{ij} = \rho_{ji} = \frac{\sum_{t=1}^{T} u_{it} u_{jt}}{\left(\sum_{t=1}^{T} u_{it}^2\right)^{1/2} \left(\sum_{t=1}^{T} u_{jt}^2\right)^{1/2}} \tag{10}$$

Based on this general formulation, several tests for cross-sectional dependence have been developed. This study applies a range of these tests, notably the Breusch-Pagan Lagrange Multiplier (LM) test, the Pesaran Scaled LM test, the Pesaran CD test and the Bias Corrected LM test.[42]

[42] Proposed by Breusch and Pagan (1980), Pesaran (2004), Pesaran (2004), and Baltagi, Feng, and Kao (2012), respectively. All four tests are performed in EViews 9.5 which provides computational convenience.

The Breusch-Pagan LM test is developed in the context of seemingly unrelated regressions and is based on the LM statistic below:

$$LM_{BP} = \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} T_{ij} \hat{\rho}_{ij}^2 \tag{11}$$

where $\hat{\rho}_{ij}$ is the correlation coefficient of the residuals of the estimated model in equation 9 above. LM follows an asymptotic χ^2 distribution with $N(N-1)/2$ degrees of freedom. This test is however characterised by substantial size distortions in large N settings with finite T.

The Pesaran Scaled LM test is proposed to address this size distortion of the LM_{BP} using the following standardized form of the LM statistic.

$$LM_{PS} = \sqrt{\tfrac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T_{ij} \hat{\rho}_{ij}^2 - 1) \tag{12}$$

Unlike the $LM_{BP,}$ this statistic is asymptotically standard normal as $T_{ij} \to \infty$ and then $N \to \infty$. However, the problem of size distortion persists for small T_{ij} and even worsens as N gets larger.

Pesaran (2004) proposes an alternative test statistic to address the shortcomings of both the LM_{BP} and the LM_{PS} test statistics above. The new statistic, the Pesaran CD (CD_P), is computed on the basis of the average of the pairwise correlation coefficients $\hat{\rho}_{ij}$ and is asymptotically standard normal for $T_{ij} \to \infty$ and $N \to \infty$, irrespective of the order.

$$CD_P = \sqrt{\tfrac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} T_{ij} \hat{\rho}_{ij} \tag{13}$$

On the basis on Monte Carlo experiments, Pesaran (2004) shows that the CD_P exhibit good properties for both small N and T_{ij} .

Baltagi et al. (2012) also sought to resolve the size distortion problem that is characteristic of the Scaled LM test statistic by proposing a simple asymptotic bias correction. This Bias Corrected LM test, LM_{BC}, considers a fixed effects homogenous panel data model and shows that the scaled LM test has an asymptotic bias term, $N/\left(2\left(T-1\right)\right)$, arising from incidental parameters problem. The LM_{BC} statistic is computed by simply removing the bias component as follows:

$$LM_{BC} = \sqrt{\tfrac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T_{ij}\hat{\rho}_{ij}^{2}-1)-\tfrac{N}{2(T-1)} \tag{14}$$

Among these cross-sectional dependence tests, the Pesaran CD test is considered the most general given its suitability for stationary as well as non-stationary panels. In addition, as already mentioned, it exhibits good small sample properties. The Breusch-Pagan LM test is also appropriate when N is relatively small with respect to T, as is the case in our panel series. However, all the four tests are presented for comparison.

From the results in Table 3.2, the null of cross-sectional independence is decisively rejected for all the series and for all monetary groupings at the 1% level of significance. The value of the test statistic for the Breusch-Pagan LM test is well into the upper tail of the χ^2 distribution for all the data series. Also, though the test statistic value for the Pesaran CD test is much lower than the value for all the other three tests, it nonetheless rejects the null hypothesis at conventional significance levels. The outcome of these tests underscores the close relationships among the member countries of the ECOWAS and provides justification for placing more premium on empirical techniques that accommodate cross-sectional dependence.

Table 3.2: Cross-sectional dependence test results

Test	ECOWAS Statistic	ECOWAS P-value	WAEMU Statistic	WAEMU P-value	Non-WAEMU Statistic	Non-WAEMU P-value
Variable - LM2						
Breusch-Pagan LM	2215.48***	0.000	710.93***	0.000	360.13***	0.000
Pesaran scaled LM	187.09***	0.000	106.46***	0.000	78.29***	0.000
Bias-corrected scaled LM	186.92***	0.000	106.36***	0.000	78.22***	0.000
Pesaran CD	47.01***	0.000	26.64***	0.000	18.98***	0.000
Variable - LMB						
Breusch-Pagan LM	2016.33***	0.000	604.49***	0.000	339.79***	0.000
Pesaran scaled LM	169.75***	0.000	90.03***	0.000	73.74***	0.000
Bias-corrected scaled LM	169.59***	0.000	89.94***	0.000	73.67***	0.000
Pesaran CD	44.76***	0.000	24.51***	0.000	18.43***	0.000
Variable – LMM						
Breusch-Pagan LM	527.43***	0.000	119.18***	0.000	130.63***	0.000
Pesaran scaled LM	40.16***	0.000	15.15***	0.000	26.97***	0.000
Bias-corrected scaled LM	40.00***	0.000	15.05***	0.000	26.90***	0.000
Pesaran CD	9.08***	0.000	4.59***	0.000	11.10***	0.000
Variable - LBC						
Breusch-Pagan LM	1894.81***	0.000	650.44***	0.000	349.83***	0.000
Pesaran scaled LM	159.18***	0.000	97.13***	0.000	75.99***	0.000
Bias-corrected scaled LM	159.01***	0.000	97.03***	0.000	75.92***	0.000
Pesaran CD	43.18***	0.000	25.45***	0.000	18.70***	0.000

Source: Author's computation

Note: Null hypothesis – No cross-section dependence (correlation)
*** implies rejection of the null hypothesis at the 1% level of significance.
Econometric software employed: EViews 9.5

3.4.2.2 Panel unit root tests

Understanding the statistical properties of the data is crucial to implementing the estimation procedures and addressing the research questions. As a first step, a visual examination of plots of the money multiplier and its main components (broad money and monetary base, both expressed in logarithms), reported in Appendices 3.2 and 3.3, depict volatility in the money multiplier with no discernible trend over the research period for most of the member countries. Broad money and the monetary base both clearly trended upwards throughout the horizon in all cases.

The statistical properties of the data are investigated empirically by performing panel unit root tests to determine the stationarity or non-stationarity of each panel series. In view of indications of the existence of cross-sectional dependencies among the panel series confirmed in the preceding section, emphasis is placed on tests for stationarity and model estimation techniques that accommodate potential correlations across residuals of the panel units. However, this study applies both first-generation panel unit root tests (PURTs) in addition to the second-generation PURT to ensure robustness of the stationarity test results.[43]

The first-generation tests are built on the assumption of cross-sectional independence among the panel units. In other words, the errors are assumed to be independent and identically distributed (i.i.d) across the units. Any correlations across the panel units are considered nuisance parameters. The range of first-generation PURTs applied here are notable tests developed by Levin et al. (2002), Im et al. (2003), Maddala and Wu (1999) and Choi (2001).

The test by Levin et al. (2002), henceforth LLC, is based on a pooled t-statistic of the estimator and assumes homogenous autoregressive coefficients between the panel units. Thus, assuming a variable observed on N countries and T periods, the test considers a model wherein the coefficient of the lagged dependent variable is restricted to be homogenous across the cross-sectional units:

$$\Delta y_{i.t} = \alpha_i + \rho y_{i.t-1} + \sum_{j=1}^{p_i} \beta_{i.j} \Delta y_{i,t-j} + \varepsilon_{i,t} \tag{15}$$

for $i = 1,....,N$ and $t = 1,....,T$. The $\varepsilon_{i,t}$ s are assumed to be independent and identically distributed across the cross-sectional units. The model contains individual effects and no time trends.

Under the LLC test, the null hypothesis $H_0 : \rho = 0$ is tested against the alternative hypothesis $H_1 : \rho = \rho_i < 0$ for all $i = 1,....,N$. The alternative hypothesis assumes that the autoregressive parameters are identical across the panel units and is thus considered restrictive.

The test by Im et al. (2003), henceforth IPS test, unlike the LLC test, allows for heterogeneity in the value of ρ_i under the alternative hypothesis, with each panel member assuming a different autoregressive parameter and deterministic component(s). The model in equation (15) above, thus becomes:

43 The use of panel data increases the number of observations and helps to address the issue of lower power characteristic of unit root tests in small samples (Baltagi and Kao, 2000).

$$\Delta y_{i.t} = \alpha_i + \rho_i y_{i.t-1} + \sum_{j=1}^{p_i} \beta_{i.j} \Delta y_{i,t-j} + \varepsilon_{i,t} \tag{16}$$

where the null hypothesis $H_0 : \rho_i = 0$ for all $i = 1,....,N$ is now tested against the null hypothesis $H_1 : \rho_i < 0$ for $i = 1,....,N_1$ and $\rho_i = 0$ for $i = N_1 + 1,....N$, with $0 < N_1 \leq N$. This alternative hypothesis allows for some, though not all, of the individual series to be contain unit roots.

The IPS test is a group mean test which averages the augmented Dickey-Fuller statistics on each of the cross-sectional units within the panel.

The panel tests developed by Maddala and Wu (1999) and Choi (2001), also referred to as ADF-Fisher test and PP-Fisher test, respectively, are predicated on Fisher (1932) type tests, which combine the p-value from the unit root test for each cross section i. These tests are non-parametric and allow for different lag lengths in the individual ADF regression. Importantly, they do not require the data to be in the form of a balanced panel. The Maddala and Wu (1999) test is quite attractive on account of its robustness to statistic choice, lag length and sample size (Banerjee, 1999).

Assuming cross-sectional independence, the statistic for the ADF-Fisher test is as follows:

$$P = -2 \sum_{i=1}^{N} \ln(p_i) \tag{17}$$

where P is distributed as χ^2 with 2N degrees of freedom as $T_i \to \infty$ for all N.

Choi (1999) proposes a Z test when N is large, whereby:

$$Z = \frac{\frac{1}{\sqrt{N}} \sum_{i=1}^{N} (-2 \ln p_i - 2)}{2} \tag{18}$$

It is a standardized statistic since $E[-2 \ln p_i] = 2$ and $\mathrm{var}[-2 \ln p_i] = 4$, and represents the cross-sectional average of individual p-values.

Unlike the panel tests above, the second-generation test procedure allows for cross sectional dependence in the data, by either imposing restrictions on the covariance matrix and through the use of a common factor representation of the data. The latter involves treating cross sectional dependence as a disturbance term or as a component of the panel series itself. Notable contributions in this regard include Pesaran (2007), Moon and Perron (2004), and Bai and Ng (2004).

This study applies the Pesaran (2007) panel unit root test. The test involves augmenting the standard augmented Dickey-Fuller (ADF) regressions with cross-sectional averages of lagged levels and the first differences of the individual time series. The test is based on the t-ratio of the OLS estimate $\hat{b}_i$ in the cross-sectionally augmented ADF regression (CADF):

$$\Delta y_{i,t} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + \varepsilon_{i,t}, \tag{19}$$

where a_i, b_i, c_i, and d_i are slope coefficients estimated from the ADF test for the country *i*, $\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} y_{i,t}$, $\Delta\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} \Delta y_{i,t}$ and $\varepsilon_{i,t}$ are the error terms.

By this augmentation, the unobserved common factors are proxied by the cross-sectional averages, $\bar{y}_{t-1}$ and $\Delta\bar{y}_t$.

Pesaran (2007) proposes a truncated test statistic denoted as cross-sectional augmented IPS (CIPS) test:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_{i}, \tag{20}$$

where $CADF_i$ is the cross-sectionally augmented Dickey-Fuller statistic for the *i*th cross-sectional unit given by the t-ratio of b_i in equation 19 above. The test statistic is thus a modified IPS statistic that is based on the average of individual CADF.

The panel unit root tests discussed above possess significantly improved power compared to conventional time series unit root tests, even in relatively small panels. However, the null of non-stationarity that is tested is a joint hypothesis for all members of the panel. They do not differentiate between the fraction of the panel that follows a stationary process and the units that are nonstationary.[44] To address this limitation, Chortareas and Kapetanios (2009)

[44] Identifying the series in the panel that are stationary processes may be of immense importance, as in the case of the purchasing power parity (PPP) theory where stationary real exchange rate processes indicate support for the proposition (see Bahmani-Oskooee and Hegerty, 2009).

propose a Sequential Panel Selection Method (SPSM) that distinguishes the panel into a group of stationary and a group of non-stationary series. The SPSM involves applying the IPS test, or the other panel unit root tests, sequentially on progressively smaller fractions of panel data whereby the elimination process depends on series that exhibits stationarity as reflected by low individual t-statistics. The detailed test procedure is outlined in Chortareas and Kapetanios (2009, p. 392).[45] The SPSM test is nonetheless ideal in a situation 'where most series considered are stationary and very persistent' and is primarily aimed at uncovering stationarity in the data (op. cit.). Thus, unlike the SPSM, the objective of this study is more in line with establishing non-stationarity of the broad money multiplier, a necessary condition for instability.

Against this backdrop, the study proceeds using the first- and second-generation panel tests discussed above. In view of confirmation of the existence of cross-sectional dependence in the panel series, the stationarity tests focus on the second-generation Pesaran's (2007) CIPS test, though the first-generation tests are computed for comparison. The results of the CIPS test computed using specifications with and without a deterministic trend, for the three sub-monetary groupings—ECOWAS, WAEMU and Non-WAEMU—are presented in Table 3.3 below. The results of the specification without trend indicate that the tests fail to reject null hypothesis of unit root for the levels of LM2, LMB and LBC, at the conventional 5 percent level for the three groupings. There is however indication of stationarity in the second lag of LBC for the Non-WAEMU group, but only at the 10 percent significance level. The variables are all rendered stationary following first-differencing, indicating they are integrated of order one. Incorporating a deterministic trend in the specification, the test results show that ECOWAS and Non-WAEMU countries, the levels of LM2, LMB and LBC are all non-stationary. For the WAEMU, the test rejects the null of unit root for both LM2 and LBC at zero lag at the conventional 5 percent level of significance. The three variables, LM2, LMB and LBC, are non-stationary at the 5 percent level. By first differencing the variables, they become stationary, except for the second lag of LM2 and LBC for the Non-WAEMU group.

The results of the first-generation panel tests—LLC, IPS, ADF-Fisher and PP-Fisher—for the three groupings are presented in Appendix A.11. For the entire ECOWAS region, there is broad agreement among all four panel tests that the level of series—LM2, LMB, and

[45] Extensions to the SPSM test procedure have been developed, including by Smeeks (2010) and Bahmani-Oskooee et al. (2013).

LBC—contain unit root and become stationary after first differencing. A similar outcome is reported for the WAEMU and the Non-WAEMU, with all variables been integrated of the order one, especially the deterministic component including a constant and a trend.

Table 3.3: Results of Pesaran's CIPS Panel Unit Root Tests
(a): Specification without Trend

		ECOWAS		WAEMU		Non-WAEMU	
Variable	**Lags**	**Zt - bar**	**P-value**	**Zt - bar**	**P-value**	**Zt - bar**	**P-value**
Levels							
lm2	0	2.58	0.995	0.16	0.564	0.34	0.632
lm2	1	2.02	0.979	0.03	0.510	-0.11	0.457
lm2	2	1.95	0.974	0.96	0.831	-0.59	0.279
lmb	0	-0.88	0.189	-0.34	0.367	-0.35	0.364
lmb	1	-0.68	0.249	-0.36	0.360	-0.36	0.361
lmb	2	-1.01	0.156	0.56	0.711	-0.92	0.179
lmm	0	0.33	0.628	-0.86	0.196	-0.75	0.228
lmm	1	1.30	0.903	0.06	0.525	-0.53	0.300
lmm	2	1.46	0.927	0.70	0.759	-0.72	0.237
lbc	0	3.66	1.000	-0.58	0.279	0.22	0.588
lbc	1	2.96	0.998	0.33	0.628	-0.39	0.348
lbc	2	2.26	0.988	0.99	0.840	-1.33*	0.092
First Differences							
dlm2	0	-10.63***	0.000	-10.93***	0.000	-6.40***	0.000
dlm2	1	-5.15***	0.000	-7.13***	0.000	-3.24***	0.001
dlm2	2	-3.29***	0.000	-6.14***	0.000	-1.39*	0.082
dlmb	0	-14.12***	0.000	-11.42***	0.000	-8.50***	0.000
dlmb	1	-7.03***	0.000	-6.78***	0.000	-2.70***	0.003
dlmb	2	-4.46***	0.000	-4.64***	0.000	-1.88**	0.030
dlmm	0	-14.55***	0.000	-11.89***	0.000	-8.77***	0.000
dlmm	1	-8.87***	0.000	-8.57***	0.000	-4.44***	0.000
dlmm	2	-5.05***	0.000	-5.09***	0.000	-2.95***	0.002
dlbc	0	-12.07***	0.000	-11.85***	0.000	-7.79***	0.000
dlbc	1	-6.54***	0.000	-7.88***	0.000	-4.63***	0.000
dlbc	2	-3.19***	0.001	-5.33***	0.000	-1.85**	0.032

Source: Author's computation

Note: Test assumes cross-section dependence is in the form of a single unobserved common factor
Null hypothesis – Series is I(1)
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed: Stata 15

(b): Specification with Trend

		ECOWAS		WAEMU		Non-WAEMU	
Variable	**Lags**	**Zt - bar**	**P-value**	**Zt - bar**	**P-value**	**Zt - bar**	**P-value**
				Levels			
lm2	0	4.24	1.000	-1.99**	0.023	1.25	0.895
lm2	1	3.08	0.999	-1.21	0.113	0.56	0.711
lm2	2	2.38	0.991	-1.54*	0.062	0.31	0.620
lmb	0	1.21	0.888	-1.23	0.110	0.76	0.775
lmb	1	1.59	0.944	-1.09	0.138	1.64	0.949
lmb	2	1.23	0.890	-1.36*	0.088	0.76	0.777
lmm	0	-0.09	0.464	-2.25**	0.012	0.07	0.527
lmm	1	0.94	0.827	-1.68**	0.046	0.73	0.769
lmm	2	1.70	0.955	-0.27	0.393	0.74	0.770
lbc	0	2.00	0.977	-1.64**	0.050	1.23	0.891
lbc	1	1.17	0.878	-0.57	0.285	0.77	0.781
lbc	2	1.49	0.931	0.51	0.694	0.67	0.749
				First Differences			
dlm2	0	-10.65***	0.000	-10.22***	0.000	-5.89***	0.000
dlm2	1	-5.12***	0.000	-5.89***	0.000	-2.46***	0.007
dlm2	2	-3.54***	0.001	-4.94***	0.002	-0.54	0.295
dlmb	0	-13.74***	0.000	-10.95***	0.000	-8.03***	0.000
dlmb	1	-5.90***	0.000	-5.77***	0.000	-2.02**	0.021
dlmb	2	-3.30***	0.006	-3.63***	0.000	-1.61*	0.054
dlmm	0	-13.80***	0.000	-11.45***	0.000	-8.23***	0.000
dlmm	1	-7.40***	0.000	-7.69***	0.000	-3.42***	0.000
dlmm	2	-3.68***	0.006	-3.93***	0.000	-2.02**	0.022
dlbc	0	-12.10***	0.000	-11.16***	0.000	-7.06***	0.000
dlbc	1	-6.78***	0.000	-6.92***	0.000	-4.27***	0.000
dlbc	2	-3.06	0.001***	-4.15***	0.000	-0.84	0.200

Source: Author's computation

Note: Test assumes cross-section dependence is in the form of a single unobserved common factor
Null hypothesis – Series is I(1)
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed: Stata 15

3.4.3 Model estimation methodologies

The testable hypotheses outlined in Table 3.1 above are investigated using a range of advanced empirical techniques in panel data modelling, in respect of panel unit roots, cointegration and panel causality testing. The study adopts an empirical strategy that is implemented in two parts. First, the stability of the money multiplier is investigated by assessing the stationarity of the money multiplier using the second-generation panel test (Pesaran, 2007) presented in section 3.4.2 above and the battery of first-generation panel unit root tests (LLC, IPS, ADF-Fisher and PP-Fisher). This is complemented by an examination of the long-run association between the key components of the money multiplier—broad money and the monetary base—using the Pedroni (2004) residual-based panel cointegration test and the Westerlund (2007) error correction-based panel cointegration test. Second, the causal relationships between bank credit and the key monetary aggregates—broad money, the monetary base, and the money multiplier—as established by the underlying theoretical postulations, are examined with the help of the dynamic panel Granger-non-causality tests developed by Dumitrescu and Hurlin (2012). The panel cointegration tests and panel causality test are outlined below.

3.4.3.1 Pedroni (2004) panel cointegration test

The Pedroni (2004) panel cointegration test is based on the Engle and Granger (1987) cointegration method that examines the residuals from an estimated regression. The test allows for heterogeneous intercepts and trend coefficients across the cross-sectional units. It utilizes individual OLS residuals obtained by estimating the single cointegration regression below.

$$y_{it} = \alpha_i + \beta_i x_{it} + \varepsilon_{it} \tag{21}$$

where y_{it} and x_{it} are the variables of interest, which in this case are the log of the broad money supply and the log of the monetary base. x_{it} and y_{it} are assumed to be integrated of the order one.

The Pedroni (2004) test involves running an auxiliary regression on each cross section to test the absence of a long-run relationship as the null hypothesis and the existence of cointegration as the alternative.

$$\hat{\varepsilon}_{it} = \rho_i \hat{\varepsilon}_{it-1} + u_{it} \tag{22}$$

where ρ_i is the autoregressive coefficient of the estimated residuals.

The null hypothesis of no cointegration is thus tested against two alternative hypotheses as follows:

Null hypothesis: $H_0 : \rho_i = 1 \quad \forall_i$ (No cointgeration)

Homogeneous alternative: $H_1 : \rho_i = \rho < 1 \quad \forall_i$ (Cointegration)

Heterogeneous alternative: $H_1 : \rho_i < 1 \quad \forall_i$ (Cointegration)

The Pedroni (2004) test proposes seven panel cointegration statistics, divided into two classes—panel statistics and group mean statistics. There are four panel statistics[46]—panel *v*, panel rho, panel PP, and panel ADF—which relate to the homogeneous alternative above that involves pooling the data along the within dimension. The panel statistics are developed as ratios of the sum of the numerators and denominators of individual unit root statistics across the within dimension of the panel. The group mean statistics, on the other hand, are constructed on the basis of averages of individual unit root statistics along the between dimension and they allow for heterogeneity among the panel reflecting the second alternative hypothesis above. The three between-dimension statistics are the Group rho, Group PP, and Group ADF.

While the Pedroni (2004) cointegration test generally assumes cross section independence of panel units, it could be modified to address simple cross-sectional dependency by including common time dummies[47]. This involves time demeaning the data for each unit and variable as follows:

$$\overline{y_t} = \frac{1}{N} \sum_{i=1}^{N} y_{i,t} \tag{23}$$

This study applies the modification to the Pedroni (2004) test framework in order to accommodate cross-sectional dependence.

[46] Pedroni (2004) reports four additional statistics which are weighted averages of each of the panel statistics
[47] See Neal (2014)

3.4.3.2 Westerlund (2007) panel cointegration test

The Westerlund (2007) panel cointegration test addresses the potential low power characteristic of residual-based cointegration tests, like the Pedroni (2004) test presented above. The residual-based panel tests have often failed to reject the null of no cointegration contrary to established economic theory, and this has been attributed to common-factor restriction which constrains long-run parameters for variables in their levels to be equal to the short-run parameters of said variables in their differences (Banerjee et al. 1998). The Westerlund (2007) test does not require imposition of common-factor restriction as they are based on structural dynamics and not residual dynamics. The Westerlund (2007) panel test is therefore built on the error correction formulation below:

$$\Delta y_{it} = \delta_i^{'} d_t + \alpha_i y_{i,t-1} + \lambda_i^{'} x_{i,t-1} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{i,t-j} + \sum_{j=-q_i}^{p_i} \gamma_{ij} \Delta x_{i,t-j} + e_{it} = 0 \qquad (24)$$

where i = 1,….., N indexes the cross-sectional units and t = 1, 2,….., T the time series. d_t captures the deterministic terms. α_i is the error correction parameter which, when negative ($\alpha_i < 0$), indicates the existence of error correction and thus confirms cointegration. When the parameter is equal to zero ($\alpha_i = 0$), there is no error correction and therefore no cointegration.

Westerlund (2007) developed four panel cointegration statistics—two Panel statistic and two Group-mean statistic—the construction of which depends on the homogeneity assumption of α_i. The test statistics share the same null of no cointegration. That is:

Null hypothesis: $H_0 : \alpha_i = 0$ for all i (No cointegration)

With respect to the panel tests, α_i is assumed to be equal for all i_s . In this case, the alternative hypothesis which implies cointegration for the panel as a whole is presented as follows:

Homogeneous alternative: $H_1 : \alpha_i = \alpha < 0$ for all i (Cointegration)

For the group-mean statistic, the $\alpha_i s$ are not required to be equal and thus tests the alternative hypothesis that at least one unit is cointegrated. This takes the following form:

Heterogeneous alternative: $H_1 : \alpha_i < 0$ for all i (Cointegration)

The Westerlund (2007) error-correction-based test is robust to more complex cross-sectional dependence and accommodates heterogeneity. It is thus relatively more appropriate for this study given evidence of strong cross-sectional correlation among the countries in the sample.

3.4.3.3 Dumitrescu-Hurlin (2012) Panel Non-Causality Test

The Dumitrescu and Hurlin (2012) dynamic panel test (henceforth DH test) is used to investigate causality among variables within a panel framework, taking into account heterogeneity both in terms of individual effects or differing intercepts among cross sections and in terms of causal variations in the slope parameters or coefficients.

Abstracting from the Granger causality test (Granger, 1969) which investigates whether past values of a variable x significantly affect the present value of y, Dumitrescu and Hurlin (2012) extends the framework to a panel setting using the following regression:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_{ij} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \qquad (25)$$

with i = 1, ….., N and t = 1, ….., T

where $x_{i,t}$ and $y_{i,t}$ are observations of two variables from cross section *i* in time period *t*. The coefficients are allowed to vary across the cross sections *is,* though assumed to be time-invariant.

The null hypothesis for the DH test is defined as follows:

$$H_0 : \beta_{i1} = ... = \beta_{ik} = 0 \qquad \forall_i = 1,....., N$$

Under the null hypothesis, there is no causality in any of the cross sections.

On the assumption that there could exist causality for some cross sections but not necessarily all cross sections, DH presents the following alternative hypothesis:

$$H_1 : \beta_{i1} = ... = \beta_{ik} = 0 \qquad \forall_i = 1, ..., N_1$$

$$\beta_{i1} \neq 0 \text{ or } .... \text{ or } \beta_{ik} \neq 0 \quad \forall_i = N_1 + 1, ..., N$$

where $N_1 \in [0, N-1]$ is unknown. If $N_1 = 0$, there is causality for all cross sections.

The DH test for granger non-causality is based on a Wald statistic and is computed as a panel test value of cross-sectional averages of individual Wald statistic obtained separately from each of the cross sections. The computed average Wald statistic $\overline{W}$ is :

$$\overline{W} = \frac{1}{N} \sum_{i=1}^{N} W_i \tag{26}$$

where W_i represents the cross-sectional Wald statistics.

Following from the above, the test is constructed to investigate causality at the panel level, and thus rejection of the null hypothesis of no causality at the panel level does not preclude non-causality for some cross sections.

The DH test[48] presents a number of advantages which makes it quite appropriate for this study. First, it assumes all coefficients to be different across the individual cross sections and allows lag structures to vary among them, rendering it more reliable relative to traditional granger causality tests. Second, the test is conducted on stationary data series within a VAR framework. It therefore accommodates the investigation of causality in nonstationary and non-cointegrated panels, unlike some recent panel causality techniques which are restricted to only nonstationary and cointegrated series, such as Canning and Pedroni (2008). Third, the procedure accommodates cross-sectional dependence, a critical issue in dynamic macro-panel data modelling as discussed earlier, by employing bootstrapped critical values instead of asymptotic critical values. Lastly, the test possesses good finite sample properties. Monte Carlo simulations reveal increased power of the test even for samples with small T and N dimensions (Dumitrescu and Hurlin, 2012).

[48] This study employs the DH test adaption of Lopez and Weber (2017) which develops a user-written Stata program command 'xtgcause' allowing for lag selection on the basis of Akaike, Bayesian and Hannan-Quinn information criteria and using block bootstrap procedure to allow for cross sectional dependence. The test proceeds only with balanced panel.

3.5 Estimations Results and Analyses

This section presents and analyses the results of the estimations, commencing with tests of stability of the broad money multiplier and the direction of causation between key monetary aggregates and bank credit, as reflected in the testable hypotheses outlined in Table 3.1 above.

3.5.1 Stability of the traditional broad money multiplier

The stationarity of the broad money multiplier, determined on the basis of the panel unit root tests, could be considered a necessary condition for stability. Given the confirmation of the existence of strong cross-sectional dependence among the data series for the member countries (Table 3.2 above), stationarity of the money multiplier is investigated using the second-generation Pesaran 2007 CIPS test. From the results in Table 3.3, the tests for the ECOWAS region fail to reject the null hypothesis of non-stationarity, with or without the deterministic specification of a trend. Similarly, for the Non-WAEMU region, the test results reveal that the money multiplier series contain unit root, irrespective of the deterministic assumption. In both the ECOWAS and the Non-WAEMU regions, the results provide indication that the money multiplier has been unstable over the sample period. However, for the WAEMU, the test rejects the null hypothesis of non-stationarity at zero and one lag, once a deterministic trend is included in the specification. However, the absence of a trend in the plots of LMM, reported in Appendices 3.2 and 3.3, implies that the specification without trend produces a more realistic representation of the data. On this basis, it is evident that the money multiplier is non-stationary for all the groupings. By transforming the series through first differencing, all tests unanimously reject the null hypothesis of unit root.

The data series are also subjected to a range of first-generation panel unit root tests, namely the LLC, IPS, ADF-Fisher and PP-Fisher tests, discussed in section 3.4.2.2 above mainly for comparison to assess the effect of cross-sectional dependence on the test outcomes. The results, presented in Appendix A.11, show that the IPS test rejects the null hypothesis of a unit root in the money multiplier series in all three regions, once an intercept and a deterministic are incorporated into the model. These results are in contrast with the outcomes for the ECOWAS and Non-WAEMU regions based on the second-generation test, underscoring the need for accommodating cross-sectional dependence to ensure robustness. The results of the other first-generation tests produced broadly mixed results on the stationarity of the broad money multiplier for the ECOWAS, WAEMU and Non-WAEMU regions over the research period.

As highlighted in section 3.4.3 above, the tests for stationarity of the money multiplier are complemented by investigations of the long-run association between broad money and the monetary base, employing both the Pedroni (2004) residual-based cointegration and the Westerlund (2007) error-correction-based cointegration tests outlined above. Table 3.4 below reports the results of the Pedroni (2004) panel cointegration tests for the ECOWAS, WAEMU and the Non-WAEMU.[49]

Table 3.4: Results of Pedroni (2004) panel cointegration tests - LM2 and LMB

	ECOWAS		WAEMU		NON-WAEMU	
	Statistic	**P-value**	**Statistic**	**P-value**	**Statistic**	**P-value**
Trend Assumption - No Deterministic Trend						
Within-dimension						
Panel v-Statistic	0.354	0.362	-0.632	0.264	1.368*	0.086
Panel rho-Statistic	-1.141	0.127	0.566	0.286	-0.858	0.196
Panel t-Statistic	-1.362*	0.087	0.263	0.396	-1.091	0.138
Panel ADF-Statistic	-1.066	0.143	0.274	0.392	-1.005	0.157
Between-dimension						
Group rho-Statistic	-0.238	0.406	-0.257	0.399	-0.163	0.435
Group t-Statistic	-1.102	0.135	-0.404	0.343	-0.807	0.210
Group ADF-Statistic	-0.808	0.210	-0.618	0.268	-0.770	0.221
Trend Assumption - Deterministic Intercept and Trend						
Within-dimension						
Panel v-Statistic	2.643***	0.004	1.668**	0.048	0.933	0.175
Panel rho-Statistic	0.342	0.366	-2.551***	0.005	0.732	0.232
Panel t-Statistic	0.084	0.467	-3.262***	0.001	0.205	0.419
Panel ADF-Statistic	0.652	0.257	-3.128***	0.001	0.837	0.201
Between-dimension						
Group rho-Statistic	1.189	0.117	-1.226	0.110	0.809	0.209
Group t-Statistic	0.796	0.213	-2.708***	0.003	0.094	0.463
Group ADF-Statistic	1.181	0.119	-2.538***	0.006	0.858	0.196

Source: Author's computation

Note: Data has been time-demeaned to correct for simple cross section correlation. The test is undertaken in Stata using the 'xtpedroni' command and p-values are computed for a one-tailed test.

All test statistics are distributed N(0,1), under a null of no cointegration.
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed: Stata 15

[49] The test reports both within-dimension and between-dimension outputs. Within-dimension tests assume common AR coefficients among cross sectional units, whereas Between-dimension presupposes individual AR coefficients. Spectral estimation was undertaken with Bartlett method and bandwidth was selected using Newey-West approach. Lag lengths are determined through automatic selection based on Schwarz Information Criteria.

For the ECOWAS region, the cointegration test indicates no cointegration between broad money and the monetary base, with most panel statistics and all group statistics failing to reject the null of no cointegration at the conventional levels of significance. For the WAEMU, the outcome depends on the underlying deterministic assumption, as the null of no cointegration could not be rejected assuming only intercept, whereas the test rejects the null hypothesis with the inclusion of a trend. The results for the Non-WAEMU reveal the absence of cointegration between the two series, with all test statistics decisively failing to reject the null hypothesis.

Given the presence of strong cross-sectional dependence in both series, the validity of the outcome of the residual-based Pedroni cointegration test may be questionable as it addresses only simple cross-sectional correlation. Thus, the Westerlund (2007) panel cointegration test, which is robust to heterogeneity and complex cross-sectional correlation, is applied.

Table 3.5: Results of Westerlund (2007) panel cointegration tests - LM2 and LMB

	ECOWAS			WAEMU			NON-WAEMU		
Statistic	**Value**	**Z-value**	**Robust P-value**	**Value**	**Z-value**	**Robust P-value**	**Value**	**Z-value**	**Robust P-value**
Deterministic specification: constant only									
Gt	-1.527	0.966	0.720	-1.206	1.682	0.867	-1.976	-0.494	0.323
Ga	-6.116	0.653	0.384	-5.772	0.666	0.522	-6.598	0.224	0.277
Pt	-4.708	0.309	0.416	-2.724	1.112	0.738	-2.666	0.574	0.563
Pa	-5.194	-0.752	0.154	-4.418	-0.112	0.369	-3.133	0.552	0.575
Deterministic specification: constant and trend									
Gt	-1.983	1.636	0.914	-1.742	2.033	0.935	-2.864	-1.37	0.212
Ga	-5.839	3.144	0.988	-6.172	2.272	0.945	-4.712	2.4	0.989
Pt	-5.405	2.187	0.914	-3.884	1.950	0.917	-5.567	-0.965	0.245
Pa	-5.532	1.921	0.896	-5.321	1.558	0.895	-4.142	1.747	0.961

Source: Author's computation

Note: The Westerlund test is conducted using the Stata command 'xtwest' and assumes a null hypothesis of no cointegration. The test is fitted with a constant only and a constant and trend and the lags and leads are determined using the Bayesian information criteria. The kernel bandwidth is set according to the rule $4(T/100)^{2/9}$.

The robust p-values are for a one-sided test based on 799 bootstrap replications.

Econometric software employed: Stata 15

The results for the three monetary groupings, under the different deterministic specifications, are presented in Table 3.5 above. In all cases, it is evident from these results that the null of no cointegration cannot be rejected at the widely-employed levels of significance, irrespective of the deterministic assumption and for all test statistics, panel and group.[50]

While the above results point to an unstable money multiplier in the region, the assessment of the long-run cointegrating relationship between the monetary base and the money supply may have been influenced by a few factors. To start with, the underlying relationship may potentially exhibit nonlinear (asymmetric) characteristic, in contrast to the linear (symmetric) long-run proportional relation between the money supply and the monetary base assumed in the empirical approaches. Nonlinearity would imply that increases and decreases in the monetary base may exert separate impacts on the money supply in terms of magnitude and sign, or that increases in the monetary base may impact the money supply whereas decreases may not or vice versa. This potential nonlinear (asymmetric) characteristic of the money supply determination process may arise from increased uncertainties in financial markets and changing portfolio choices among economic agents (Ongan and Gocer, 2019).[51] Another characteristic feature that could influence the long-run cointegrating relationship between the monetary base and the money multiplier is the presence of structural breaks in the country-specific time series, as is often the case with data covering a long period of time. Failure to account for potential breaks in the cointegrating vector when the true process is subject to structural change could lead to misleading test outcomes.

To ascertain the robustness of the results obtained above, the relationship is re-examined using the Westerlund and Edgerton (2008) panel cointegration test which accommodates unknown structural breaks in both the intercept and slope. In addition, the test allows for cross-sectional dependence, heteroscedastic and serially-correlated errors, and also cross unit-specific time trends.

[50] The Westerlund (2007) tests are predicated on the assumption of weakly exogenous regressors. In all instances of the test, reverse regressions fail to reject the null of no error correction. Thus, there is no indication of violation of the weak exogeneity assumption.

[51] Nonlinear ARDL modelling approach proposed by Shin et al. (2014) has been adopted to account for nonlinearity. Ongan and Gocer (2019) applied the nonlinear ARDL model alongside the linear version of this model to examine the money supply determination process in Canada. Unlike the linear approach, the nonlinear ARDL method successfully detected potentially concealed proportional relations between the money supply and monetary base. However, the nonlinear ARDL in a panel setting does not account for the critical problem of cross-sectional dependence.

Westerlund and Edgerton (2008) considered the following model

$$y_{it} = \alpha_i + \eta_i t + \delta_i D_{it} + x_{it}^{'}\beta_i + (D_{it}x_{it})'\gamma_i + z_{it} \qquad (16)$$

$$x_{it} = x_{it-1} + w_{it}$$

where the indices $i = 1, \ldots, N$ and $t = 1, \ldots, T$ denote the cross-section units and the time period, respectively. The k-dimentional vector x_{it} contains the regressors and is modelled as a pure random walk process. The variable D_{it} is a scalar break dummy such that $D_{it} = 1$ if $t > T_i$ and zero otherwise. Within the framework, α_i and β_i represent the change in these parameters at the time of the shift. w_{it} represents an error term with mean zero and independent across i_s . The disturbance term z_{it} assumes a data-generating process that allows for cross-sectional dependence through the use of unobserved common factors.

Westerlund and Edgerton (2008) propose two versions of the test for the null hypothesis of no cointegration, derived from the Lagrange multiplier-based unit roots tests by Schmidt and Philips (1992), Ahn (1993) and Amsler and Lee (1995). They test the null hypothesis that all N cross sectional units are spurious, i.e., $H_0 : N_1 = 0$ with $N_0 := N - N_1$, against the alternative that the first N_1 cross-sectional units are cointegrated while the remaining $N_0 := N - N_1$ units are spurious, i.e., $H_1 : N_1 > 0$.

The results of the cointegration test by Westerlund and Edgerton (2008) for the three groupings—ECOWAS, WAEMU and Non-WAEMU—are presented in Table 3.6 below. Based on these results, the null hypothesis of no cointegration cannot be rejected at the conventional 5 percent level of significance in the presence of structural breaks. For all three groupings, there is clear agreement between the two test statistics, $Z_\tau(N)$ and $Z_\varphi(N)$, in terms of level shift and the regime shift. However, with regards the Non-WAEMU group, the null of no cointegration is slightly rejected for the regime shift specification, but only at the 10 percent level of significance.

These outcomes are consistent with the results of both the Pedroni (2004) residual-based and the Westerlund (2007) error-correction-based panel cointegration tests, thus confirming the absence of a long-run cointegrating relationship between the broad money supply and the monetary base for the ECOWAS, WAEMU and Non-WAEMU groupings over the study period.

Table 3.6: Westerlund and Edgerton (2008) panel cointegration test

ECOWAS

	$Z_\tau(N)$		$Z_\varphi(N)$	
Model	Value	P-value	Value	P-value
No shift	0.327	0.628	-2.76^{***}	0.003
Level shift	2.256	0.988	1.822	0.966
Regime shift	3.954	1.000	2.241	0.987

WAEMU

	$Z_\tau(N)$		$Z_\varphi(N)$	
Model	Value	P-value	Value	P-value
No shift	-2.237^{**}	0.013	-4.532^{***}	0.000
Level shift	-0.789	0.215	0.085	0.534
Regime shift	0.701	0.758	0.566	0.714

Non-WAEMU

	$Z_\tau(N)$		$Z_\varphi(N)$	
Model	Value	P-value	Value	P-value
No shift	-0.058	0.477	-0.733	0.232
Level shift	-0.086	0.466	0.118	0.547
Regime shift	-1.304^{*}	0.096	-1.317^{*}	0.094

Source: Author's computation

Note: The p-values are for a one-sided test based on the normal distribution. The estimation assumes at most two common factors. Null hypothesis is no cointegration
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed: Gauss 17 (program codes written by Professor Joakim Westerlund).

3.5.2 Direction of Causation between Monetary Aggregates and Bank Credit

This section investigates the existence of causal relationships between monetary aggregates and bank credit to the private sector, which underpin the endogenous money theory. As highlighted in section 3.2.3 (Table 3.1), the following hypotheses are examined:

Ho[2]: A unidirectional causality from monetary base to bank credit (Neoclassical perspective)

Ho[3]: A unidirectional causality from bank credit to the monetary base (Accommodationist/ Horizontalist perspective)

Ho[4]: A bidirectional causality between bank credit and the broad money supply (Structuralist postulation – Liquidity preference)

Ho[5]: A bidirectional causality between bank credit and the broad money multiplier (Structuralist postulation)

The causality procedure has been preceded by unit root tests for each of the panel series to determine their stationarity, followed by tests of cointegration for the pair of variables corresponding to the stipulated hypotheses. The outcome of the panel unit root and cointegration tests determines whether the causality is conducted within a VAR or a VECM framework. As with time series estimation, if the panel series are integrated of the same order I(1) and are cointegrated, then the VECM technique is applied to investigate both short-run and long-run causality (Granger 1988). If, on the other hand, the panel series are integrated of the same order I(1) but not cointegrated, test for Granger non-causality proceeds on the basis of a differentiated VAR framework (Sims et al., 1990; Toda and Phillips, 1993; and Hurlin and Venet, 2008). In the latter situation, the non-stationary stochastic trend is eliminated by taking first order differences of the level series.

The range of first generation panel unit root tests (LLC, IPS, ADF-Fisher and PP-Fisher) reported in Appendix A.11 reveals that all the panel series are non-stationary and integrated of order one [I(1)]. However, given that the null of no cross-sectional dependence is resoundingly rejected for all the panel series (see Table 3.2 for results) using the Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM, and Pesaran CD tests, the non-stationarity of the panel series is re-assessed applying the second-generation Pesaran (2007) panel unit root test which allows for cross sectional dependence.

The results of the Pesaran (2007) test, with constant only and constant and trend as deterministic components, indicate that the relevant series—LBC, LMB, LM2 and LMM—are non-stationary in levels but become stationary after first differencing. The outputs of this diagnostic test are reported in Table 3.3 above.

3.5.2.1 Tests for Panel Cointegration

Cointegration between bank credit and the key monetary aggregates is investigated by employing both the Pedroni (2004) residual-based panel cointegration test and the error-correction-based Westerlund (2007) panel cointegration test. As pointed out in section 3.5.1 above, the Pedroni test only addresses simple cross-sectional dependence among the cross-sectional units, whereas the Westerlund (2007) test fully accommodates cross section correlation among the panels by computing robust p-value using bootstrap procedure.[52]

i. Bank credit and the monetary base

The results of the Pedroni (2004) cointegration test between bank credit and the monetary base, presented in Table 3.7 below, reveal that under the deterministic assumptions of intercept only the null of no cointegration could not be rejected by all panel and group test statistics at the 5% level of significance. In fact, only the panel t-statistic rejects the null at the 10% level. Assuming the inclusion of a time trend, the null hypothesis of no cointegration is mostly rejected. While the Pedroni test results appear contradictory under the different deterministic assumptions, the Westerlund (2007) cointegration test for its part clearly indicates the lack of cointegration between the two series. The robust p-values for the test statistics, under both deterministic specifications—intercept only and intercept and trend—show that the null hypothesis of no cointegration cannot be rejected at the traditional levels of significance. These results are reported in Table 3.8 below.

ii. Bank credit and broad money supply

In line with the preceding section (i.) above, cointegration tests employing both the Pedroni (2004) and the Westerlund (2007) cointegration tests are first performed between bank credit and broad money to determine the long-run relationship between the two series. The results of the Pedroni test, in Table 3.9 below, generally point to a rejection of the null hypothesis of no cointegration. With the exception of the Group t-Statistic, all other test statistic fails to

[52] The alternative Pedroni (2004) and Westerlund (2007) panel cointegration test results with bank credit as the right-hand side variable are reported in Appendix 3.5. They mimic the outcomes discussed below.

reject the null of no cointegration at the 5% levels of significance, assuming a deterministic specification of constant only. With both intercept and trend incorporated, all test statistics fail to reject the null hypothesis.

Table 3.7: Pedroni (2004) Cointegration Tests – LBC and LMB

	Statistic	P-value
Trend Assumption - No Deterministic Trend		
Within-dimension		
Panel v-Statistic	0.298	0.383
Panel rho-Statistic	-1.109	0.134
Panel t-Statistic	-1.393*	0.082
Panel ADF-Statistic	-0.888	0.187
Between-dimension		
Group rho-Statistic	-0.061	0.476
Group t-Statistic	-0.894	0.186
Group ADF-Statistic	-0.511	0.305
Trend Assumption - Deterministic Intercept and Trend		
Within-dimension		
Panel v-Statistic	0.581	0.281
Panel rho-Statistic	1.304*	0.096
Panel t-Statistic	1.066	0.143
Panel ADF-Statistic	1.870**	0.031
Between-dimension		
Group rho-Statistic	2.171**	0.015
Group t-Statistic	2.048**	0.020
Group ADF-Statistic	2.670*	0.004

Source: Author's computation

Note: All test statistics are distributed N(0,1), under a null of no cointegration
** and * reject the null at the 5% and 10% significance levels, respectively.
Data has been time-demeaned.
Econometric software employed: Stata 15

Table 3.8: Westerlund (2007) Cointegration Test Results - LBC and LMB

Statistic	Value	Z-value	P-value	Robust P-value
Deterministic specification: constant only				
Gt	-1.7	0.299	0.618	0.571
Ga	-6.681	0.293	0.615	0.325
Pt	-5.124	-0.11	0.456	0.345
Pa	-4.068	0.127	0.550	0.397
Deterministic specification: constant and trend				
Gt	-1.878	2.084	0.981	0.978
Ga	-5.11	3.516	1.000	1.000
Pt	-4.528	3.189	0.999	0.985
Pa	-3.97	2.804	0.998	0.989

Source: Author's computation

Note: The Westerlund test is conducted using the Stata command 'xtwest' and assumes a null hypothesis of no cointegration. The test is fitted with a constant only and a constant and trend and the lags and leads are determined using the Bayesian information criteria. The kernel bandwidth is set according to the rule $4(T/100)^{2/9}$.
The robust p-values are for a one-sided test based on 799 bootstrap replications.
Specifications with constant only: Average AIC selected lag length (1.25) and lead length (0.5)
Specifications including trend: Average AIC selected lag length (1.42) and lead length (0.5)
Econometric software employed: Stata 15

The Westerlund (2007) test procedure presents broadly similar outcome as those of the Pedroni (2004) test results. As reported in Table 3.10 below, under the assumption of constant only, both the group Ga statistic and panel Pa statistic reject the null hypothesis of no cointegration at the 1% and 5% levels of significance, respectively. With both intercept and trend included in the model, all test statistics unanimously fail to reject the null of no cointegration. A visual assessment of the two series—LBC and LM2—depicts upward trending over the study period, thus placing more weight on the testing model incorporating a time trend. Against this backdrop, it is evident that the test fails to reject the null of no cointegration between the series.

Table 3.9: Pedroni (2004) Panel Cointegration test – LBC and LM2

	Statistic	P-value
Trend Assumption - No Deterministic Trend		
Within-dimension		
Panel v-Statistic	1.148	0.126
Panel rho-Statistic	-1.019	0.134
Panel t-Statistic	-1.450*	0.074
Panel ADF-Statistic	-1.065	0.143
Between-dimension		
Group rho-Statistic	-1.151	0.125
Group t-Statistic	-2.058**	0.020
Group ADF-Statistic	-1.552*	0.060
Trend Assumption - Deterministic Intercept and Trend		
Within-dimension		
Panel v-Statistic	1.203	0.115
Panel rho-Statistic	-0.459	0.323
Panel t-Statistic	-1.044	0.148
Panel ADF-Statistic	-1.162	0.123
Between-dimension		
Group rho-Statistic	0.572	0.284
Group t-Statistic	-0.434	0.332
Group ADF-Statistic	-0.758	0.224

Source: Author's computation

Note: All test statistics are distributed N(0,1), under a null of no cointegration
** and * reject the null at the 5% and 10% significance levels, respectively.
Data has been time-demeaned.
Econometric software employed: Stata 15

Table 3.10: Westerlund (2007) Cointegration Test Results – LBC and LM2

Statistic	Value	Z-value	P-value	Robust P-value
Deterministic specification: constant only				
Gt	-2.097	-1.230	0.109	0.193
Ga	-10.712***	-2.271	0.012	0.010
Pt	-6.644	-1.639	0.051	0.106
Pa	-7.312**	-2.405	0.008	0.036
Deterministic specification: constant and trend				
Gt	-2.757	-1.667	0.048	0.215
Ga	-7.390	2.354	0.991	0.961
Pt	-6.901	0.477	0.683	0.690
Pa	-5.808	1.765	0.961	0.930

Source: Author's computation

Note: The Westerlund test is conducted using the Stata command 'xtwest' and assumes a null hypothesis of no cointegration. The test is fitted with a constant only and a constant and trend and the lags and leads are determined using the Bayesian information criteria. The kernel bandwidth is set according to the rule $4(T/100)^{2/9}$.
The robust p-values are for a one-sided test based on 799 bootstrap replications.
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Specifications with constant only: Average AIC selected lag length (1.33) and lead length (0.25)
Specifications including trend: Average AIC selected lag length (1.33) and lead length (0.42)
Econometric software employed: Stata 15

iii. Bank credit and broad money multiplier

The two panel tests for cointegration between bank credit and the money multiplier present contrasting results as shown in Tables 3.11 and 3.12 below. Following the Pedroni (2004) test procedure, all the test statistics, except panel v, reject the null of no cointegration at the 5% level of significance, assuming both constant and trend. Removing the deterministic trend component, the results become skewed towards non-rejection of the null hypothesis. With regards the Westerlund (2007) cointegration test procedure, all test statistics strongly fail to reject the null hypothesis under both deterministic specifications of intercept only and intercept and trend. The apparent conflict in the results of the Pedroni (2004) test and the Westerlund (2007) panel test could be attributed to the inability of the former test to address incidences of multiple or complex cross-sectional dependence among the cross sections or member countries. Thus, given the consistency in results across the test statistics of the Westerlund (2007) procedure, one could conclude that bank credit and the broad money multiplier are non-cointegrated over the study period.

Table 3.11: Pedroni (2004) Panel Cointegration test – LBC and LMM

	Statistic	**P-value**
Trend Assumption - No Deterministic Trend		
Within-dimension		
Panel v-Statistic	-2.229**	0.013
Panel rho-Statistic	0.685	0.247
Panel t-Statistic	-0.397	0.346
Panel ADF-Statistic	-0.297	0.383
Between-dimension		
Group rho-Statistic	2.030**	0.021
Group t-Statistic	0.725	0.234
Group ADF-Statistic	0.822	0.206
Trend Assumption - Deterministic Intercept and Trend		
Within-dimension		
Panel v-Statistic	0.495	0.310
Panel rho-Statistic	1.796**	0.036
Panel t-Statistic	1.697**	0.045
Panel ADF-Statistic	2.223**	0.013
Between-dimension		
Group rho-Statistic	3.020***	0.001
Group t-Statistic	3.289***	0.001
Group ADF-Statistic	3.782***	0.000

Source: Author's computation

Note: All test statistics are distributed N(0,1), under a null of no cointegration
*** and ** reject the null hypothesis at the 1% and 5% significance levels, respectively.
Data has been time-demeaned.
Econometric software employed: Stata 15

Table 3.12: Westerlund (2007) Cointegration Test Results – LBC and LMM

Statistic	Value	Z-value	P-value	Robust P-value
Deterministic specification: constant only				
Gt	0.439	8.547	1.000	1.000
Ga	0.791	5.048	1.000	1.000
Pt	-1.07	3.968	1.000	0.983
Pa	-0.613	2.822	0.998	0.984
Deterministic specification: constant and trend				
Gt	-1.624	3.164	0.999	0.998
Ga	-5.335	3.401	1.000	1.000
Pt	-4.824	2.851	0.998	0.968
Pa	-4.506	2.501	0.994	0.989

Source: Author's computation

Note: The Westerlund test is conducted using the Stata command 'xtwest' and assumes a null hypothesis of no cointegration. The test is fitted with a constant only and a constant and trend and the lags and leads are determined using the Bayesian information criteria. The kernel bandwidth is set according to the rule $4(T/100)^{2/9}$.

The robust p-values are for a one-sided test based on 799 bootstrap replications.

***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.

Specifications with constant: Average AIC selected lag length (1.25) and lead length (0.17)

Specifications including trend: Average AIC selected lag length (1.33) and lead length (0.25)

Econometric software employed: Stata 15

3.5.2.2 Dumitrescu and Hurlin (2012) Panel Granger Non-Causality Tests

Evident from the panel cointegration tests between the monetary aggregates and bank credit in section 3.5.2.1 above is the absence of cointegration between the set of panel series. As highlighted in section 3.5.2, causality between series that are non-stationary and non-cointegrated cannot be investigated within the common testing framework offered by the VECM. In this circumstance, the Dumitrescu and Hurlin (2012) panel non-causality test becomes appropriate as it is built on a VAR framework that accommodates non-cointegrated series. The test however requires that the series are stationary to ensure validity of the results. Of crucial importance is the fact that the DH test computes robust critical values using bootstrap procedure to address the identified correlation among the cross sections.

As already confirmed by both the first- and second-generation panel unit root tests, the four panel series of relevance here, i.e. log of bank credit, log of monetary base, log of broad money and the log of the broad money multiplier, are non-stationary and integrated of the order one. As such, each of the variables is first-differenced to obtain log-differenced series which are stationary.

To ensure robustness of the results, the lag selection is determined on the basis of the Bayesian information criteria (BIC).[53] The choice of the BIC in this study stems from its determination of optimal loglikelihood function value and its severe penalty for overparameterization. Moreover, the number of bootstrap replications to address cross-sectional dependence among the panels in all instances is 799.[54] As pointed out in section 3.4.3.3 above, the DH test is designed to investigate causality at the panel level, and as such rejection of the null hypothesis of no causality at the panel level does not imply that non-causality does not exist for some cross sections.[55]

i. Unidirectional causation from monetary base to bank credit

In addition to determining the stability of the traditional money multiplier, the orthodox theory of the money creation process is assessed by investigating the existence of a unidirectional relationship from the monetary base to bank credit. From the results of the DH panel non-causality tests documented in Table 3.13 below there is lack of strong evidence to support this traditional monetarist view. The bootstrap p-value for the Z-bar statistic indicates rejection of the null hypothesis that monetary base does not granger-cause bank credit only at the 10% level of significance. At both the 1% and 5% levels, the null hypothesis is not rejected. The Z-bar tilde statistic, on the other hand, fails to reject the null hypothesis that the monetary base does not cause bank credit at the standard levels of statistical significance of 1%, 5% and 10%. These results point to a weak influence of exogenously determined monetary base by the central bank on commercial banks' credit to economic agents.

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[53] Note that the DH (2012) test procedure does not provide guidance on the selection of the lag order. However, the extension by Lopez and Weber (2017) allows for lag selection using the Akaike, Bayesian or Hannan-Quinn information criteria.

[54] The version of the STATA software used for the tests, STATA IC 15 (64 bit), allows for a maximum of 799 replications.

[55] The analyses of the direction of causation between bank credit and the relevant monetary aggregates using the DH panel non-causality method is undertaken only for the ECOWAS region as a whole. The investigation is not conducted separately for the WAEMU and the Non-WAEMU in view of the small number of cross sections. The finite sample properties of the DH test for less than 10 cross sectional units have not been established.

ii. Unidirectional causation from bank credit to the monetary base

The results of the DH panel non-causality tests in Table 3.13 below provide evidence in support of the hypothesis that bank credit granger causes monetary base. The bootstrap p-values for both the Z-bar and Z-bar tilde statistics reject the null hypothesis that bank credit does not granger-cause the monetary base at the 5% level of significance. The optimal number of lags applied for the test is 1 and is obtained using the Bayesian information criteria (BIC). This outcome provides support for the accommodationist or horizontalist view of the money creation process, whereby the central bank fully accommodates demand for monetary reserves by the commercial banks to finance the demand for bank credit by non-bank private agents.

iii. Bidirectional causality between bank credit and broad money supply

The hypothesized bidirectional causal relationship between bank credit and broad money supply is investigated within the DH test framework in two parts: First, the null hypothesis that bank credit does not granger-cause broad money, and next, the null that broad money does not granger-cause bank credit. On the former, both the Z-bar and Z-bar tilde statistics agree on the non-rejection of the null hypothesis, implying that there is no causal relationship at the panel level running from bank credit to the money supply. With regards the alternate null hypothesis, results indicate that the null hypothesis that broad money does not granger cause bank credit could be rejected at the 5% level of significance. These results however fail to provide adequate support for the postulated bidirectional causality between bank credit and broad money supply, as espoused by the liquidity preference perspective of the endogenous money theory.

iv. Bidirectional causality between bank credit broad money multiplier

The causal relationship between bank credit and the broad money multiplier also provides the basis for investigating the structuralist perspective of the money creation process. The DH causality tests are conducted on an optimal lag of 1, chosen using the BIC. In this case, both the Z-bar and Z-bar tilde statistics reported in Table 3.13 fail to reject the null hypothesis that bank credit does not granger-cause the money supply. Similarly, the null hypothesis that the money multiplier does not granger-cause bank credit is not rejected at the conventional levels of significance. These results do not provide evidence to support the theoretical postulation of a bidirectional causality between bank credit and the money multiplier.

Table 3.13: Dumitrescu and Hurlin (2012) Panel Causality Tests

Null Hypothesis (Ho)	Z-bar Statistic	Bootstrap Critical Value (95%)	P-value	Z-bar tilde Statistic	Bootstrap Critical Value (95%)	P-value
Ho[2]: Monetary base does not Granger-cause bank credit	1.940*	2.581	0.095	1.583	2.155	0.110
Ho[3]: Bank credit does not Granger-cause monetary base	3.005**	2.664	0.035	2.532**	2.228	0.035
Ho[4]: Bank credit does not Granger-cause broad money supply	0.016	2.922	0.994	-0.131	2.458	0.886
Broad money supply does not Granger-cause bank credit	4.466**	2.302	0.018	3.834**	1.925	0.018
Ho[5]: Bank credit does not Granger-cause broad money multiplier	0.061	2.665	0.956	-0.091	2.229	0.931
Broad money multiplier does not Granger-cause bank credit	1.055	2.636	0.338	0.794	2.203	0.439

Source: Author's computation

Note: P-values computed using 799 bootstrap replications.
Null hypothesis is of no causality
** and * reject the null at the 5% and 10% levels of significance, respectively.
Econometric software employed: Stata 15

3.7 Summary and Conclusion

The study has sought to investigate the viability of monetary targeting as an operational framework for monetary policy in the proposed monetary union in the ECOWAS region. To this end, it has examined the theoretical underpinnings of the money creation process from both the standpoint of orthodox monetary theory by assessing the stability of the conventional money multiplier and that of Post Keynesian economics by investigating the causal relationships between key monetary aggregates and commercial bank credit to the private sector. Given the dearth of research studies on the money creation process in the region and the fact that the limited papers on the subject are predominantly country-specific, this study makes an important contribution to the empirics and the theoretical literature, including in combining the orthodox money multiplier theory and the heterodox endogenous money perspective in its assessment. From a practical standpoint, the study is quite timely as it serves to provide some policy guidance on monetary issues as the authorities in the region work on building the requisite institutional structures for establishing a monetary union in the near term. An important nuance in this study is its application of dynamic panel data estimation techniques made possible by recent methodological advancements in the field of economics. Importantly, the study appealed to more advanced techniques that accommodate cross-sectional dependence among the cross-sectional units (member countries) which could be attributed to similarities in the economic structures and macroeconomic policy frameworks of countries in the region.

The first part of the study assessed the stability of the conventional money multiplier from two angles. First, by determining the stationarity of the money multiplier using panel unit root tests, and second, by investigating the existence of a long-run cointegrating relationship between the broad money supply and the monetary base. Here, the analyses are conducted at the regional ECOWAS level and at the level of the sub-regional monetary arrangements—the WAEMU and the Non-WAEMU countries. For the ECOWAS region, the results of the first-generation panel unit root tests—LLC, IPS and ADF-Fisher—reveal that the broad money multiplier has been non-stationary over the research period. To ensure robustness of the results, the second generation Pesaran (2007) CIPS test is applied to mitigate the adverse impacts of cross-sectional dependence that was confirmed in the data by a series of tests. The outcome of this test is consistent with the earlier first-generation tests in affirming the non-stationarity of the money multiplier. In investigating the existence of cointegration between the broad money and the monetary base, the Pedroni (2004) residual-based cointegration test and the Westerlund (2007) error-correction-based cointegration tests were employed, with the latter fully accommodating cross-sectional dependence. Both tests for cointegration fail to reject the null hypothesis of no cointegration, indicating the absence of long-run association between broad money and the monetary base for the panel of countries in the ECOWAS region. On the basis of these analyses, one could conclude that the broad money multiplier in the ECOWAS has been unstable over the research period.

For the WAEMU countries, the first-generation panel unit root tests indicate that the broad money multiplier is non-stationary. This outcome of non-stationarity is confirmed by the second generation Pesaran (2007) CIPS test. Application of both the Pedroni and Westerlund cointegration tests to examine the long-run co-movement between broad money and the monetary base in the region reveals the absence of a long-run cointegrating relationship. A similar picture was reported for Non-WAEMU countries, with both approaches to determining stability indicating that the money multiplier has been unstable. To further ensure robustness of the results in the presence of structural breaks, the Westerlund and Edgerton (2008) panel cointegration test is conducted and confirms the instability of the money multiplier.

In the second part of the study, causal relationships between key monetary aggregates and bank credit underpinning the endogenous money theory were investigated using the dynamic panel Granger-non-causality test developed by Dumitrescu and Hurlin (2012). From the results, the causation from the monetary base to bank credit, espoused by traditional monetary theorists, was found to be weak. On the other hand, the tests indicate that causality runs from bank credit to the monetary base, consistent with the accommodationist view that the central bank fully accommodates demand for monetary reserves from the commercial banks to meet credit demand of economic agents. The tests could however not confirm the bidirectional relationship between the money supply and bank credit in the region, based on the structuralist perspective. Similarly, the expected bidirectional causal relationship between the broad money multiplier and bank credit was not obtained. These results point to the significant contribution of the non-bank private sector to the process of money creation in the ECOWAS region through the demand for bank loans.

The instability of the traditional money multiplier at the level of ECOWAS contrasts with the assumption of a stable money multiplier which has underpinned the monetary targeting framework operated by several central banks in the region. The study's finding differs from the outcome of the few country-specific empirical researches on SSA countries, including Adam and Kessy (2010), Rusuhuzwa (2015), and Tule and Ajilore (2016), which found stable long-run relationship between the monetary base and the money supply. On the process of money supply determination, the evidence of endogeneity of money uncovered by this study is in line with the conclusion of the growing number of studies, such as Panagopoulus and Spiliotis (2008) on G7 economies, Lopreite (2014) on the Euro area, and Lovrero and Deleidi (2017) on the United States. Similarly, this finding tends to lend support to the assertion that the relationship espoused by the traditional money multiplier works in the reverse direction from bank loans to the monetary base (Sheard, 2013; McLeay et al., 2014; and Goodhart, 2017).

Chapter 4 The Demand for Money in ECOWAS and its Implications for the conduct of a common monetary policy

4.1 Introduction

This chapter examines the relationship between the demand for money and its determinants in the ECOWAS. It seeks to investigate the long-run stability of the money demand function, with a view to informing the decision on an appropriate monetary policy framework within which the common monetary policy could be effectively conducted. Unlike most research studies on money demand within the ECOWAS, the study is undertaken within a dynamic macro panel framework. Model diagnostics include tests for cross-sectional dependence and first- and second-generation panel unit root tests. The estimations proceed by employing an array of dynamic panel data estimators, with the common correlated effects mean group (CCEMG) which accommodates heterogeneity and cross-sectional dependence as the core empirical technique. The robustness of the results is confirmed using an alternative measure of inflation expectations, a higher frequency dataset and by adopting the augmented mean group (AMG) estimator, which also accommodates cross-sectional dependence.

4.1.1 Background

The harmonisation of monetary policy frameworks is an important preoccupation of the authorities in implementing the roadmap of the ECOWAS single currency. Determination of an appropriate monetary policy regime to accommodate the structural and institutional peculiarities of member countries is crucial to ensuring the effective conduct of a common monetary policy. Knowledge of the relationship between the demand for money and its determinants and the long-run stability of the money demand function would contribute to making an informed decision on the choice of a monetary policy framework and a suitable monetary policy instrument to guide attainment of policy objectives.

There is broad consensus that a stable money demand implies that monetary aggregates could play an important role in the conduct of monetary policy as it ensures a reliable and predictable long-run relationship between monetary aggregates and inflation. Stability of the money demand function is also perceived as a prerequisite for the non-neutrality of monetary policy that would ensure that monetary policy actions are effective in mitigating potentially destabilising impacts of shocks to the money supply on key macroeconomic indicators such as inflation and national income (Foresti and Napolitano, 2014, p. 479). As argued by Poole

(1970), when demand for money is stable, central banks should adopt monetary aggregates as their policy instrument, while, on the other hand, interest rate should be the policy instrument of choice in the event instability arises in the money demand function. Any instrument mismatch would only serve to heighten instability and render policy targets unattainable. However, there appears to be a growing consensus against the exclusive dependence on a single policy instrument as both interest rate and monetary aggregates are relevant in policy formulation. A well-specified money demand provides useful information even within an inflation targeting regime, as the 'real money gap', i.e. the residuals from the estimated money demand function, could be helpful in forecasting future changes in the output gap or the inflation rate. (Valadkhani, 2008, p. 77).

In effect, irrespective of the monetary policy regime in operation—inflation targeting, monetary targeting or use of an exchange rate anchor—understanding the key factors driving the demand for money and its long-run stability remains crucial. Under a monetary targeting regime, stability of the demand for money is a prerequisite for controlling the money supply to attain the ultimate policy objective. Extreme fluctuations in money demand distort the transmission of monetary policy impulses and impede control of the money supply and the attainment of the ultimate objective of price stability. Unstable and/or unpredictable money demand could alter the co-movement between monetary aggregates and inflation or the real economy, a key underlying assumption of the monetary targeting framework. In the context of inflation targeting, monetary aggregates could be adopted as important indicators in monitoring progress towards hitting the inflation target and in helping generate robust inflation forecasts. In this regard, monetary aggregates could serve as supplementary intermediate target variables in a monetary regime that targets inflation. In a regime predicated on an exchange rate anchor, monetary aggregates may also convey relevant information about the real economy that could provide early warning signals about future inflation.

The implementation of financial reforms and its attendant increase in competition in financial markets and the introduction of more efficient instruments of financial transactions has often given rise to instability in the demand for money. In advanced economies, the acceleration in the pace of financial innovation and the development of financial markets rendered money demand unpredictable, leading central banks to abandon monetary aggregates in favour of interest rates as policy instrument (Goodhart, 1989). As markets in emerging economies develop, many have also shifted away from monetary targeting as a viable policy framework on account of the associated instability or unreliability of its underlying relationships. In Sub-Saharan Africa, the transition has been gradual, with only a few countries abandoning monetary targeting or relying much less on monetary aggregates as a policy anchor.[56] In the ECOWAS region, though financial markets remain relatively underdeveloped, countries have since the late 1980s to the early part of the 1990s initiated programs of structural monetary and financial market reforms. Implementation of these reform measures has continued over the years. Yet, some central banks in the region continue to target monetary variables such as broad money as the main strategy to achieve their policy goal(s), while others place significant premium on trends in monetary aggregates to inform monetary policy decisions.

With the potential for money demand to be unstable following the implementation of structural reforms in most of the ECOWAS countries, the stability of underlying monetary relationships is rendered questionable. In the context of the proposed monetary union, determination of money demand stability not only informs whether monetary aggregates should play a dominant role in the common monetary policy framework, it also measures their relevance as an information variable in a framework predicated on inflation targeting with short-term interest rate as a policy instrument.

4.1.2 Research objectives

This study investigates the relationship between the demand for money in the ECOWAS region and its key determinants. To this end, the study seeks to:

i. identify the key determinants of the demand for money in the ECOWAS within a panel framework

ii. determine the long-run stability of the money demand function for the ECOWAS region.

4.1.3 Research contribution

The effectiveness of the proposed common monetary policy in the ECOWAS depends, to a large extent, on the choice of an appropriate monetary policy framework, especially against the backdrop of the diversity in existing institutional and policy arrangements and the

[56] Only South Africa and Ghana have introduced a full-fledged inflation targeting regime.

underlyging economic structures. By investigating the demand for money in the ECOWAS and the nature of its relationship with its key determinants, this study helps inform the monetary authorities' decision on a suitable monetary policy regime for the conduct of a common monetary policy for the region. The specific policy and empirical contributions are three-fold:

First, this study helps fill the gap in empirical research on the demand for money in the ECOWAS. In spite of the critical policy relevance of understanding the forces influencing money demand in the member states as a bloc, published research on this policy subject is limited. The handful of studies on the demand for money in the region mostly focus on individual countries. A few studies have estimated money demand functions for the sub-groupings—the WAEMU and the WAMZ—separately, but there is little evidence of a comprehensive analysis of the money demand in the region.[57]

Second, this study examines the demand for money in the region within a panel framework. The limited research work on money demand on countries within the ECOWAS region mostly employ time series analyses of country-specific money demand functions. The results, inferences and policy recommendations of most of these studies are questionable in view of the short-time series data on most of the relevant variables. Combining both the cross-sectional and time dimensions of the data into a panel helps mitigate these shortcomings and enhances consistency and efficiency using panel data techniques. With robust parameter estimates, more reliable inferences and policy implications could be obtained, notwithstanding the limited individual time dimension of the data.

Third, the study makes an empirical contribution to the estimation of money demand using macro panel methods. Most panel data studies on money demand have estimated the parameter coefficients by applying panel dynamic ordinary least squares (DOLS) and panel fully modified least squares (FMOLS) estimators, with a few using pooled mean group (PMG) estimator in the context of panel autoregressive distributed lag (ARDL) models.[58] This research adds to the studies which have exploited the advantage of conducting estimation within the panel ARDL model framework, especially its ability to accommodate stationary and non-stationary variables within the model. More importantly, the study

[57] The only study (unpublished) that focuses on the ECOWAS region is a research paper by WAMA titled 'The Demand for Money in ECOWAS countries' presented at the Institution's end-of-year statutory meetings in Abuja, Nigeria from January 11-18, 2013.
[58] Appendix A.13 presents a matrix of panel studies on the demand for money

proceeds by adopting estimators that address the issue of cross-sectional dependencies which is characteristic of most panel data but overlooked by many panel methods. It employs the common correlated effects mean group (CCEMG) estimator of Pesaran (2006) which augments the panel ADRL formulation with cross sectional averages of the dependent variable and the regressors and accommodates cross sectional correlation among the member countries. Robustness checks of the results of the baseline estimation are undertaken using the augmented mean group (AMG) estimator developed by Eberhardt and Teal (2010), a dynamic macro panel technique that also allows for cross sectional dependences. In addition, the CCEMG estimator is applied to higher frequency quarterly data to confirm robustness of the results. To the best of my knowledge, the use of these two advanced panel estimators is a novelty in money demand estimations in the panel setting. Moreover, with the exception of a few studies (Dobnik, 2013 and Kumar and Rao, 2012), most papers adopting panel data techniques only utilise first generation panel unit root tests which are prone to producing misleading outcomes on the order of integration of the respective panel series.[59] This study employs both first and second generation panel unit root tests to ensure reliability of the results.

4.2 The theoretical underpinnings of the demand for money

The theoretical literature on the demand for money has evolved over time and is well documented[60]. Drawing from the comprehensive work of these previous studies, this review provides a synopsis of money demand theories with a view to informing the modelling of the money demand function used for the empirical estimations in this study. These theories could be categorised into three broad groupings, commencing with what has been referred to as the Classical tradition to Keynesian theory and the more recent Post-Keynes theories of the demand for money.

4.2.1 Classical theory

The fundamental postulation of the Classical theory is that all markets for goods continuously clear and that relative prices flexibly adjust to ensure the attainment of equilibrium. With the exception of transitory deviations resulting from real disturbances, the economy is said to always be in full employment. In this context, money has no effect on real economic magnitudes and therefore does not influence the determination of relative

[59] First generation panel unit root tests assume cross sectional independence
[60] See Sriram (1999) and Goldfeld and Sichel (1990)

prices, real interest rates, the equilibrium quantities of commodities, and thus aggregate real income. The classical equilibrium framework formed the basis for the formulation of the quantity theory by Fisher (1911) and the work of Pigou (1917), focusing primarily on money as a means of exchange, and hence, yielding models of the transactions demand for money.

The Quantity theory establishes a direct and proportional relationship between the quantity of money and the price level. The two versions of the Quantity theory are the "*equation of exchange*" which is associated with Irving Fisher, and the "*Cambridge approach or Cash balance approach*" associated with Cambridge University economists, notably A.C. Pigou. Fisher's "equation of exchange" $M_S V_T = P_T T$ relates the quantity of money in circulation M_S to the volume of transactions T and the price level of articles traded P_T in a given period through a proportionality factor V_T called the "transactions velocity of circulation". The simplified formulation of the Cambridge model, on the other hand, states that, ceteris paribus, the demand for money in nominal terms (Md) is proportional to the nominal level of income (Py) for each individual and hence for the aggregate economy as a whole, that is, $Md = KPy$. When combined with an equilibrium condition for the money market, $Md = Ms$, the expression $Ms * (1/K) = MsV = Py$ is obtained.

4.2.2 Keynesian theory

In contrast to the classical school which examined money demand mainly from a transactions perspective, Keynes (1936) approached the subject in terms of motives for holding money balances distinguishing three types—transactions, precautionary, and speculative. The transactions motive is attributed to the necessity of holding cash to bridge the gap between receipts and planned regular payments, similar to the medium of exchange function espoused by Quantity theories. It is argued that the level of transactions undertaken at both the individual and aggregate levels bears a stable relationship to the level of income. The precautionary demand for money, on the other hand, provides a contingency arrangement for unanticipated expenditures in unexpected and unforeseen circumstances. For its part, the speculative motive entails the holding of money balances with the expectation to take advantage of future changes in interest rates and bond prices.

The speculative motive and its emphasis on the importance of the interest rate variable in economic agents' decision to hold money, otherwise referred to as "*liquidity preference*", represent Keynes' outstanding contribution to money demand theory. The theory formalises early efforts identifying future uncertainty as a factor influencing the demand for money, though it focuses on the future level of interest rate, particularly the future yield on bonds. Keynesian analysis is predicated on the concept of the 'liquidity trap' which sets a floor to the nominal rate of interest. With the expectation of the future increase in the interest rate, given the very low rate, there is increased preference for liquidity relative to alternative assets. By introducing the interest rate variable into the money demand function, the function can be represented as $m^d = f(y, i)$, where the demand for real money balances m^d is a function of real income y and interest rate i.

4.2.3 Post-Keynes perspectives

In spite of its shortcoming, Keynes' theory was indeed a watershed and of immense importance for macroeconomic analysis of the interest sensitivity of money demand. A host of research interests has evolved from the Keynesian approach, with emphasis on both income and interest rates as determinants of money demand. These contributions are centred on two key functions of money: money as a medium of exchange and as a store-of-value. While several models have derived their foundations from the Keynesian postulates, this review considers the transactions demand models and asset or portfolio models as more relevant in this context.

The transactions demand models, instead of focussing on Keynes' speculative demand for money, present an alternative approach to explaining the transactions demand for money. Of these, the inventory-theoretic models are most common. Significant contribution in this regard was made by Baumol (1952) and Tobin (1956) which formulated a theory of money demand in which money was essentially perceived as an inventory held for transactions purposes similar to inventory management of goods and material inputs by firms. As firms strive to maintain optimal inventory of goods to minimize costs, so are economic agents expected to hold the inventory of money for transactions purposes at optimal levels. Thus, assuming the level of transactions to be known with certainty and a trade-off between money and an interest-bearing alternative asset as stores of value, the models postulate that the attainment of an optimal transactions level therefore requires a balance between the increase in transactions costs and the reduction in interest costs. According to these models, the transactions demand for money slopes downwards as less money is demanded for transactions purposes at a higher rate of interest and vice versa.

The portfolio approach to the demand for money, on the other hand, emerged as a direct response to the shortcoming of Keynes theory. It postulates that economic agents hold a portfolio of assets that includes money, interest bearing bonds, and possibly more risky assets like equity. While holding money was said to bear little or no risk, sovereign bonds and equities are exposed to market price volatility and as such riskier. The perception of risk and expected returns on the assets are considered as important considerations for holding money. Against this backdrop, Tobin (1958) put forward an alternative to Keynes' liquidity preference by establishing that the risk avoidance attributes of economic agents serve as a basis for liquidity preference which allows for a negative relationship between the demand for money and the interest rate. The asset or portfolio models thus put forward a formalisation of the relationship between interest rates and the demand for real money, and demand for wealth and liquidity as key determinants of money demand.

4.3 Modelling the demand for money

Drawing from the theoretical literature on money demand discussed in the preceding section, the general formulation of the long-run money demand function, according to Ericsson (1998), is as follows:

$$M / P = f(Y, OC) \qquad (1)$$

where M denotes nominal money balances, P the price level, Y is the scale variable, representing the volume of transactions in the economy, and OC is the opportunity cost of holding money, which captures earnings forgone from holding alternative assets. There is broad consensus in the literature that the money demand function is estimated in semi-logarithmic linear form, with the monetary aggregate and the scale variable entering the model in logarithms whilst most others enter as levels (Dreger and Wolters, 2010, p.113). Money balances in the above function are presented in real terms. The rationale behind this rests with the fact that price homogeneity is explicitly imposed on the model. This allows the complete adjustment of the demand for nominal balances to movements in prices over the long run, with real balances remaining unchanged at desired levels. Additionally, the use of real money balances as the dependent variable rather than nominal balances poses less econometric problems in relative terms (see Johansen 1992).

The baseline empirical representation of long-run demand for money in panel studies is generally of the following form (see e.g. Mark and Sul, 2003; Nautz and Rondorf, 2011):

$$\ln(M/P)_{it} = \alpha_i + \beta_{1i} \ln Y_{it} + \beta_{2i} R_{it} + U_{it} \tag{2}$$

$$U_{it} \sim iid\left(0, \delta^2\right)$$

where the index $i = 1,......, N$ represents the cross sectional units or panel members and $t = 1,......, T$ specifies the time period. $\ln(M/P)_{it}$ is the log of real money balances; $\ln Y_{it}$ is the scale variable which is a measure of real income; R_{it} is the nominal interest rate; and U_{it} is a stochastic disturbance assumed to be white noise.

Narrow money (M1), consisting of currency in circulation with the public and demand deposits at commercial banks, has been widely used to represent money balances. Several panel studies on developing economies have used M1 in modelling money demand (Kumar and Rao, 2012 on Asian countries; Hamori, 2008 on SSA countries, etc.). The justification stems from the fact that the money supply in developing countries is dominated by M1 on account of the shallow financial sector and limited financial intermediation. Some studies on developed economies have however employed M1 in research on money demand, including Dobnik (2013) and Mark and Sul (2003). For the Euro area, majority of the papers have considered the broader money aggregate M3, as it serves as a reference target variable within the monetary policy framework of the ECB (Dreger and Wolters, 2010; Nautz and Rondorf, 2011). It is however argued that the broader measure of money is more appropriate for modelling purposes given that it is less distorted by financial deregulation and innovations and exhibits more reliable relationship with income (de Brouwer, Ng and Subbaraman, 1993, p.10).

The scale variable captures the volume of transactions in the economy and is predominantly represented by real gross domestic product (RGDP). A few studies have explored other income measures especially when the estimation is based on high-frequency data for which real GDP data are unavailable. Industrial production is one such proxy variable (Hamori and Hamori, 2008). Real consumption was also employed in modelling money demand for a panel of Gulf countries (Harb, 2004).

With regards the opportunity cost of holding money, several variables have served as proxy of which the more commonly used are the nominal interest rate on deposits or the lending rate. Other studies have used interest rate spread—the difference between deposit rate and the lending rate—as the measure of the opportunity cost of holding money. The short-term interest rate, including the Treasury bills rate, and the long-term interest rate, such as the yield on long-term government bonds have been considered in other studies (e.g. Setzer and Wolff, 2013).

The other commonly applied formulation of the money demand function in panel studies involves the addition of either inflation or the exchange rate; or both to the baseline representation in equation (2) above (e.g. Rao et al., 2009; Kumar et al., 2010). Inflation is perceived as another measure of the opportunity cost of holding money, and thus a proxy on return on real assets. The rate of inflation is considered more appropriate relative to interest rates in the absence of well-developed financial markets where there is a dearth of alternative financial assets, especially in developing economies. Exchange rate is factored in money demand models to reflect the potential influence of currency substitution. In this open economy context, a depreciation in the exchange rate results in a decline in money demand as domestic currency is substituted for foreign currency. There however could be a positive wealth effect on money demand whereby acquisition of interest-bearing or income-generating foreign assets increase following a currency depreciation.

The incorporation of inflation and exchange rate gives us the following augmented functional form:

$$\ln(M/P)_{it} = \alpha_i + \beta_{1i}\ln Y_{it} + \beta_{2i}R_{it} + \beta_{3i}\pi_{it} + \beta_{4i}\ln EXR_{it} + \varepsilon_{it} \qquad (3)$$

where π_{it} represents the rate of inflation and EXR_{it} is the nominal (or real) exchange rate.

Over recent years, a number of panel studies has augmented money demand functions with a measure of wealth as an important determinant of the desire to hold cash (Arnold and Roelands, 2010; Nautz and Rondorf, 2011; Dobnik, 2013). This has been more common with studies on developed economies, notably the Euro area, where indications of instability in money demand functions have in some instances been attributed to omitted variables. Measures of wealth employed include stock prices, house prices, etc. The impact of wealth on the demand for money could be a positive effect or a negative effect and occurs through different transmission mechanisms (Dobnik, 2013, pp. 95-96). The money demand function generally takes the form:

$$\ln(M/P)_{it} = \alpha_i + \beta_{1i}\ln Y_{it} + \beta_{2i}R_{it} + \beta_{3i}\ln EXR_{it} + \beta_4\ln W_{it} + \varepsilon_{it} \qquad (4)$$

where W_{it} is the measure of wealth such as equity prices, house prices etc.

4.4 Review of empirical literature on the demand for money

The empirical literature on money-demand functions has also witnessed an evolution, very much reflecting developments in applied econometric methodology. This review focusses largely on the recent panel data methods employed in money demand estimations while providing a brief overview of early empirical modelling techniques used to conduct country-specific analyses. Insights from this review provide the basis for this study's empirical contribution to the literature on the demand for money, particularly in the context of panel data modelling.

Empirical work on money demand could be traced back to the use of a conventional single equation to relate some measure of real money balances to a small set of explanatory variables, mainly a scale variable and an opportunity cost variable. This conventional formulation of money demand was augmented by the so-called partial adjustment model (PAM) that introduces a mechanism by which actual money holdings adjust to the desired levels (Goldfeld, 1973). The PAM model includes the lagged real money balance as an explanatory variable to capture short-run dynamics in the money demand function. However, due to the PAM's inability to provide explanation for the apparent instability in money demand function experienced in the early-1970s, it became overshadowed by the buffer stock model (BSM) in empirical estimation. The BSM incorporates monetary shocks in the money demand function and accommodates a more complex lag structure to account for model dynamics.[61] The conventional money demand functions and their augmented versions highlighted above were mostly estimated using ordinary least squares (OLS) methods and provided the basis for several empirical research work both in developed and developing economies up to the early 1990s.

The challenges of dealing with non-stationarity, i.e. the tendency for systematic changes in variables over time, potential misspecification and the accompanying spurious inferences which characterised earlier models gave rise to the widespread use of cointegration and error correction modelling (ECM).[62] The dynamic formulation underpinning the error correction model incorporates the long-run equilibrium relationship between money and its determinants in a function that captures short-run variation and dynamics. The residual-based Engle and Granger (1987) and the Johansen (1988) and Johansen and Juselius (1990)

[61] see Goodfriend (1985) for details on the PAM and BSM.

[62] The application of ECM to the money demand function was first explored by Hendry and Ericsson (1991).

multivariate cointegration frameworks have been commonly employed. Some recent studies have utilized the Gregory and Hansen (1996b) cointegration test that allows for structural breaks. To examine stability of money demand functions, the CUSUM and CUSUM-Squared tests (Brown et al. 1975), and Chow break point test (Chow, 1960) are widely applied.

Increasingly, money demand studies have employed the autoregressive distributed lag (ARDL) modelling technique by Pesaran (2001) considered to be superior to the cointegration methods outlined above in that it accommodates both stationary and non-stationary variables of order of integration less than two, addresses potential endogeneity, and better captures the underlying data generation process. Unlike the Johansen (1988) methodology, it is a single equation framework that regresses changes in the money supply aggregate on its own lags, current and lagged values of the explanatory variables. Pesaran (2001) proposes an F-Test to test the presence of cointegration, based on two critical bounds—a lower bound and an upper bound.[63]

Empirical studies on money demand in the ECOWAS region, which are predominantly country-specific, have often applied either the cointegration and error correction modelling technique or the ARDL estimation approach. Employing the Johansen-Juselius multivariate cointegration technique, Sriram (2009) evaluated the demand for broad money (M2) in The Gambia over the period January 1988 – June 2007. The study uncovered a long-run cointegrating relationship between real M2 and its key determinants. However, the long-run money demand function was found to be unstable. Also, Sanya and Awe (2014) and Adamec (2016) investigated the stability of money demand in Nigeria and Ghana, respectively, adopting the cointegration and error-correction modelling technique. Both studies confirmed the existence of stable, long-run demand for money relationships. Following the Johansen (1988) empirical modelling technique, Canac et al. (2009) estimated the long-run demand for money function for the WAEMU. A long-run cointegrating relationship between the demand for real broad money and its key determinants was established. The study found the money demand equation to be stable over the sample period (1968 – 2006).

Other money demand studies on member countries of the ECOWAS have employed Pesaran's (2011) ARDL modelling technique, and these include Akinlo (2006) on Nigeria,

[63] A long-run relationship exists between two or more variables when the F-statistic is greater than the upper bound. The test fails to reject the null hypothesis of no cointegration when the test statistic falls below the lower bound. In between the two critical bounds, the test in inconclusive.

Dagner and Kovanen (2011) on Ghana, and Mansaray and Swaray (2013) on Sierra Leone. These studies reported existence of a stable long-run money demand function in the respective countries over the research periods. However, while the long-run relationship was found to be stable for Ghana and Sierra Leone, there was indication of instability for Nigeria over the first half of the sample period. Worth noting is the major downside of most of the above country-specific time-series analyses of money demand reflected in the lack of sufficiently long data series to allow the model to be properly fitted to obtain reliable results and inferences.

Over the last two decades, there has been significant advancement in panel data estimation techniques, culminating in their increased application in money demand studies.[64] These studies address the shortcomings faced in applying time series techniques to a set of countries in terms of model fit and lower power of unit root and cointegration tests. Commonly used panel methods in estimating cointegrating vectors include the panel fully modified ordinary least squares (FMOLS) estimator (Carrera, 2016; Nyumuah, 2017); the panel dynamic ordinary least squares (DOLS) estimator (Mark and Sul, 2003; Foresti and Napolitano, 2014); panel ARDL modelling using pooled mean group estimator (Nautz and Rondorf, 2011; Dobnik, 2013) and, in a limited number of cases, the generalised methods of moments (Garcia-Hiernaux and Cerno, 2006; Rao et al., 2009).

The group mean panel FMOLS estimator was proposed by Pedroni (2000) and used to estimate common cointegrated vectors in dynamic panels, accounting fully for the degree of heterogeneity. It addresses fixed effects by incorporating individual-specific intercepts and accounts for short-run dynamics by allowing differing serial correlation properties across individual cross-sectional units of the panel. Pedroni (2000) assesses the small sample properties of the estimator to be good.

Hamori and Hamori (2008) applied the panel FMOLS method to examine the stability of money demand in the Euro area. Using monthly data for the period January 1991 to March 2006, the study found the demand for the broad money aggregate (M3) to be a stable function of its determinants—overnight call rate, consumer prices, and industrial production, proxied for economic activity. The demand for money functions based on narrow money (M1) and broad money (M2) also exhibited long-run stability. The study supports the ECB's use of

[64] A summary of these panel studies, including the methodology employed, model properties and key findings, is presented in Appendix A.13.

M3 in its monetary policy formulation. It also recommends consideration of the growth in the narrower monetary aggregates (M1 and M2) for policy reference. Carrera (2016) employed the panel FMOLS estimator to estimate the long-run money demand for 15 Latin American countries covering the period 1948 to 2003. Employing a reduced form specification of the demand for money that models the money aggregate as a function of the price level, real GDP, and the short-term interest rate, the study generally obtained estimates of the expected positive values for income elasticity of money demand; and the negative values for the interest rate semi-elasticity of money demand for most countries in the panel. It attributes the income elasticity value of slightly less than 1 for the panel of countries to 'the existence of economies of scale in money management' due to de-dollarization in Latin American countries after the late 1980s (p. 147). The FMOLS estimation technique was also employed by Nyumuah (2017) on a panel of eight sub-Saharan African countries to investigate the interest elasticity of the demand for money over the period 1998 to 2012. In the short-run, the demand for money was found to be interest inelastic; whereas, in the long-run, it was interest elastic for those group of developing economies.

The panel dynamic ordinary least squares (DOLS) estimator is another widely used technique and was developed by Mark and Sul (2003).[65] It is often considered an alternative estimator to the panel FMOLS as it addresses the problem of serial correlation and endogeneity by incorporating lags and leads of the regressors into the model. The panel DOLS is a fully parametric technique and assumes the cointegrating regression to be homogenous across cross-sections, although allowing heterogeneity in the short-run dynamics, individual-specific fixed effects and individual-specific time trends. By using time-specific effects, the panel DOLS estimator permits a limited degree of cross-sectional dependence (Mark and Sul, 2003). Mark and Sul (2003) applied their estimation technique to the long-run money demand function for a panel of 19 developed economies covering the period 1957 to 1996. The results of the panel DOLS estimation were said to produce more reliable estimates, with income elasticity positive and close to 1 while the interest rate semi-elasticity was negative. By comparison, the country-specific single-equation estimates were characterized by substantial cross-sectional variability with little realistic economic

[65] The panel DOLS is an extension of the single DOLS method developed by Saikkonen (1991) and Stock and Watson (1993).

interpretation. Mark and Sul (2003) attributes this variability to the length of the individual time-series and heterogeneity in the short-run dynamics.

Foresti and Napolitano (2014) investigated whether the degree of stability of money demand in the Eurozone depends on the monetary aggregate adopted as proxy for money demand. The panel DOLS estimator was used to estimate money demand functions for M1 and M2, in addition to that for M3, which is the ECB's policy reference target. By running rolling window regressions, the study finds that stability hinges on the type of monetary aggregate used and that M2 exhibited the most stability. Some other studies have employed both the FMOLS and DOLS approaches. Narayan (2010) estimated a money demand function for a panel of eight transitional economies by applying a battery of three panel estimators: panel FMOLS, panel DOLS and panel OLS. The study finds real narrow money (M1) and real broad money (M2) to be cointegrated with their key determinants for individual countries and at the level of the panel. Using Hansen's (1992) test for parameter stability, the money demand functions for several countries in the sample were found to be unstable.

Generalized method of moments (GMM) estimation procedure, although more appropriate for micro panel data analysis, has been applied in a few money demand studies. This technique, originally proposed by Arellano and Bond (1991), estimates coefficients in a dynamic micro panel model, and uses first differences of the series to account for unobserved individual heterogeneity (Difference-GMM). The estimator was developed further by Blundell and Bond (1998) into a systems-based technique (System-GMM) that combines equations in first differences with lagged levels of the variables as instruments with the aim to address the problem of weak instruments in the initial formulation.[66] The System-GMM thus ensures improved efficiency of the estimator.

Using the system GMM approach, Rao et al. (2009) examined the demand for money for a panel of 11 Asian countries over the period 1970 to 2007. Parameter estimates were obtained for alternative specifications of real narrow money demand with real output, nominal interest rate, rate of inflation, and exchange rate. The study employed a test for structural break by Mancini-Grifoli and Pauwels (2006). The results indicate that demand for money in the sample countries is stable and that the implementation of financial reforms did not cause structural breaks. Also, Garcia-Hiernaux and Cerno (2006) studied the demand for money in a panel of 27 countries at different stages of development. Using the monetary base as

[66] Details of the empirical procedures are outlined in the respective publications

proxy for the demand for money, a dynamic panel model was estimated using the GMM approach. The output elasticity of money demand obtained from the study ranged between 0.18 and 0.20.

Increasingly, research studies have developed panel ARDL models, which incorporate dynamic error correction formulation, to examine money demand and its determinants. These studies mainly apply the pooled mean group (PMG) estimator by Pesaran et al. (1999). This estimator imposes long-run homogeneity restrictions, while allowing the short-run dynamics to vary across cross-sectional units.[67] Dobnik (2013) used the panel ARDL estimation on quarterly data from 1983 to 2006 to study the long-run money demand function for 11 OECD countries. Specifically, the study examined the adjustment of national money stocks towards an international equilibrium, represented by common factors, following decomposition of the factors driving money demand into idiosyncratic and common components. The study establishes an international long-run money demand equation in respect of the common component, with stable long-run coefficients. Nautz and Rondorf (2011) also applied the PMG method to examine the stability of money demand in the Euro area. Using data derived by computing national deviations from euro area wide means, it found the income elasticity for the panel estimate to be above 1, while the sign of the long-run interest rate semi-elasticity varied depending on the measure of interest rate used—positive for deposit rate and negative for the long-term interest rate and the interest rate spread. The long-run money demand function was considered stable.

4.5 Model Specification, Methodology and Data

This section specifies the model employed in the estimations, drawing from the theoretical underpinnings, previous empirical research and the peculiarities of the ECOWAS region. It also details the different dynamic panel methodologies applied. The data used in the study and their definitions are also presented.

4.5.1 Model Specification

The economies within the ECOWAS region share several similar institutional and structural features. Among these are the low levels of economic development and the underdeveloped state of financial systems which have been characterised by substantial monetization and the

[67] Discussed in more detail in section 4.5.2.1 below.

limited array of alternative financial assets. Equity and bond markets are quite shallow and, in most cases, non-existent. Against this background, the long-run money demand function for the panel of ECOWAS member countries is modelled adopting the following functional form:

$$\ln(RM2_i)_t = \alpha_0 + \beta_1 \ln(RGDP_i)_t + \beta_2 (INF_i)_t + \beta_3 \ln(EXR_i)_t + u_{it} \qquad (5)$$

$$U_{it} \sim iid\left(0, \delta^2\right)$$

where i represents a specific member country varying from 1 to 12 and t is time starting from 1980 to 2016. $\ln(RM2_i)_t$ is the log of real broad money balances, which is the ratio of $M2$ the stock of nominal broad money to P the consumer price index, i.e. $(M2_i / P_i)$; $\ln(RGDP_i)_t$ is the log of real Gross Domestic Product; INF_{it} is the rate of inflation; and $\ln(EXR)_t$ is the log of the nominal exchange rate.

As discussed in section 4.3 above, the use of real broad money balances as the dependent variable explicitly imposes price homogeneity into the model. Ideally, the price deflator should be an expenditure deflator whose weights reflect the components of expenditure for which money is utilised. However, these deflator series are unavailable for the panel of countries in the study. As such, the consumer price index (CPI) is considered an appropriate proxy as it provides a reasonable approximation of the true price deflator given that a substantial proportion of total expenditure is on consumption. The real Gross Domestic Product (RGDP) represents the scale variable in this estimation. In the ECOWAS region, transactions demand is the predominant motive influencing the holding of money balances, thus the demand for money is assumed to be highly dependent on the level of income. In addition to posing little measurement problems and being readily available—though at annual frequencies—the RGDP satisfies directly or indirectly both the income and wealth criteria expected of the scale variable.

The return on real assets is captured by the expected rate of inflation. Due to the unavailability of data on inflation expectations and the absence of survey measures, several studies on developing economies have proxied actual inflation for expected inflation on the grounds that the expected rate of inflation is highly correlated with the actual inflation rate (Honohan, 1994). The theoretical underpinning is derived from the work of Hicks (1939) which assumes perfect foresight whereby prices remain constant at expected levels in line with agents' expectations. Money demand studies on SSA countries have mainly followed this assumption, proxying the actual inflation rate, INF_{it}, for the expected rate of inflation (Sriram, 1999; Salisu et al., 2013; Nyong, 2014). While the baseline model here follows in the spirit of these studies on SSA countries, to ensure robustness of the estimation output the model is re-estimated using a measure of inflation expectations generated from naïve expectations formed by allowing the next period's inflation rate to be the same as the previous period's inflation rate.[68]

Contrary to most studies which use some definition of the interest rate as the opportunity cost of holding money, this study considers the rate of inflation to be most appropriate given the under-developed state of financial markets in the ECOWAS and most SSA economies. For part of the sample period, interest rates were administratively determined in all of these countries, and the substitution between money and other financial assets is constrained by the limited array of financial assets and the low levels of income. In fact, consistent and credible time series on interest rates is generally limited. EXR_t is the nominal exchange rate and is used to examine the extent to which currency substitution between domestic and foreign currencies is influenced by movements in the exchange rate.

Based on equation (5) the following functional form is obtained:

$$\ln(RM2)_{it} = \beta[\ln(RGDP)_{it}, INF_{it}, \ln(EXR)_{it}] \tag{6}$$

where $\beta_1 > 0$, $\beta_2 < or > 0$, and $\beta_3 < 0$

The above formulation indicates the expected signs of the coefficients of variables in the estimation. The scale variable ($\ln RGDP_{it}$) is expected to be positively related to the real demand for money as an increase in transactions activity would necessitate a greater demand for money balances. The magnitude of the coefficient for the scale variable depicts the underlying theoretic relationship. If the coefficient on income, β_1, is equal to 1, then the quantity theory applies; if $\beta_1 = 0.5$, the relationship is consistent with the dictates of the Baumol-Tobin inventory-theoretic model; and if $\beta_1 > 1$, then money can be perceived as a

[68] The relevance of the naïve specification of inflation expectation was popularized by Atkeson and Ohanian (2001) and 'seem to perform well compared to simple statistical models' (Meyer and Pasaogullari, 2010).

luxury or interpreted as an indication of neglected wealth effects (Valadkhani, 2008). The income elasticity of demand of unity is line with the direct and proportional relationship between the demand for money and the level of income espoused by the Quantity theory discussed in section 4.2.1 above. On the other hand, the elasticity of income of 0.5 derived from the inventory theoretic model for the transactions demand for money, developed by Baumol (1952) and Tobin (1956), indicates that transactions demand for money exhibits economies of scale in that increases in income induce less proportionate increase in transactions demand for money, resulting in a rise in income velocity of money. An important monetary policy implication is that the money stock should grow more sluggishly than income to attain the goal of price stability (Ball, 2001, p. 36). The high income elasticity of money demand greater than unity is expected in the instance whereby growth in income generates excessive demand for financial assets, as part of the broadly defined monetary aggregate.

The expected inflation (INF_{it}), generally affects the demand for money negatively. Agents prefer to hold real assets as inflation hedges rather than holding money in periods of rising inflation. From another perspective, it is possible that inflation may have a positive relationship with the demand for money because when it is expected to rise, agents could increase the money holdings expecting their planned nominal expenditures to move up (Sriram, 1999). The exchange rate variable, EXR, is used for testing the currency substitution hypothesis. The expected sign is negative, ceteris paribus. This basically implies that the currency depreciation can lead to a higher propensity to substitute away from domestic currency. The demand for money is negatively related to the nominal exchange rate. A currency depreciation can indeed lead to a significant decrease in the demand for real money balances.

4.5.2 Methodology

This study draws on previous approaches (Nautz and Rondorf, 2011; Dobnik, 2013), by developing a panel ARDL model for the ECOWAS region to examine the nature of the relationship between the demand for money and its key determinants. The choice of a panel ARDL model is informed by a number of factors. To start with, the framework allows for the combination of stationary and non-stationary variables in the model. Most conventional cointegration techniques for determining long-run cointegrating relationships require that the variables are non-stationary and integrated of the same order, mostly order one. The

ARDL model accommodates both stationary I(0) and non-stationary I(1) variables, and its error-correction formulation provides indication of the existence of long-run cointegrating relationship among the variables. In addition, it provides an opportunity for use of advanced macro panel estimators which account for cross-sectional dependence and heterogeneity.

The money demand function in equation (5) above is thus presented in panel ARDL form, whereby for each cross-sectional unit, the log of real broad money is expressed as a function of its lag and the lags of the determinants. Assuming time periods, $t = 1, 2, ..., T$, and countries, $i = 1, 2, ..., N$, this relationship is represented as follows:

$$y_{it} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \varphi'_{ij} X_{i,t-j} + u_{i,t} \qquad (7)$$

where y_{it} is the scalar dependent variable, $\ln(M2_i / P_i)_t$; X_{it} is the k x 1 vector of regressors for country *i*; α_i represent the country-specific effects (fixed effects); λ_{it} 's are scalars on the lagged dependent variable; and φ_{it} are k x 1 coefficient vectors. The u_{it} 's are disturbances and assumed to be independently distributed across the i_s and t_s.

To estimate equation (7) above, the study employs a series of dynamic macro panel estimators. The preliminary set of estimations involves the pooled mean group (PMG) estimator proposed by Pesaran et al. (1999); the mean group (MG) estimator developed by Pesaran and Smith (1995); and the dynamic fixed effects (DFE) estimator (Balgati and Levin, 1986). As discussed in the next section, the PMG estimator constrains the long-run coefficients to be homogenous, while allowing variations in the short-run coefficients and the intercepts across cross sections. The MG estimator assumes full coefficient heterogeneity in both the long run and the short run; whereas with the DFE estimator homogeneity in the parameters is assumed in both the long run and short run, though the intercepts are allowed to vary across cross-sectional units.

The more advanced second-generation panel technique—the common correlated effects (CCE) estimator by Pesaran (2006)—is applied and forms the core of the analyses. This estimator produces consistent estimates even where the variables are nonstationary and non-cointegrated, and the estimates are relatively robust in the presence of structural breaks in the data and cross-sectional dependence among the countries. The common correlated effects mean group (CCEMG) estimator which involves averaging of the parameter estimates from the panel ARDL model augmented with cross-sectional averages is employed. Unlike the common correlated effects pooled (CCEP) estimator which assumes slope homogeneity, the CCEMG allows all slopes are heterogeneous, though it remains valid under slope homogeneity. To confirm robustness of the estimation, the augmented mean group (AMG) estimator developed by Eberhardt and Teal (2010), coupled with the use of higher frequency data, is considered.

4.5.2.1 Pooled Mean Group, Mean Group, and Dynamic Fixed Effect Estimators

Reparametrizing the dynamic panel model in equation (7), gives us the following error correction formulation in which the short-run dynamics of the variables are driven by the deviation from long-run equilibrium.

$$\Delta y_{it} = \alpha_i + \theta_i (y_{i,t-j} - \beta_i' X_{it}) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \varphi_{ij}' \Delta X_{i,t-j} + u_{i,t} \qquad (8)$$

where the vector β_{i_s} contains the long-run money demand coefficients, while λ_i and φ_i represent, respectively, the short-run coefficients of the lagged dependent and independent variables. θ_i is the error correction term that measures the speed of adjustment to long-run equilibrium and is assumed to be significantly negative for all i_s . When $\theta_i = 0$, there is no evidence of a long-run relationship.

Drawing from the error-correction formulation in equation (8) above, Pesaran et al. (1999) derived a maximum likelihood estimator, the PMG estimator, to estimate the long-run coefficients, β , and the group-specific error-correction coefficients, θ_i . The PMG estimator restricts the long-run coefficients to be homogenous across cross sections, while allowing the short-run coefficients and the intercepts to vary across countries. The error correction terms and the error variances are also allowed to be heterogenous. It is thus a combination of both pooling and averaging, and the parameters are estimated using a maximum likelihood method. The PMG estimator is built on a number of assumptions that assures its efficiency and consistency: firstly, the error terms are serially uncorrelated and distributed independently of the explanatory variables. Treatment of the regressors as exogenous allows the ARDL to be consistent; second, a long-run relationship exists between the dependent variable (log of real broad money) and its explanatory variables, reflected in a negative coefficient on the error correction term; third, the long-run parameters are the same across cross sections.

In addition to the PMG, the mean group (MG) estimator developed by Pesaran and Smith (1995) is applied. Unlike the PMG which imposes homogeneity restriction on the long-run coefficients, the MG estimator does not impose any restrictions. The intercepts, slope coefficients, and error variances are allowed to be heterogenous across cross sections in both the long run and the short run. The MG estimator is thus more consistent under the assumption that both the slopes and the intercepts are permitted to vary across the countries in the sample. An important condition for the MG technique to be consistent is that the time series dimension of the data should be sufficiently large. With this, the model is fitted separately for each cross section, thereby allowing for the calculation of a simple arithmetic mean of the coefficients. The parameter estimates of the model estimated by the MG and PMG estimators are consistent and asymptotically normal for both stationary I(0] and non-stationary I(1) variables. The lag lengths for each individual regression are selected to ensure the model is appropriately fitted. Whereas the MG estimator possesses the advantage of complete heterogeneity across the panel groups, the PMG estimator is flexible enough to allow for long-run coefficient homogeneity for a subset of cross sections.

The DFE estimator, for its part, restricts the slope coefficients and error variances to be equal across all cross-sectional units in the long run, as in the case of the PMG estimator. However, unlike the PMG and MG estimators, it also constrains the speed of adjustment coefficient and the slope coefficients to be equal in the short run. With the DFE estimator, however, the intercepts are allowed to be cross section-specific, varying across members of the panel. One key downside of the DFE estimator is the fact that it is subject to simultaneous equation bias on account of endogeneity between the error term and the lagged dependent variable in small samples (Baltagi et al., 2000).

Of particular note is the assumption of cross-sectional independence on which the PMG, MG and DFE estimators are based. As such, in the presence of unobserved common factors among the cross sections, these estimators could produce inconsistent parameter estimates.

4.5.2.2 Common Correlated Effects Estimators

The CCE estimator is proposed by Pesaran (2006) to address potential presence of unobserved common effects that could be correlated with the independent variables or may be driving the error process in the panel ADRL models. Failure to account for unobserved effects in the presence of dependence among panel units, the equation ceases to be i.i.d, rendering OLS estimation inconsistent (Everaert and De Groote, 2015). To accommodate cross-sectional dependence, Pesaran (2006) recommends augmentation of the panel model with cross-sectional averages of the dependent and independent variables.

The estimator is developed assuming that u_{it} in equation (8) above takes the following form:

$$u_{i,t} = \gamma_i' f_t + e_{i,t} \tag{9}$$

where f_t is a vector of unobserved common factors and γ_i represents country-specific heterogenous factor loadings. The heterogeneous coefficients are randomly distributed around a common mean, $\beta_i = \beta + v_i,\ v_i \sim IID(0, \Omega_v)$.

Pesaran (2006) shows that equation (8) above can be consistently estimated in the presence of unobserved dependencies across panel units by approximating the unobserved common factors with cross sections means $\bar{X}_t$. $\bar{X}_t$ is however expected to be strictly exogenous to ensure consistency.[69]

The augmented equation to be estimated is thus represented as follows:

$$y_{i,t} = \beta_i X_{i,t} + \eta_i \bar{X}_t + \lambda_i \bar{y}_t + \varepsilon_{i,t} \tag{10}$$

where $\bar{X}_t = \frac{1}{N}\sum_{i=1}^{N} X_{i,t}, \qquad \bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} y_{i,t}$

Pesaran (2006) distinguishes between two types of CCE estimators: Common correlated effects mean group (CCEMG) estimator and Common correlated effects pooled (CCEP) estimator. The CCEMG involves estimation of separate regressions for each cross-sectional unit, with the coefficients obtained through averaging. The CCEP, on the other hand, constrains the estimated coefficients to be equal across the cross-sectional units. Both

[69] Note that the coefficients of the cross-sectional average variables do not possess any meaningful interpretation. They merely cancel out the biasing effects of the unobservable common factor.

estimators produce consistent estimates even in the presence of stationary I(0) and nonstationary I(1) series, including in respect of the unobserved common factors.

The CCE method has been shown to be robust to different types of unknown error cross-sectional dependence (Chudik et al., 2011), the presence of unit root in factors (Kapetanios et al., 2011), serially correlated errors (Pesaran and Tosetti, 2011) and spatial or other forms of weak cross-sectional dependence (Chudik et al., 2011). However, in the presence of lagged dependent variables and/or weakly exogenous regressors in heterogeneous panel data models, the CCEMG estimator could only remain valid if a sufficient number of lags of cross-sectional averages are included in individual equations of the panel, and the number of cross section averages are at least as large as the number of unobserved common factors (Chudik and Pesaran, 2015). As discussed in section 4.5, the money demand model specified in this study does not include lagged dependent variables or weakly exogenous regressors, thus the CCE method as proposed by Pesaran (2006) remains appropriate for this study.

4.5.2.3 Augmented Mean Group Estimator

The AMG estimator is proposed by Eberhardt and Teal (2010) as an alternative technique to estimate long-run relationships in dynamic panels and addresses the problem of cross-sectional dependence. Unlike the CCEMG estimator which treats the unobserved common factor as a nuisance of no relevance to the empirical analysis, the AMG estimator accommodates the unobserved factor as part of a common dynamic process.[70] Here, the coefficients of year dummies from a pooled regression model are used to capture the evolution of the unobserved common factor(s). The country-specific regression model is augmented by this so-called common dynamic process and the country-specific model parameters averaged across the panel.

Two distinct stages are thus followed in the AMG estimation procedure. The first stage involves employing first difference OLS method to estimate a pooled regression model that is augmented with year dummies as in equation (11) below:

$$\Delta y_{it} = b'\Delta x_{it} + \sum_{t=2}^{T} c_t \Delta D_t + e_{it} \qquad (11)$$

where c_t are coefficients of the year dummies D_t.

[70] The AMG estimator meaningfully applies to the estimation of macro production functions wherein unobservables are transformed into a common dynamic process which represents total factor productivity (Eberhardt and Teal, 2011).

In the second stage, the group-specific regression model is augmented by the common dynamic process ($\hat{\mu}_t^*$) which is a collection of the average coefficients of the year dummies.

$$y_{it} = a_i + b' x_{it} + c_i t + d_i \hat{\mu}_t^* + e_{it} \qquad (12)$$

Following the MG approach of Pesaran and Smith (1995) and the CCEMG of Pesaran (2006), the AMG estimates ($\hat{b}_{AMG}$) are obtained by averaging the group-specific model parameters across the panel as indicated below:

$$\hat{b}_{AMG} = N^{-1} \sum_i \hat{b}_i$$

Compared to the CCE approach outlined in 4.5.2.2, the common dynamic process $\hat{\mu}_t^* = h(\bar{\lambda} f_t)$ and carries economically meaningful interpretation. Moreover, Eberhardt and Teal (2010) argues that AMG performs quite well as the CCEMG in terms of bias in both cointegrated and non-cointegrated nonstationary variables in panel data and in the presence of cross-sectional dependence.

4.5.3 Data

As discussed in section 4.5.1 above, the money demand model is specified with real broad money balances as the proxy for money demand and thus the dependent variable, while real gross domestic product, the rate of inflation, and the nominal exchange rate are considered its main determinants. Broad money (M2) is the sum of narrow money (M1) plus quasi-money (comprising mostly savings and time deposits), where M1 is currency in the hands of the non-bank public and demand deposits. M2 is deflated by the consumer price index to obtain the real money balances. Real GDP is proxy for the level of income and is defined as the total value of goods and services produced in an economy deflated by the overall price index, the GDP deflator. The inflation rate (INF) serves as proxy for the expected rate of inflation which in this study measures the opportunity cost of holding money and is computed as $\Delta \ln(P_t) = \ln(P_t) - \ln(P_{t-1})$ where $\ln(P_t)$ is the logarithm of the consumer price index and Δ is the first difference operator. EXR is the nominal exchange rate measured in domestic currency per U.S. dollar.

The data used in the baseline estimations represents annual frequencies covering the period 1980 – 2016. The panel is unbalanced due to variations in data availability across the member countries. As a result of data limitations, twelve countries in the ECOWAS region with appreciable time series on all the variables in the model are included in the estimation sample: Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Data are mostly obtained from the International Financial Statistics (IFS) of the International Monetary Fund.[71] Compilation of the data is consistent with statistical manuals in line with international best practices and are verified by the IMF. CPI data is collected at the country level according to the Classification of Individual Consumption by Purpose (COICOP) developed by the United Nations Statistics Division and scrutinized by the IMF before publication, thereby minimizing comparability issues across countries. Country-specific graphs of all the variables used in the estimations are presented in Appendix A.14.

4.6 Model Diagnostics, Estimation and Analyses

Analyses of the estimation results are preceded by an examination of the statistical properties of the data. The data series are tested for the existence of cross-sectional dependence among the member countries which is crucial to determining the appropriate estimators on which the analyses should be predicated. Panel unit root tests are then conducted to assess stationarity. Model estimation analyses are undertaken in respect of both the baseline regression and the parsimonious representation. The results are subjected to robustness checks to ensure that the inferences provide a valid basis for policy analyses.

4.6.1 Data diagnostics

The test for the presence of cross-sectional dependence in panel series has become immensely important in the choice of panel data methodology, with adverse implications for the efficiency of the estimator and the validity of the estimation results, if not fully accommodated (see Baltagi et al. 2012). To mitigate such occurrences, this study employs a range of cross-sectional dependence tests—Breusch-Pagan test, Pesaran scaled LM test,

[71] The data are available online at the following address: https://www.imf.org/data (accessed on January 8, 2019). For Sierra Leone, annual CPI series (base year 2010=100) for the period 1994 – 2004 was computed by Splicing (see Hill and Fox, 1997).

Bias-corrected scaled LM test, and the Pesaran CD test[72]—described in detail in Chapter 3, section 3.4.2.

Based on the results of the cross-sectional dependence tests in Table 4.1 below, the test statistic value for the Breusch-Pagan LM test is well into the upper tail of the χ^2 distribution, and that for the Pesaran CD test, though much lower, also rejects the null hypothesis at conventional significance levels. In fact, there is consensus among all four tests in rejecting the null hypothesis of cross-sectional independence for all four data series employed in the model. This is indicative of potential similarity of shocks impacting countries within the ECOWAS and some level of integration of economic structures. The confirmation of cross-sectional dependence among the variables across the panel units implies that the more reliable estimation results would be obtained on the basis of panel data methodologies that accommodate the cross-section correlation.

Table 4.1: Cross-sectional dependence tests

Test	Statistic	Probability Value
Variable - LRM2		
Breusch-Pagan LM	1665.70***	0.000
Pesaran scaled LM	139.24***	0.000
Bias-corrected scaled LM	139.07***	0.000
Pesaran CD	40.46***	0.000
Variable - LRGDP		
Breusch-Pagan LM	2098.95***	0.000
Pesaran scaled LM	176.95***	0.000
Bias-corrected scaled LM	176.78***	0.000
Pesaran CD	45.57***	0.000
Variable – INF		
Breusch-Pagan LM	559.59***	0.000
Pesaran scaled LM	42.96***	0.000
Bias-corrected scaled LM	42.79***	0.000
Pesaran CD	16.09***	0.000
Variable - LEXR		
Breusch-Pagan LM	1681.28***	0.000
Pesaran scaled LM	140.59***	0.000
Bias-corrected scaled LM	140.43***	0.000
Pesaran CD	40.22***	0.000

Source: Author's computation
Note: Null hypothesis – No cross-section dependence (correlation)
*** implies rejection of the null hypothesis at the 1% level of significance.
Econometric software employed - EViews 9.5

[72] Breusch and Pagan (1980), Pesaran (2004), Baltagi, Feng, and Kao (2012), and Pesaran (2004), respectively.

Given the existence of cross-sectional dependence, the stationarity properties of the data series used in the estimations are investigated using the second-generation CIPS panel unit root test of Pesaran (2007). This test, outlined in section 3.4.2, allows for individual dynamics in each cross-sectional specification and is robust to the presence of unobserved common factors. The test is conducted separately with the assumption of trend and that of no trend for up to two lags. The test results are presented in Table 4.2a below.[73] The test fails to reject the null hypothesis of unit root for LRGDP on all lags considered, with and without a deterministic trend. LRM2 is found to be non-stationary in levels on zero and one lag, but stationary at two lags. The INF series is stationarity at the one percent level, with the exception of the second lag in the specification with deterministic trend which exhibits non-stationarity. For the LEXR series, there is an indication of non-stationarity only at zero lag with a deterministic trend. The null of unit root is rejected for both one and two lag specifications. All the four data series are however stationary following first differencing, irrespective of the lag truncation or deterministic specification. These outcomes indicate that all data series are at most integrated of the order one, making the panel ARDL model an appropriate framework for estimation of the demand for money model in the ECOWAS.

The Pesaran (2007) CIPS test is complemented by the Maddala and Wu (1999) panel unit root test which allows for different lag lengths in the individual ADF regression and combines the p-value from each cross-sectional unit root test.[74] Given the test assumption of cross section independence, its relevance is limited to comparison. The test results indicate that both LRM2 and LRGDP are non-stationary in levels while INF is stationary, at the 1 percent significance level. LEXR is found to be non-stationary in the absence of a deterministic trend but exhibits non-stationarity under a trend specification. Like in the case of the CIPS test, all series are stationary when first-differenced.

[73] For presentational convenience, LRM2 and LRGDP are used to represent $\ln(M2_i / P_i)_t$ and $\ln RGDP_{it}$, respectively.

[74] Both PURTs are conducted using the STATA command ‘multipurt’ that produces the two sets of output.

Table 4.2a: Pesaran (2007) CIPS Panel Unit Root Test Results

		Without trend		With trend	
Variable (Levels)	Lags	Zt-bar	P-value	Zt-bar	P-value
lrm2	0	0.32	0.626	-0.13	0.447
lrm2	1	-0.74	0.230	-1.27	0.103
lrm2	2	-1.70**	0.044	-2.49***	0.006
lrgdp	0	3.07	0.999	1.25	0.895
lrgdp	1	2.04	0.979	1.33	0.908
lrgdp	2	0.52	0.699	0.44	0.670
inf	0	-8.97***	0.000	-8.93***	0.000
inf	1	-4.72***	0.000	-4.20***	0.000
inf	2	-2.67***	0.004	-0.73	0.233
lexr	0	-1.30*	0.096	-0.06	0.476
lexr	1	-3.23***	0.001	-3.54***	0.000
lexr	2	-2.38***	0.009	-2.45***	0.007
First Difference					
dlrm2	0	-12.49***	0.000	-11.61***	0.000
dlrm2	1	-8.59***	0.000	-7.42***	0.000
dlrm2	2	-5.53***	0.000	-4.12***	0.000
dlrgdp	0	-12.95***	0.000	-12.00***	0.000
dlrgdp	1	-8.38***	0.000	-6.39***	0.000
dlrgdp	2	-3.60***	0.000	-1.56**	0.040
dinf	0	-16.08***	0.000	-15.71***	0.000
dinf	1	-14.38***	0.000	-13.56***	0.000
dinf	2	-11.36***	0.000	-10.20***	0.000
dlexr	0	-11.42***	0.000	-12.98***	0.000
dlexr	1	-7.41***	0.000	-7.82***	0.000
dlexr	2	-4.33***	0.000	-1.53*	0.063

Source: Author’s computation

Note: Test assumes cross-section dependence is in the form of a single unobserved common factor
Null hypothesis – Series is I(1)
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed – Stata 15

Table 4.2b: Maddala and Wu (1999) Panel Unit Root Test Results

		Without trend		With trend	
Variable (Levels)	Lags	Chi_sq	P-value	Chi_sq	P-value
lrm2	0	0.55	1.000	23.83	0.471
lrm2	1	1.25	1.000	19.01	0.752
lrm2	2	0.89	1.000	21.16	0.629
lrgdp	0	1.61	1.000	29.60	0.198
lrgdp	1	0.95	1.000	23.51	0.490
lrgdp	2	1.18	1.000	17.65	0.820
inf	0	173.31***	0.000	166.18***	0.000
inf	1	108.32***	0.000	93.96***	0.000
inf	2	86.67***	0.000	82.85***	0.000
lexr	0	34.26*	0.080	15.63	0.901
lexr	1	39.11**	0.027	20.27	0.681
lexr	2	62.22***	0.000	54.66***	0.000
First Difference					
dlrm2	0	295.96***	0.000	294.08***	0.000
dlrm2	1	147.93***	0.000	156.64***	0.000
dlrm2	2	97.19***	0.000	83.94***	0.000
dlrgdp	0	322.06***	0.000	300.78***	0.000
dlrgdp	1	175.20***	0.000	172.31***	0.000
dlrgdp	2	104.01***	0.000	83.87***	0.000
dinf	0	647.20***	0.000	546.58***	0.000
dinf	1	372.19***	0.000	304.09***	0.000
dinf	2	231.35***	0.000	173.49***	0.000
dlexr	0	318.45***	0.000	280.47***	0.000
dlexr	1	156.03***	0.000	140.30***	0.000
dlexr	2	120.89***	0.000	84.56***	0.000

Source: Author’s computation

Note: Test assumes cross-section independence
Null hypothesis – Series is I(1)
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed – Stata 15

4.6.2 Model estimation and analyses

Estimation of the long-run coefficients of the money demand model proceeds within the panel ARDL framework. Most traditional tests for cointegration, including within the panel framework, require that the variables are non-stationary and integrated of the same order, mostly order 1 or I(1). With the data series confirmed to contain a mix of I(1) and I(0) variables (Tables 4.2a and 4.2b), the panel ARDL model becomes appropriate as it accommodates both stationarity properties in the same model. Moreover, its error-correction formulation provides a straight-forward determination of the existence of a long-run relationship among the variables of interest. Preliminary estimation of the model proceeds using the pooled mean group (PMG) estimator proposed by Pesaran et al. (1999), the mean group (MG) estimator of Pesaran and Smith (1995), and the dynamic fixed effects (DFE) estimator (Balgati and Levin, 1986). The application of these estimators in addition to allowing for comparison among different panel estimators which assume cross sectional independence, also gives an indication of the existence of long-run cointegrating relationship among the variables. A negative and statistically significant coefficient of the error correction term indicates a return to equilibrium trend following a shock, thus implying the presence of a long-run cointegrating relationship.

Table 4.3 below presents the results for the regressions using the PMG, MG, and DFE estimators.[75] The application of all three panel estimators indicate that level of income impacts positively on the demand for real money balances over the long run and the relationship exhibits statistical significance at the 1 percent level. The coefficients of income are however somewhat high, with elasticities of 1.97, 2.25 and 1.77 for the PMG, MG, and DFE estimators, respectively, in the baseline model. There is also consensus among the estimators that inflation exerts a negative influence on money demand; however, while the PMG and the DFE estimators produce a highly statistically significant relationship, the outcome from the MG is not significant statistically. The exchange rate impacts negatively on the demand for money, though statistically insignificant, with the exception of the PMG estimator which is statistically significant only at the 10 percent level. A broadly similar outcome is obtained using the parsimonious representation that excludes the exchange rate. The coefficients of the error correction terms (ECT) obtained from applying all three panel estimators are negative and highly statistically significant at the 1 percent level. These

[75] Estimations implemented using the 'xtpmg' command in Stata (see Blackburne and Frank, 2007)

outcomes point to the existence of a long-run co-integrating relationship between real demand for broad money and its determinants.

Table 4.3: Results of PMG, MG and DFE Regressions

	PMG		MG		DFE	
	[1]	[2]	[3]	[4]	[5]	[6]
	coefficients		coefficients		coefficients	
			Long Run			
lrgdp	1.968*** (0.000)	1.775*** (0.000)	2.254*** (0.002)	2.525*** (0.000)	1.772*** (0.000)	1.700*** (0.000)
inf	-6.622*** (0.000)	-6.146*** (0.000)	-8.762 (0.103)	-5.988 (0.183)	-9.883*** (0.002)	-8.422*** (0.001)
lexr	-0.097* (0.078)		-0.024 (0.894)		-0.038 (0.670)	
ECT	-0.089*** (0.000)	-0.092*** (0.000)	-0.188*** (0.000)	-0.163*** (0.000)	-0.066*** (0.001)	-0.071*** (0.001)
			Short Run			
d.lrgdp	0.488 (0.000)	0.421 (0.000)	0.319 (0.016)	0.265 (0.012)	0.386 (0.001)	0.322 (0.006)
d.inf	0.071 (0.315)	0.124 (0.129)	0.071 (0.550)	0.151 (0.227)	-0.026 (0.686)	0.009 (0.883)
d.lexr	0.085 (0.066)		0.094 (0.070)		0.074 (0.006)	
cons	-1.023 (0.000)	-0.969 (0.000)	-1.862 (0.000)	-1.78 (0.000)	-0.662 (0.003)	-0.682 (0.003)
Observations	409	409	409	409	409	409

Source: Author's computation

Note: Figures in parentheses are probability values of the respective coefficients
The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Econometric software employed – Stata 15

4.6.2.1 Baseline Regression Analyses

From the results in Table 4.1 above, there is overwhelming evidence of cross sectional dependence in all series across the member countries. Against that backdrop, more reliable results relative to the outcome of the PMG, MG, and DFE estimators in the previous section are obtained using estimators that take full account of the statistical properties of the panel data. To that end, this study resorts to the CCEMG estimator proposed by Pesaran (2006). As discussed in section 4.5.2.2 above, the CCEMG estimator accommodates cross sectional dependence in panel ARDL models. It accounts for the influence of unobserved common factors on the parameter estimates by incorporating cross-sectional averages of the dependent variable and the regressors in the models. The results obtained using the CCEMG approach[76] are posted in Table 4.4 below.

The CCEMG estimation results indicate a positive impact of changes in income on money demand in the ECOWAS region over the research period and is statistically significant at the 1 percent level. The income elasticity is approximately unity and thus in line with the dictates of the quantity theory which posits a direct and proportional relationship between the level of income and money demand. The coefficient on inflation is negative and statistically significant at the 10 percent level. This implies that as the rate of inflation increases the public's desire to hold money balances is reduced. Individuals shift their preference to other forms of assets instead of holding their wealth in cash which is faced with a loss in real value as inflation rises. The results also indicate an inverse relationship between the nominal exchange rate and the demand for money. A depreciation in the exchange rate, i.e. an increase in domestic currency per unit of U.S. dollars, is expected to induce a substitution effect from domestic currency towards foreign currency thereby reducing the holding of money balances. However, the coefficient on the exchange rate is statistically insignificant. These outcomes hold irrespective of the underlying deterministic assumption of constant only or constant and trend.

[76] The estimations were undertaken using the 'xtmg' user-written Stata command (see Eberhardt, 2012).

Table 4.4(a): Common Correlated Effects (CCE) Mean Group Regressions

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	1.025***	0.929***	0.860***	0.988***	0.832*	0.784*
	(0.000)	(0.000)	(0.001)	(0.006)	(0.066)	(0.074)
Inf	-0.302	-0.332	0.162	-0.114	-0.900**	-0.838
	(0.077)*	(0.075)*	(0.177)	(0.739)	(0.037)	(0.045)**
lexr	-0.118	-0.029	-0.120	0.322	0.442***	0.334**
	(0.179)	(0.755)	(0.247)	(0.458)	(0.003)	(0.024)
CR_lrm2	1.072	0.942	0.794	0.96	0.966	1.017
	(0.000)	(0.000)	(0.030)	(0.065)	(0.007)	(0.064)
CR_lrgdp	-1.229	-1.729	-1.119	-1.279	-0.649	-0.83
	(0.023)	(0.007)	(0.018)	(0.115)	(0.398)	(0.483)
CR_inf	0.498	0.489	-0.249	0.401	1.055	1.24
	(0.128)	(0.126)	(0.383)	(0.575)	(0.292)	(0.190)
CR_lexr	0.165	-0.046	0.100	-0.788	-0.44	-0.352
	(0.039)	(0.626)	(0.196)	(0.406)	(0.009)	(0.050)
cons	1.299	0.05**	2.895	0.064	-1.498	0.006
	(0.681)	(0.017)	(0.348)	(0.474)	(0.774)	(0.944)
trend		5.278		3.654		0.443
		(0.183)		(0.421)		(0.950)
RMSE	0.1070	0.1022	0.0669	0.0557	0.0691	0.0608
Observations	421	421	193	193	228	228

Source: Author's computation

Notes: Figures in parentheses are probability values of the respective coefficients.
The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
All parameters prefixed by 'CR_' are cross-sectional averages employed to address cross-sectional dependence. They possess no meaningful economic interpretation otherwise.
Econometric software employed – Stata 15

To discount any possible distortions in the estimation outputs arising from the existence of two different exchange rate regimes within the ECOWAS, the model is re-estimated excluding the exchange rate variable. Given that the coefficients of the exchange rate variable are insignificant in the baseline model, the re-estimated model excluding these coefficients produces a more parsimonious representation of the money demand function. The results, reported in Table 4.4b below, reveal statistically significant relationship between the level of income and the demand for money. Under the two deterministic assumptions, the elasticity of income with respect to money demand is close to unity, implying consistency with the quantity theory and that income is a strong determinant of the demand for money in the ECOWAS region. The coefficient on inflation is negative and statistically significant at the 5 percent level. This result indicates that the level of consumer prices is an important factor driving economic agents' desire to hold money balances within the region. A hike in the inflation rate would initiate a substitution effect away from domestic currency towards foreign currency or the holding of foreign assets.

Table 4.4(b): Common Correlated Effects (CCE) Mean Group Regressions+

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	1.068***	0.941***	0.988***	0.719*	0.691	0.869*
	(0.000)	(0.000)	(0.002)	(0.076)	(0.127)	(0.059)
Inf	-0.596**	-0.431**	-0.038	0.034	-0.51	-0.28
	(0.018)	(0.027)	(0.815)	(0.838)	(0.255)	(0.538)
CR_lrm2	0.88	1.029	0.83	0.84	0.978	1.064
	(0.000)	(0.000)	(0.028	(0.061	(0.008	(0.054
CR_lrgdp	-0.819	-1.63	-0.950	-1.312	-0.505	-0.915
	(0.045)	(0.018)	(0.070)	(0.104)	(0.573)	(0.359)
CR_inf	0.764	0.465	-0.125	-0.271	1.000	0.928
	(0.103)	(0.160)	(0.597)	(0.254)	(0.280)	(0.267)
cons	-1.814	4.305	0.226	0.015	-1.712	0.003
	(0.494)	(0.300)	(0.934)	(0.423)	(0.741)	(0.965)
trend		0.033*		4.469		-0.295
		(0.093)		(0.330)		(0.960)
RMSE	0.1392	0.1202	0.1178	0.0906	0.0854	0.0770
Observations	421	421	193	193	228	228

Source: Author's computation

Notes: Figures in parentheses are probability values of the respective coefficients.
The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
All parameters prefixed by 'CR_' are cross-sectional averages employed to address cross-sectional dependence. The possess no meaningful economic interpretation otherwise.
+The parsimonious model that excludes LEXR variable as a regressor
Econometric software employed – Stata 15

An important aspect of this study involves examining the stability of the money demand model and thus its relevance for policy purposes. Unlike time series estimation methods wherein procedures for testing model parameter stability are established—notably, CUSUM, CUSUMSQ, and Chow test—no robust stability tests have been developed for dynamic heterogeneous panel models, to the best of my knowledge. In the panel context, therefore, the approach has involved estimating the model over different sample periods or recursively (Setzer and Wolff, 2013; Albuquerque et al. 2014). Adopting a similar approach to determining parameter stability, the model is estimated over two different sub-periods, split almost evenly (1980 – 1997 and 1998 – 2016). The baseline results, presented in Table 4.4a (columns 3 – 6), indicate some evidence of instability in the coefficients of the money demand model. The earlier period 1980 – 1997 reveals a positive and highly statistically significant income elasticity of money demand of unity, whereas it registered 0.78 for the period 1998 – 2016 and is significant only at the 10 percent level, under the assumption of a deterministic trend.

The influence of inflation on money demand exhibits conflicting impacts over the two sub-periods. Under the deterministic specification with no trend, inflation exerts a positive and statistically insignificant impact on money demand during the earlier period, while a negative and statistically significant relationship at the 5 percent level is established thereafter. The incorporation of a trend does not improve the divergence in terms of statistical significance, though the coefficients are both negative. Similarly, for the exchange rate, the coefficients are conflicting both in terms of sign and statistical significance. The results of the parsimonious model in Table 4.4b (columns 3 – 6) above broadly reflect the variances over the two periods. The model is further estimated over two additional sets of sub-periods (1980-1994 and 1995-2016; 1980-2000 and 2001-2016) using both annual and quarterly frequency data. The detailed output of these estimations using the various sub-periods are presented in Appendices 4.3 and 4.4. These results confirm the marked divergences in the coefficients across the sub-periods. From the above, it is evident that the money demand model exhibited parameter instability over the sample period.

4.6.2.2 Robustness checks

Ascertaining the robustness of the estimation results has mostly entailed re-estimating the baseline model by incorporating alternative proxies for the variables in the model or by employing alternative estimation techniques. Different data frequencies have also been utilized to establish robustness of estimation results. Consistent with these approaches, this study undertakes a series of robustness checks by adopting an alternative macro panel estimation technique, an alternative measure of inflation expectations, and a higher frequency data.

The alternative empirical technique entails estimating the panel ARDL model using the AMG estimator of Eberhardt and Teal (2010). The AMG estimator, discussed in section 4.5.2.3 above, accounts for heterogeneity and cross-sectional dependence in panel data. The results of the re-estimation using the AMG estimator[77] are posted in Table 4.5. The outcome of the full sample estimation (Table 4.5a) is broadly consistent with that of the baseline CCE estimator in terms of sign and statistical significance of the coefficients on income, inflation and the exchange rate. Income is found to be positively related to the demand for money with a statistical significance of at most 5% irrespective of the underlying deterministic assumption. Inflation impacts money demand negatively and is statistically significant at the 5% level when a trend is included in the model. The coefficients on the exchange rate mimics those obtained using the CCEMG estimator, in respect of sign and significance. The common dynamic process (CDP_c variable) is positive and highly statistically significant at the 1% level and represents unobservable factors influencing economic agents' desire to hold money balances. The parsimonious model using the AMG estimator (reported in Table 4.5b below) also produces identical outcomes compared with the CCEMG estimator, with both income and inflation registering highly statistically significant results.

With regards stability of the model parameters, application of the AMG technique to the defined sub samples (1980 – 1997 and 1998 – 2016) reveals evidence of instability, similar to that of the CCEMG approach. Parameter instability is more evident assuming a deterministic trend, with the income elasticity of money demand at 0.7 and statistically significant only at the 10 percent level during the earlier period, while it registered 1.1 at 1 percent level of statistically significance over the later period (Table 4.5a). Similarly, the

[77] The estimation is implemented using the 'xtmg' command in Stata (see Eberhardt, 2012)

coefficient on inflation is positive and statistically insignificant over the earlier sub-sample (1980 – 1997), but negative and statistically significant at the 5% level in the latter period (1998 – 2016). With regards the exchange rate variable, the coefficients are negative but statistically insignificant in the earlier sub-period, while positive and highly statistically significant afterwards. A broadly similar model stability outlook is replicated in the parsimonious representation (excluding the exchange rate) in Table 4.5(b) below.

Table 4.5(a): Augmented Mean Group (AMG) Regressions

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	0.799***	0.613**	0.829**	0.727*	0.827***	1.108***
	(0.000)	(0.024)	(0.015)	(0.052)	(0.001)	(0.000)
Inf	-0.156	-0.193**	-0.090	0.025	-0.831***	-0.769***
	(0.105)	(0.049)	(0.426)	(0.882)	(0.000)	(0.000)
lexr	-0.092	-0.049	-0.079	-0.034	0.225***	0.248***
	(0.200)	(0.520)	(0.444)	(0.772)	(0.001)	(0.002)
CDP_c	0.802***	0.821***	0.883*	0.493	0.733***	1.279**
	(0.000)	(0.000)	(0.068)	(0.178)	(0.000)	(0.012)
cons	-2.18	-2.099	-2.735	-2.087	-6.642***	-0.057
	(0.212)	(0.312)	(0.237)	(0.449)	(0.000)	(0.145)
trend		0.012		-0.003		-7.670***
		(0.453)		(0.835)		(0.000)
RMSE	0.1410	0.1244	0.0975	0.0847	0.0918	0.0757
Observations	421	421	193	193	228	228

Source: Author's computation

Note: Figures in parentheses are probability values of the respective coefficients
The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
CDP_c refers to the common dynamic process
Econometric software employed – Stata 15

Table 4.5(b): Augmented Mean Group (AMG) Regressions+

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	0.699** (0.044)	0.596** (0.029)	0.891** (0.031)	0.470 (0.135)	0.856*** (0.001)	1.012*** (0.000)
Inf	-0.331*** (0.005)	-0.311** (0.012)	-0.268 (0.184)	-0.217 (0.198)	-0.582*** (0.003)	-0.436 (0.112)
CDP_c	0.735*** (0.002)	0.930*** (0.000)	0.728 (0.213)	0.937* (0.064)	0.772*** (0.000)	1.094** (0.049)
cons	-2.345 (0.405)	-2.016 (0.319)	-4.823 (0.163)	-0.006 (0.662)	-5.652*** (0.003)	-0.032 (0.511)
trend		0.002 (0.874)		-1.586 (0.362)		-6.468*** (0.001)
RMSE	0.1659	0.1394	0.1330	0.1060	0.0993	0.0851
Observations	421	421	193	193	228	228

Source: Author's computation

Note: Figures in parentheses are probability values of the respective coefficients

The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

CDP_c refers to the common dynamic process

+The parsimonious model that excludes LEXR variable as a regressor

Econometric software employed – Stata 15

The second approach to ascertaining robustness of the estimation results involves employing an alternative measure of inflation expectations. This is contrary to the original baseline model which follows other money demand studies on SSA countries by proxying the actual inflation rate for the expected rate of inflation which essentially assumes perfect foresight. Here, the model is re-estimated incorporating an inflation expectations measure derived using a naïve specification in which the next period's inflation rate is the same as the previous period's inflation rate. The results of the revised baseline model are presented in Table 4.6(a) and those of the parsimonious model reported in Table 4.6(b) below. These results are broadly in line with the output from the original estimations using the CCEMG estimator. Real income positively influences the demand for money with income elasticity close to unity, while inflation exerts a negative impact. Both effects are statistically significant at the 1% level. Similarly, the exchange rate is shown to have an inverse relationship with the demand for money, but with a statistically insignificant coefficient. Parameter instability appears to be more evident as reflected in marked disparity in the parameter estimates, both in terms of magnitude and statistical significance.

Table 4.6(a): Common Correlated Effects (CCE) Mean Group Regressions based (with alternative measure of Inflation Expectations)

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	0.865***	0.812	1.325	1.123	0.496	0.503
	0.000	0.000	0.000	0.000	0.200	0.174
Inf	-0.516	-0.510	0.817	-0.781	-0.530	-0.324
	0.001	0.006	0.000	0.000	0.160	0.318
lexr	-0.049	-0.005	0.077	0.083	0.440	0.371
	0.535	0.954	0.590	0.578	0.004	0.017
CR_lrm2	1.009	0.963	0.974	0.941	1.041	1.115
	0.000	0.000	0.011	0.039	0.003	0.081
CR_lrgdp	-1.011	-1.463	-1.553	-1.511	-0.481	-0.392
	0.046	0.016	0.011	0.050	0.534	0.740
CR_inf	0.742	0.663	0.817	0.780	0.600	0.378
	0.067	0.069	0.026	0.018	0.413	0.614
CR_lexr	0.130	0.004	0.038	0.017	-0.446	-0.371
	0.147	0.971	0.747	0.920	0.006	0.022
cons	0.057	3.58	0.334	0.970	-0.398	-0.542
	0.985	0.327	0.917	0.830	0.936	0.939
trend		0.035		0.003		-0.013
		0.079		0.940		0.901
RMSE	0.1109	0.1079	0.0824	0.0557	0.0682	0.0694
Observations	409	409	181	181	228	228

Source: Author's computation

Notes: Figures in parentheses are probability values of the respective coefficients.

The asterisks ***, ** and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

All parameters prefixed by 'CR_' are cross-sectional averages employed to address cross-sectional dependence. They possess no meaningful economic interpretation otherwise.

Econometric software employed – Stata 15

Table 4.6(a): Common Correlated Effects (CCE) Mean Group Regressions based (with alternative measure of Inflation Expectations)+

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	1.173	0.884	1.145	1.087	0.484	0.559
	0.000	0.000	0.002	0.009	0.282	0.205
Inf	-0.576	-0.504	-0.673	-0.795	-0.230	-0.152
	0.013	0.018	0.000	0.001	0.611	0.720
CR_lrm2	0.768	0.939	0.885	1.030	1.082	1.300
	0.000	0.000	0.000	0.002	0.009	0.027
CR_lrgdp	-0.744	-1.609	-0.664	-1.266	-0.550	0.028
	0.043	0.024	0.112	0.105	0.583	0.974
CR_inf	0.571	0.579	0.287	0.488	0.673	0.649
	0.205	0.133	0.349	0.274	0.408	0.404
cons	-3.397	3.868	-3.457	0.590	-0.288	-3.982
	0.086	0.391	0.127	0.888	0.959	0.425
trend		0.043		0.013		-0.050
		0.054		0.500		0.424
RMSE	0.1427	0.1216	0.1257	0.0975	0.0829	0.0770
Observations	409	409	181	181	228	228

Source: Author's computation

Notes: Figures in parentheses are probability values of the respective coefficients

The asterisks ***, ** and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

All parameters prefixed by 'CR_' are cross-sectional averages employed to address cross-sectional dependence. They possess no meaningful economic interpretation otherwise.

+The parsimonious model that excludes LEXR variable as a regressor

Econometric software employed – Stata 15

Finally, the application of the CCEMG estimator on quarterly data[78] for all variables in the panel model. The estimation outputs of the baseline model and the parsimonious model are presented in Tables 4.7(a) and 4.7(b), respectively. The results are consistent with those obtained applying the CCEMG estimator on annual data in Tables 4.4(a) and 4.4(b) above. This outcome reveals that the income elasticity of the demand for money is close to unity and is positive and statistically significant at the 1% level of significance. Inflation similarly exerts a negative impact on money demand, with an even higher statistical significance relative to using lower frequency (annual) data. The coefficient on the exchange rate remains negative and insignificant statistically, underscoring the status of the exchange rate as a less important factor influencing the demand to hold money balances in the region. For the parsimonious model, reported in Table 4.7(b), the respective positive and negative impacts of income and inflation on money demand at statistically significant levels of less than 5% affirm that the cointegrating relationship governing the long-run money demand in the ECOWAS region comprises real broad money balances, real GDP and inflation.

[78] All data obtained from the same source as the baseline model (IFS database of the IMF). Gaps in the data (Cabo Verde: M2 for Q1 & Q2; Togo: CPI for Q1 & Q2) filled by extrapolating based on respectively quarterly patterns the preceding three years. The quarterly inflation rate is computed using the following formula: $\Delta \ln(P_t) = 4*[\ln(P_t) - \ln(P_{t-1})]$. Given the absence of annual real GDP for all countries in the sample, the quarterly series were obtained by interpolation using the Chow-Lin interpolation routine. All quarterly data are seasonally adjusted using the X-13ARIMA-SEATS method embedded in the EViews 9.5 econometric software.

Table 4.7(a): Common Correlated Effects (CCE) Mean Group Regressions based on Quarterly data

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	0.872***	0.971***	0.546	0.102	0.938***	1.063**
	(0.002)	(0.001)	(0.174)	(0.901)	(0.000)	(0.013)
Inf	-0.168***	-0.146***	-0.065*	-0.062	-0.113*	-0.149**
	(0.000)	(0.001)	(0.180)	(0.159)	(0.081)	(0.043)
lexr	-0.083	-0.082	-0.139	-0.134*	0.257	0.187
	(0.327)	(0.421)	(0.076)	(0.076)	(0.154)	(0.272)
CR_lrm2	0.916	1.005	0.697	0.864	1.029	0.941
	(0.000)	(0.000)	(0.008)	(0.001)	(0.000)	(0.001)
CR_lrgdp	-0.703	-0.811	-0.565	-0.61	-0.888	-1.474
	(0.003)	(0.002)	(0.318)	(0.296)	(0.000)	(0.011)
CR_inf	0.151	0.122	0.09	0.09	0.124	0.084
	(0.213)	(0.272)	(0.246)	(0.299)	(0.210)	(0.361)
CR_lexr	0.001	-0.022	0.063	0.089	-0.298	-0.305
	(0.988)	(0.866)	(0.557)	(0.493)	(0.098)	(0.100)
cons	-0.187	-0.885	4.726	9.902	-0.282	5.959
	(0.970)	(0.850)	(0.418)	(0.290)	(0.944)	(0.549)
trend		-0.001		0.004		0.010
		(0.866)		(0.667)		(0.378)
RMSE	0.1160	0.1084	0.0855	0.0806	0.0815	0.0773
Observations	1646	1646	741	741	905	905

Source: Author's computation

Notes: Figures in parentheses are probability values of the respective coefficients.

The asterisks ***, ** and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

All parameters prefixed by 'CR_' are cross-sectional averages employed to address cross-sectional dependence. They possess no meaningful economic interpretation otherwise.

Econometric software employed – Stata 15

Table 4.7(b): Common Correlated Effects (CCE) Mean Group Regressions based on Quarterly data+

	Full Sample 1980 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016	
	Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	0.878***	0.983***	0.852*	0.551	1.023***	1.271***
	(0.001)	(0.002)	(0.067)	(0.149)	(0.000)	(0.000)
Inf	-0.239***	-0.188***	-0.138**	-0.10*	-0.071	-0.14***
	(0.000)	(0.000)	(0.032)	(0.071)	(0.305)	(0.010)
CR_lrm2	0.738	0.94	0.6	0.82	0.991	0.952
	(0.035)	(0.002	(0.130	(0.008)	(0.000)	(0.009)
CR_lrgdp	-0.531	-0.663	-0.314	0.727	-0.854	-1.463
	(0.248)	(0.081)	(0.624)	(0.273)	(0.018)	(0.002)
CR_inf	0.472	0.179	0.217	0.092	0.162	0.146
	(0.011)	(0.198)	(0.104)	(0.397)	(0.160)	(0.200)
cons	-2.304	-3.347	-3.505	5.353	-1.811	2.104
	(0.743)	(0.592)	(0.732)	(0.449)	(0.725)	(0.773)
trend		-0.002		-0.003		0.005
		(0.602)		(0.482)		(0.643)
RMSE	0.1482	0.1289	0.1284	0.0948	0.093	0.0866
Observations	1646	1646	741	741	905	905

Source: Author's computation

Notes: Figures in parentheses are probability values of the respective coefficients

The asterisks ***, ** and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

All parameters prefixed by 'CR_' are cross-sectional averages employed to address cross-sectional dependence. They possess no meaningful economic interpretation otherwise.

+The parsimonious model that excludes LEXR variable as a regressor

Econometric software employed – Stata 15

4.7 Summary and Conclusion

This study has examined the demand for money in the ECOWAS region within a dynamic panel framework over the period 1980 to 2016. It discussed the theoretical literature underpinning the demand for money and reviewed recent empirical studies on money demand investigated using panel data methods. Drawing from the theoretical literature, the alternative model specifications adopted in related empirical research, and the peculiarities of the region, an appropriate specification for the estimations was determined. The baseline long-run money demand function is specified to include the log of real broad money balances as the dependent variable, with the log of real GDP, the rate of inflation, and the log of the nominal exchange rate as regressors. The parsimonious model formulation excluded the exchange rate found to be statistically insignificant and potentially distortionary on account of the different exchange rate regimes existing in the region.

A range of tests confirm the existence of cross-sectional dependence among the panel series. The second generation CIPS panel unit root test proposed by Pesaran (2007) was thus employed to assess the stationarity properties of the data series. None of the variables was found to be integrated of the order two or higher, even using the Maddala and Wu (1999) ADF-Fisher panel unit root test which assumes cross-sectional independence. With the presence of only stationary I(0) and non-stationary I(1) variables, a panel ARDL model formulation was considered appropriate to estimate the model parameters.

Preliminary model estimation using the PMG, MG and DFE estimators confirmed the existence of a long-run cointegrating relationship among the variables, as reflected by negative and highly statistically significant coefficients of the error correction terms in all panel models. The results indicate that the level of income impacts positively on the demand for real money balances over the long run and the relationship is highly statistically significant. There is also consensus among the estimators that inflation exerts a negative influence on money demand, with the results of the PMG and the DFE estimators statistically significant. The exchange rate impacts negatively on the demand for money, though statistically insignificant, with the exception of the PMG estimator which is only marginally significant at conventional levels. The parsimonious model reproduces highly significant coefficients on income and inflation, indicating that the level of income and inflation are key determinants of the desire to hold money balances in the region.

In view of confirmation of the existence of cross-sectional dependence among the data series, the second-generation dynamic panel CCEMG estimator was applied to obtain more reliable results. The CCEMG estimation results confirmed that the level of income exerts a positive and statistically significant influence on money demand in the ECOWAS region at the 1 percent level. The income elasticity is approximately unity, in line with the dictates of the quantity theory which posits a direct and proportional relationship between the level of income and money demand. The impact of inflation on money demand is negative and statistically significant, implying that as the rate of inflation increases the public's desire to hold money balances is reduced. An inverse relationship was established between the nominal exchange rate and the demand for money, though statistically insignificant. The more parsimonious model representation, excluding the nominal exchange rate, generated similar outcomes. Robustness tests conducted using the AMG estimator, an alternative measure of inflation expectations, and by applying the CCEMG estimator on higher frequency quarterly data, reaffirmed that the level of income and the rate of inflation are the key determinants of the demand for money in the ECOWAS.

In line with recent approaches in dynamic heterogeneous panel settings, the stability of the long-run money demand function was investigated by estimating the model over different sample periods to examine changes in the parameter estimates. The results uncovered evidence of instability in the coefficients of the money demand model over the research period. The differences were particularly pronounced using the higher frequency quarterly data, both in terms of direction of impact and statistical significance of the income elasticity of money demand and the semi-elasticity of inflation.

This study's finding of long-run cointegrating relationship between broad money and its key determinants (real income and inflation, in this instance) is broadly consistent with some key panel studies on the Euro area (Hamori and Hamori, 2008; Nautz and Rondorf, 2011; and Foresti and Napolitano, 2014) and on advanced economies, including Mark and Sul (2003) covering 19 developed economies and Dobnik (2013) on 11 OECD countries. Similarly, the few studies on the SSA region employing panel techniques (Hamori, 2008; Salisu et al., 2013) attained a similar conclusion. However, several of these SSA studies found the long-run money demand function to be stable, in contrast with the outcome of this research. Moreover, unlike most of the predominantly country-specific research papers on the ECOWAS, reviewed in section 4.4 above, the established long-run money demand relationship within the panel framework is found to be unstable.

Chapter 5 Monetary policy transmission in the ECOWAS: Evidence from heterogeneous panel analyses

5.1 Introduction

This chapter examines the monetary policy transmission mechanism in the ECOWAS. It reviews the conventional channels of monetary policy transmission in the broader context of SSA economies but focusing on the ECOWAS and presents a comprehensive appraisal of the empirical literature on monetary policy transmission in monetary unions. The study employs the dynamic heterogeneous panel technique developed by Pedroni (2013) which allows for heterogeneous country-specific dynamics and accommodates cross-sectional dependencies. Identification of the unanticipated common monetary shock proceeds by imposing short-run recursive restrictions. Member-specific responses to the common shock are analyzed to determine the existence of potential asymmetries and the panel responses provide an insight into union-level dynamics. The relevant transmission variables are incorporated into the baseline model to examine the viability of the plausible channels of monetary policy transmission in the region.

5.1.1 Background

A defining institutional feature of the proposed monetary union in the ECOWAS region is the common central bank that will be charged with the responsibility for formulating and implementing a centralized monetary policy. The current central bank of the WAEMU, the BCEAO, and the national central banks of the Non-WAEMU member states—Cabo Verde, The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone—will relinquish their decision-making power to this common monetary authority that would serve as the apex regional monetary institution. In addition, the currency issued by the BCEAO, the CFA franc, will be delinked from its current peg to the euro and the currencies of the other ECOWAS member countries replaced in favour of a single currency for the union, the Eco. This development would amount to an important institutional transformation, with potentially far-reaching implications for the economies of the proposed union. Member countries will lose their ability to use monetary policy instruments to influence domestic monetary conditions and the exchange rate will no longer serve as an adjustment mechanism to mitigate the impact of macroeconomic shocks. Important concerns for both monetary authorities and economic agents, therefore, are whether the common monetary policy will be effective in influencing aggregate demand in the member countries and if the impact will be evenly distributed.

The OCA literature outlines the conditions under which centralised monetary and exchange rate management and a common currency among a group of countries would achieve optimal outcomes. The traditional theory, originally espoused by Mundell (1961) and extended by McKinnon (1963) and Kenen (1969), proposes ex-ante criteria to assess optimality, including the degree of labour mobility, the extent of openness and product diversification, and the incidence of asymmetric shocks among the aspiring countries. The modern OCA perspective, as reflected by the endogeneity theory, refocused the concept towards ex post conditions attained on account of the economic and structural changes emanating from joining a monetary union (Frankel and Rose, 1997; 1998), such as enhanced credibility and effectiveness of monetary policy for countries where the conduct of monetary policy has been weak (Calvo and Reinhart, 2002) and trade integration and the synchronisation of business cycles (De Grauwe, 2005). There is however broad consensus between the two schools of thought that the degree of association of shocks among member countries, including arising from monetary policy actions, is crucial to attaining the ultimate policy objective(s) of the union (De Grauwe, 2014).

An examination of the monetary policy transmission mechanism in the prospective member countries would provide an insight into how monetary policy affects aggregate demand (real output and inflation) in the respective countries. The conventional channels through which monetary policy is transmitted to the real economy are established in the literature (Mishkin, 1995) and are influenced by the nature and extent of development of the existing economic and financial infrastructure (Mishra and Montiel, 2012). The existence of differences in economic structures and institutional arrangements among member countries could affect the magnitude and duration of impact of monetary policy actions across member states. Asymmetries in the impacts of a common monetary policy shock implies disproportionate distribution of the associated costs among member countries, both in terms of disinflation and productivity losses, with the propensity to widen cyclical variations among countries in the monetary union. The divergent and uncoordinated macroeconomic policy responses from member countries to mitigate the impact of the shock would undermine the effectiveness of the monetary union.

The existence of asymmetries in monetary transmission in a monetary union also possesses important implications for the structure of the institutional framework of the decision-making process. It informs the choice between a centralized institutional structure whereby policy is predicated on union-wide aggregates, focussing principally on the stipulated objective(s) of the common monetary authority, and a decentralised structure, as in the Eurosystem, that incorporates extensive information on local economic conditions into the decision process and includes Governors of the national central banks in the decision-making council. In the case of the ECB, Mandler et al. (2016) pointed out that marked differences among member countries in the responsiveness of output could imply 'an asymmetrical distribution of the burden of adjusting to euro-area-wide inflationary disequilibria, where welfare losses could be reduced by taking national information into account instead of just looking at euro-area-wide aggregates'. This is in line with the findings of Angelini et al. (2002) that welfare losses from a monetary policy strategy based on union-wide aggregates and one based on national data of member states is sizeable. They argue in favour of a monetary policy reaction function that responds to developments at the national level, even if the central bank's objectives and its loss function are predicated on union-wide fundamentals.

As countries of the ECOWAS gravitate towards a monetary union, it is therefore crucial that the transmission mechanism of monetary policy in individual member countries and at the level of the prospective union be understood to determine whether the impact of monetary policy on the countries exhibits asymmetries. This would not only help inform development of an appropriate and robust institutional framework for monetary policy, it would provide guidance for policy formulation at least in the initial period following establishment of the common central bank.

5.1.2 Relative contributions

The monetary integration process in the EMU shows that the period prior to the establishment of the ECB and since its inception, has witnessed considerable research directed at understanding the monetary policy transmission mechanism in the Euro area and determining whether asymmetries exist in the transmission of monetary policy signals to the member states (see, for example, Ehrmann, 1998; Montecelli and Tristani, 1999; Peersman and Smets 2001; Mojon and Peersman, 2001; Smets and Wouters, 2002; Cecioni and Neri, 2010; Ciccarelli et al., 2013). In fact, some of the early studies were commissioned under what was referred to as the Eurosystem Monetary Transmission Network (EMTN) that examined the monetary transmission process in the euro area.[79] Undoubtedly, these studies have helped inform policy design and implementation at the ECB thereby contributing to strengthening policy effectiveness.

Unlike the EMU, empirical studies on the potential effects of common monetary policy shocks within the current and proposed monetary unions in the Sub-Saharan African region are limited. A few studies have investigated the channels and the strength of impact of monetary policy transmission in the CEMAC (Bikai and Kenkouo, 2015; IMF, 2015) and the EAMU (Buigit, 2009; Davoodi et al., 2013). Within the ECOWAS, the handful of papers on the monetary transmission mechanism in the context of monetary integration have focussed mainly on one of the two sub-regional monetary arrangements, the WAEMU (IMF, 2014; Kireyev, 2015). For the WAMZ, studies on monetary integration have mostly either investigated country-specific transmission of monetary policy, for example, Kovanen (2011) on Ghana; Ndekwu (2013) on Nigeria; and Olawale-Ogunkula and Tarawalie (2008) on Sierra Leone, or have examined the broader question of whether the zone is an optimum currency area, for example, Cham (2010); Asongu (2014). At the level of ECOWAS, there is no evidence of empirical work that has attempted to investigate the monetary policy transmission mechanisms in the region as a group, in spite of recent advancements in panel data modelling techniques.

This study is therefore an attempt at filling these critical gaps in the run-up to the introduction of a single currency and common monetary policy for the proposed ECOWAS monetary union. The contribution of this paper to the existing knowledge of monetary transmission in monetary unions is two-fold:

First, the study presents a comprehensive review of the empirical studies on the monetary policy transmission mechanism undertaken in the context of monetary unions. The various empirical methodologies that have been adopted to investigate current and prospective regional monetary arrangements around the world are appraised.

Second, the study examines the impact of monetary policy transmission on the real economy of ECOWAS member countries within a panel framework. It investigates the effects of a

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[79] The EMTN comprised a group of economists affiliated with the ECB and the national central banks of the Eurosystem.

common monetary policy shock on aggregate demand, as reflected in real GDP and inflation, to determine whether policy impulses have asymmetric effects on member countries. As evidenced from section 5.3 below, most of the empirical studies on the effects of monetary policy shocks in monetary unions employ the structural VAR methodology. However, the multi-country approach followed by these studies may produce questionable results with limited insights for policy formulation, as a result of the short data length for some of the series and the fact that the impulse responses for the individual country studies are in some cases generated on the basis of dissimilar empirical strategies, including in terms of the dimension of the VAR matrix and the set of underlying assumptions. Importantly, most of these studies do not isolate the common component of the identified shock to capture the unanticipated common monetary policy action to assess the impact of the economy. This could be considered a misidentification of the appropriate shock for the analyses.

Specifically, this study employs the dynamic heterogeneous panel technique developed by Pedroni (2013). This technique helps address the problem of inconsistent estimates and possible misleading inferences obtained using the individual VAR procedure on data of insufficient length, by adopting a panel estimation framework. However, unlike most conventional panel methods, which assume homogeneous dynamics among the members of the panel and pool the data, the Pedroni (op. cit.) approach allows for heterogeneous country-specific dynamics and accommodates cross-sectional dependencies. The technique identifies both common shocks—shocks impacting all member countries—and idiosyncratic shocks—shocks predominantly affecting a single country—and generates member specific responses to both shocks, in addition to the composite shock. The identified common shocks are used to capture the exogenous common monetary policy shock. Within the dynamic panel framework, the study also investigates the plausible channels of monetary policy transmission in the ECOWAS.

5.1.3 Research Questions

Against the backdrop of the research gaps identified above, this study seeks to address the following research questions:

i. How effective is monetary policy in member countries of the ECOWAS?
ii. Will a common monetary policy shock have asymmetric impact on member countries of the ECOWAS?

iii. How effective are the monetary channels in transmitting policy impulses at the level of ECOWAS?

5.2 Monetary policy framework and channels of transmission

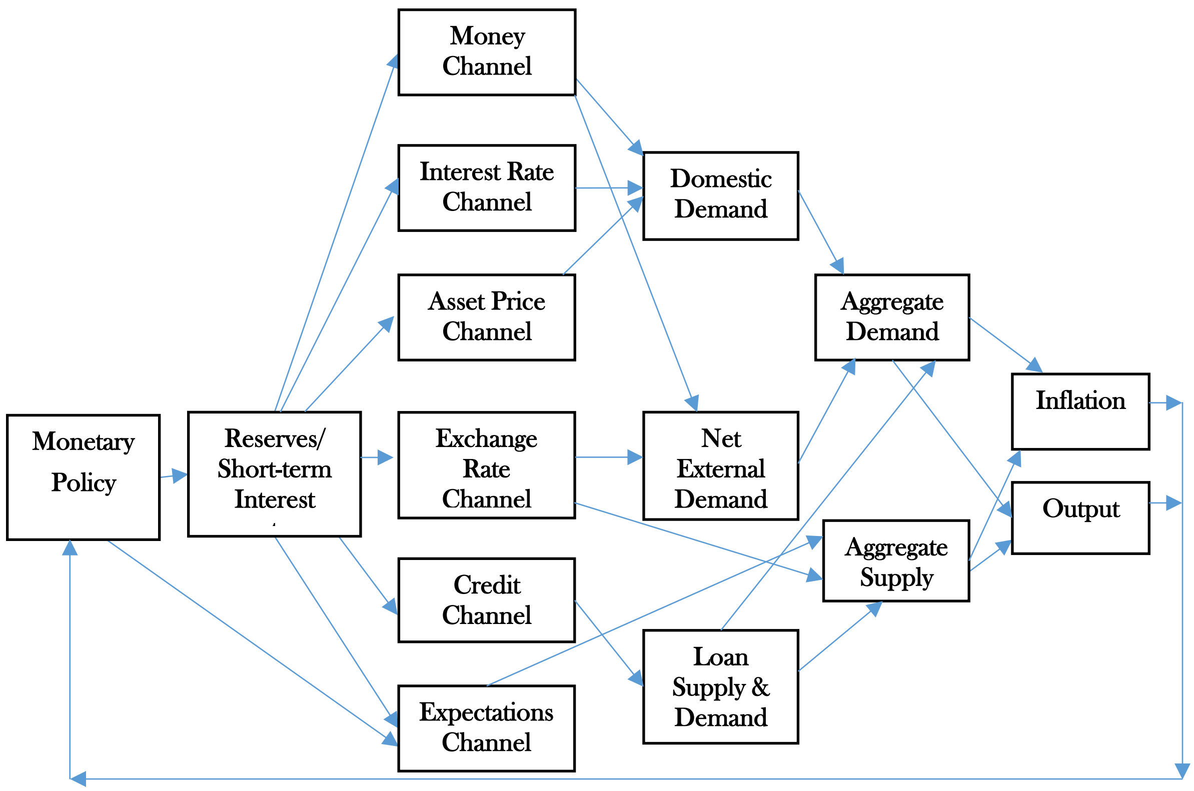
This section presents the general framework within which monetary policy operates and discusses the channels of monetary policy transmission in the context of their applicability to SSA countries, with particular reference to the ECOWAS. This helps inform model specification and provides a basis for which plausible monetary transmission channels are investigated in this study.

5.2.1 The mechanism of monetary policy transmission

The formulation and effective implementation of monetary policy requires a reasonable understanding by policy makers of the mechanism through which policy actions are transmitted to the real economy. In the conduct of monetary policy, the monetary authority seeks to influence market conditions by regulating the level of liquidity in the banking system. The provision of liquidity is occasioned by changes to some items on the central bank balance sheet, notably the monetary base, or some measures with direct influence on the interest rates. The monetary transmission mechanism thus maps out the process through which changes to the monetary base or the short-term nominal interest rate affect the real economy, as reflected in indicators of aggregate demand notably real output and inflation.

Figure 5.1 below outlines the monetary transmission mechanism depicting the network of impacts emanating from central bank policy decisions that changes the operational instruments—the monetary base or the short-term interest rate—transmitted through one or more established channels. At the aggregate level, these policy impulses influence demand and supply which in turn impacts the level of prices and real output. The timing and magnitude of the policy-induced changes on real sector indicators vary widely, depending on several factors, including the extent of development of financial markets and policy credibility or economic agents' confidence in the monetary authorities. Knowledge of the lags with which monetary policy actions are transmitted and the strength of their impact allows policy makers to form a judgement on the timing and scope of policy decisions to properly anchor inflation expectations and stabilize output fluctuations. Also, as depicted in Figure 5.1, there is feedback from output and inflation to monetary policy whereby the central bank reaction function incorporates inflation and output developments. In addition, an understanding of the transmission mechanism ensures an informed assessment of which monetary indicator best reflects the stance of monetary policy.

Figure 5.1: The Framework of Monetary Policy Transmission



Source: Davoodi et al. (2013, p. 9)

5.2.2 Review of the Channels of monetary policy transmission

Efforts at understanding how money affects economic activities could be traced back to the work of early monetarists like Friedman and Schwartz (1963). However, recent studies over the past two and a half decades by prominent economists, including Taylor (1995) and Bernanke and Gertler (1995), synthesized in the seminal paper by Mishkin (1995), have proven to be a watershed in identifying the channels through which monetary policy impulses are transmitted in an economy. Drawing from these contributions, the channels of monetary policy transmission that have been identified in the literature are the Money channel, Interest rate channel, Exchange rate channel, Credit channel, Other Assets price channel, and the Expectations channel. These channels are highlighted in Figure 5.1 above. As noted earlier, the operability of these channels is, to a large extent, dependent on the state of development of the economy. This review discusses these channels of monetary transmission in respect of their relevance and applicability to SSA economies, particularly in the ECOWAS.

5.2.2.1 Money channel

This channel derives its theoretical foundation from the notion that changes in central bank reserves or the monetary base affects the real economy by altering the consumer's portfolio preferences and thus the desire to hold money balances to finance real investment.[80] Assuming a portfolio of only money and bond, the reduction (increase) in central bank reserves on account of a monetary contraction limits (stimulates) the banking system's ability to create deposits. A shift in consumer's portfolio occurs whereby more bonds and less money are held. The decrease in money holdings amounts to a decline in real money balances, assuming prices do not adjust instantaneously to the money supply changes. The resulting rise in the cost of investment capital arising from efforts to restore equilibrium through an increase in the real interest rate on bonds, dampens nominal output growth.

This channel of monetary transmission appears to provide the basis for the monetary targeting framework that continues to operate in several developing economies, including in the ECOWAS region, whereby changes to reserve money (the operational target) affect broad money balances (the intermediate target) which in turn influences real output and prices. The framework operates under the assumption that the money multiplier, which relates reserve money (monetary base) to the money supply is stable and that the income velocity of money or the relationship between the monetary aggregate and inflation and output is direct, stable and thus predictable.

In recent years, however, the increasing pace of financial innovation in these countries has tended to undermine the underlying money multiplier and money demand relationships. Moreover, with the gradual mainstreaming of the endogeneity view of the money creation process (Sheard 2013; McLeay et al., 2014) and recent evidence from the global financial crisis questioning the conventional money relationship (Goodhart, 2017), the monetary

[80] This view draws from the theoretical underpinnings of the Modigliani and Miller (1958) portfolio model and considers the banking system a mere issuer of bank deposits.

targeting framework is becoming untenable and being abandoned, even among LICs, in favour of an operational framework of monetary policy that relies on short-term interest rates signalling.

5.2.2.2 Interest rate channel

This channel is somewhat similar to the money channel discussed above, though monetary policy actions are initiated through changes to the short-term interest rates that influence consumption and investment spending decisions by both households and businesses and impacts aggregate demand. Two components of the interest rate channel could be distinguished: the short-term interest rate channel and the long-term interest rate channel. With regards the former, policy actions are reflected in changes in the short-term real interest rate which affect aggregate demand by altering intertemporal household consumption. Thus, this channel is expected to be more effective the greater the degree of intertemporal substitution in consumption and the lesser credit is rationed to households. On the latter, the changes in the short-term interest rate feeds into the long-term real interest rate which in turn affects household spending on durables and the cost of capital for investment spending by firms. Within this context, economic agents respond to a monetary tightening by either holding back or cutting down on planned investment and consumer spending, culminating in a decline in aggregate demand. Conversely, following expansionary monetary policy action, the long-run real interest rate falls leading to lowering of the cost of capital. This induces business and personal expenditures, culminating in an increase in aggregate demand.

Of particular note is the fact that investment spending decisions are influenced by the real interest rate, not the nominal short-term rate directly under the control of the monetary authorities. To that end, operation of this channel is predicated on the presence of nominal price rigidity which prevents instantaneous price adjustments, thus allowing changes to the short-term nominal interest rates to translate into short-term real interest rate. Moreover, in line with the rational expectations hypothesis, expectations about the path or term structure of interest rates are crucial for investment decisions as these determine the long-term real interest rates on which firms base their business decisions.

For the interest rate channel to be operable, the financial markets should be reasonably developed and competitive to allow policy impulses to be effectively transmitted. With SSA countries generally characterised by underdeveloped financial markets and highly concentrated banking systems, both the short-term and long-term interest rate channels are potentially weak. In most of these countries, the money and interbank securities markets are underdeveloped, with transactions among banks quite limited. More often, the interbank market is segmented and the handful of large banks occasionally trading among themselves. Moreover, the banking system generally exhibits oligopolistic attributes, including high concentration and low competitiveness compared to those in advanced economies. Given the imperfectly competitive banking system, changes in policy interest rates exert only weak influence on market rates as the changes are not fully passed on to borrowers. Instead, banks often only alter their profit margin, thereby inhibiting the transmission of policy impulses following changes to the policy interest rate. The ECOWAS member states broadly share these features of underdeveloped and uncompetitive financial systems which constrain the operability of the interest rate channel in the region. However, with recent efforts by most member countries to broaden the array of monetary policy instruments and strengthen monetary policy frameworks, as discussed in Chapter 2, the interest rate channel holds the potential as an active medium for transmitting monetary policy, going forward.

5.2.2.3 Credit Channel

The credit channel is another important mechanism of monetary policy transmission and arises as a result of asymmetric information that inhibits the efficient functioning of credit markets. This channel is known to work through effects on the lending behaviour of banks and through effects on the balance sheets of firms and households, thus giving rise to two sub-channels.

i. Bank lending channel

This channel is grounded on the unique role played by banks in dealing with the problem of asymmetric information in credit markets, by providing loans to bank-dependent borrowers. These often small and medium-sized business entities have little or no access to loanable funds from alternative sources in the credit market. This channel is initiated through monetary policy actions that affect banks' resource portfolios, with the propensity to change both the interests charged on loans or bank lending rate and the volume of loans. In this context, an expansionary monetary policy that ignites an increase in bank reserves and bank deposits will increase the availability of loanable resources at the disposal of the small and medium-sized businesses, thereby supporting investment expenditures. Similarly, increased consumer spending from greater access to loans will raise aggregate demand and foster production. Ultimately, output and employment increase. On the other hand, a monetary tightening will depress output through its effect on bank-dependent borrowers.

The size of the formal financial sector in SSA countries is small and dominated by a handful of commercial banks, effectively constraining the reach of monetary policy actions in significantly impacting aggregate demand. The generally less competitive banking systems and mostly inactive interbank market for liquidity inhibit the pass-through of the monetary policy rate to the bank lending rate. Banks in the region tend to accumulate huge amounts of excess reserves at the central bank as a result of the limited interbank transactions.[81] Instead of extending loans to the private sector, even for bankable projects, banks exercise preference for investing in ‘risk free’ treasury securities. Moreover, the institutional environment in which banks operate in the region, characterised by ineffective governance structures, including pervasive corruption, weak accounting and disclosure standards, and political instability is broadly unfavourable, rendering the cost of financial intermediation high and reinforcing exclusion from the formal sector (see Appendix A.17 on Governance indicators for ECOWAS countries).

In spite of the challenges outlined above which undermine the strength and reliability of the bank lending channel, it appears to be a potentially viable channel of transmission of monetary policy impulses for most SSA economies, including within the ECOWAS. The underdeveloped financial markets, especially the thin credit market, which oblige small and medium-sized enterprises and other economic agents to rely almost exclusively on banks for loanable funds provide theoretical justification of the operability of this channel. From an empirical standpoint, Mishra and Montiel (2012) and Mishra et al. (2012) present an overview of the evidence that points to the potential viability of the bank lending channel in the region.

ii. Balance sheet channel

The Balance sheet channel reflects the impact of changes in interest rate as a result of monetary policy decisions on the net worth of economic agents, mainly firms, and how this

[81] Sacerdoti (2005) estimates that about 30-50 percent of deposits of African banks are held as reserves at the central bank or in the form of short-term foreign assets. Saxegaard (2006) puts the estimate of excess reserves at over 13 percent of deposits for banks in sub-Saharan Africa.

in turn affects the external finance premium[82] the borrower contends with in making decisions about accessing credit. The greater the borrower's net worth, the lower the external finance premium, and vice versa. Given that agents' financial positions affect the external finance premium and thus the overall terms of credit that they face, fluctuations in the quality of their balance sheets are expected to affect their investment and spending decisions. Higher net worth of firms and households implies increased availability of collateral for securing loans and reduced potential losses of banks from adverse selection. The diminished incidence of adverse selection and moral hazard by credit institutions, induces bank lending which in turn increases investment and aggregate output.

As earlier noted, the formal financial sector in most SSA economies is much smaller relative to those of emerging market and advanced economies, implying that business firms relying on formal credit institutions for loanable funds for investment or business expansion are limited. Unlike other channels of monetary transmission, the balance sheet channel has not been subjected to extensive empirical investigations, possibly on account of the relatively restricted access to balance sheet information of banks and firms in the region. It is however evident that monetary policy actions affect the balance sheets of relatively small number of firms in the formal financial sector and thus exerts limited impact on aggregate demand.

5.2.2.4 Exchange rate channel

The exchange rate channel is an important conduit for transmitting monetary policy impulses and of particularly relevance in small, open economies with a flexible exchange rate regime. The transmission of monetary policy actions through the exchange rate is underpinned by the theory of uncovered interest rate parity (UIP) which relates the difference between domestic and foreign interest rate to the expected future changes in the nominal exchange rate. The UIP condition allows the exchange rate to be influenced by monetary policy and thus involves interest rate effects. Within this context, following a rise in domestic real interest rates, domestic currency deposits become more attractive in relation to deposits denominated in foreign currencies. This leads to currency appreciation. The high value of the domestic currency makes domestic goods more expensive than foreign goods

[82] The external financial premium is the wedge between the cost of funds raised externally (by issuing equity or debt) and the opportunity cost of funds raised internally (by retaining earnings).

and causes a fall in net exports and thus aggregate output. This channel is particularly relevant in small, open economies with a flexible exchange rate regime.

Under a fixed exchange rate regime, this channel is subdued as a mechanism for transmitting monetary policy on account of the fact that domestic interest rates closely track foreign interest rates thereby constraining the UIP condition. To that end, an expansionary monetary policy that initially lowers the domestic interest rate raises income, resulting in capital outflows as well as a current account deficit. The central bank's attempt to increase the money supply is unsuccessful as its acquisitions of domestic bonds are offset by its losses of foreign exchange reserves. This imposes a constraint on the monetary authorities' ability to effectively conduct monetary policy.

The effectiveness of the exchange rate channel is largely dependent on the exchange rate regime in place, coupled with the inclination of the central bank to minimize intervention in the foreign exchange market, the degree of openness to capital flows, and the extent of exchange rate pass-through (Taylor 1995). Broadly speaking, the small and open nature of most SSA economies makes the exchange rate channel a theoretically important conduit for monetary policy impulses, provided they do not operate a fixed exchange rate regime. However, the underdeveloped financial markets in the ECOWAS and imperfect integration of domestic markets with international financial markets, as discussed in section 2.4, are serious impediments to foreign participation in domestic financial markets, thereby weakening the exchange rate channel. The limited degree of integration and capital mobility constrain the arbitrage margin between domestic and foreign financial assets on which the UIP condition is built. As a result, monetary policy action that is reflected in a change in the domestic interest rate translates into only a smaller change in the exchange rate.

Within the ECOWAS, two contrasting exchange rate regimes—a fixed exchange rate system and a flexible exchange rate system—operate, with conflicting implications for the relevance of the exchange rate channel of monetary transmission for the region. The fixed exchange rate parity with the euro maintained by WAEMU member countries and Cabo Verde undermines the operability of the exchange rate channel. For countries in the WAMZ which, on the other hand, operate 'de jure' flexible exchange rate regimes there is greater potential for the exchange rate channel to serve as an important conduit of monetary policy impulses.

5.2.2.5 Other Assets Price channel

This channel is viewed as an extension beyond the interest rate and exchange rate channels through which monetary policy affects the economy. It instead examines the effects of monetary policy on the 'universe of relative asset prices and real wealth' (Mishkin, 1995). It captures the impact of monetary policy-induced action on investment and output via changes in the prices of other financial assets, notably equity and bond prices. The two main theoretical mechanisms identified in the literature involve *Tobin's q theory of investment* and *Modigliani life-cycle model.*

With respect to Tobin's q theory of investment[83], monetary policy affects the economy through its effect on the valuation of equities. When the market price of firms exceeds the replacement cost of capital, i.e. high q, firms could expand investment by issuing equity. Conversely, in a low q situation, firms are expected to hold back on new investment. In this context, a contractionary monetary policy that reduces the money supply (or increases interest rate making bonds more attractive relative to equities) lowers equity prices through a decrease the demand for equities. Investment spending is adversely affected resulting in a decline in aggregate output and employment.

With regards *Modigliani's life-cycle model*, monetary policy is said to have the ability to influence the balance sheet of consumers, i.e. their lifetime resources or wealth, through changes in equity prices. By relaxing monetary policy, for example, equity and property prices increase, thereby raising the lifetime resources of consumers and increasing consumption and consequently expanding output.

The Other assets price channel is active and reliable in advanced economies with well-functioning and highly liquid markets for equities and real estate. However, for LICs in general and SSA in particular, most economies are characterised by either non-existent or illiquid markets for equities and real estate. Even in instances where the stock market has been established, there often only a small number of listed companies and the stock market capitalisation as a ratio of GDP is quite low. In the WAEMU, the regional stock exchange, BRVM, has a market capitalization ratio of less than a quarter that for advanced economies over the period 2014 – 2016 (Figure 2.13). A broadly similar picture obtains for Cabo Verde, Ghana, and Nigeria, though continued efforts are being made to promote development of

[83] Tobin's q is defined as the market value of firms divided by the replacement cost of capital (Tobin, 1969).

their stock markets. For Sierra Leone, there has been limited stock market trading since its inception in 2009. The rudimentary state of securities markets in these countries severely weakens the Other assets prices channel.

Moreover, in SSA economies transactions in long-term bonds are infrequent at least relative to what obtains in advanced economies with highly developed and well-functioning financial markets. As a result of the scarcity of long-maturing assets, the wealth effects which operates through changes in the value of these assets are likely to be weaker (Kamin et al. 1998). Lastly, the real estate market in SSA countries is generally poorly developed and highly illiquid, partly on account of the weak or non-existent institutional framework and policy, such as appropriately-defined property rights required to promote the buying and selling of real estate. Under these circumstances, the strength of the Other assets price channel is diminished.

5.2.2.6 Expectations channel

The role of inflation expectations in determining the effectiveness of monetary policy action in attaining its ultimate objective has assumed growing significance over the years. With the mainstreaming of the rational expectations theory, economic agents are presumed to make business decisions on the basis of their rational outlook of the economy, in addition to available information and past experiences. As such, inflation expectations could exert immense influence on future inflation outcomes by directly altering pricing decisions. Firms' expectations of costs and revenue streams are crucial in determining prices and their production capacity going forward. Workers undertake negotiations with firms on future wages in a forward-looking manner, on the basis of their perception of price developments. And households make consumption and savings decisions which influence their future consumption possibilities. In a similar vein, expectations of future changes in interest rate affect medium and long-term interest rates.

The expectations channel is known to transmit monetary policy signals more effectively in advanced economies where financial markets function efficiently and the central banks possess a high degree of credibility. While in SSA the authorities have over the years taken steps to enhance the autonomy of the central bank and strengthen their statutes, including by establishing monetary policy committees and strengthening statutory legislation to protect the tenure of Bank Governors, central banks continue to significantly lag behind counterpart institutions in advanced economies in terms of independence. Various measures of central bank independence, including by Arnone et al. (2006), point to the relative disparity between advanced economies and LICs. In the absence of a high level of central bank credibility, the expectations channel becomes weak as the central bank's ability to effectively anchor economic agents' expectation of future inflation is somewhat eroded. In fact, measures of inflation expectations, often survey-based, are mostly absent for ECOWAS countries.

5.2.2.7 Summary and Research Implications

The foregoing analyses underscore the fact that the impact of the central bank's monetary policy actions on the real economy is initiated either through changes in the short-term interest rates or the monetary base, and that the effectiveness of both monetary policy instruments is dependent on key underlying assumptions. Paramount among these assumptions is the existence of some degree of nominal price rigidity required to prevent instant and proportional price adjustment that would either cancel out the changes in the monetary base or inhibit changes in the nominal short-term interest rate from fully translating into changes in the real interest rate crucial in investment spending decisions. In addition, for changes in the monetary base to exert the desired impacts, the central bank should have monopolistic control over the monetary base for which no perfect substitutes exist.

The monetary base continues to serve as the operational instrument in a number of developing countries, including within the ECOWAS region, but has been abandoned by most developed and emerging market economies in favour of the short-term interest rate. The increasing preference for short-term interest rate arises from the unpredictability of money demand on which the monetary targeting framework is predicated. This is consistent with Poole's (1970) analysis that associates an economy's capacity to respond to random shocks with the operational tool employed in the conduct of monetary policy. It recommends that in order to insulate output and prices from large and unpredictable money demand shocks, short-term interest rate should be adopted as the appropriate policy instrument.

However, from a practical operational standpoint, monetary policy actions are initiated through open market operations that result in a change in the monetary base. In this context, the monetary base continues to be employed as the policy instrument in examining the transmission of monetary policy impulses and its impact on aggregates demand, including in the case of developed economies in instances where the short-term nominal interest rate hits the zero-lower bound. Against this backdrop, as discussed in section 5.4.2 below, this study utilises the monetary base as the policy instrument in examining the impact of a common monetary shock on real output and inflation within the ECOWAS.

The above analyses also reveal that generally in developing countries, the weak policy and institutional framework, underpinned by underdeveloped financial markets and low central bank policy credibility, undermine the operability of most traditional channels of monetary transmission. In this regard, the interest rate channel, the other assets prices channel and the expectations channel are mostly dysfunctional. The importance of the money channel has continued to dwindle as a result of increasing financial innovation in SSA economies and the instability in the money velocity. The bank lending conduit of the credit channel is a potentially active transmission channel in these economies given the characteristic information asymmetries in the credit market and the prevalence of bank-dependent business enterprises. Lastly, as most SSA countries are small, open economies, the exchange rate channel is a theoretically important conduit for monetary policy impulses provided the country or group of countries do not operate a fixed exchange rate regime. However, the effective functioning of the exchange rate channel is constrained by the underdeveloped financial markets and risks arising from often unstable macroeconomic environment which limit foreign participation in domestic financial markets, thereby inhibiting arbitrage inherent in the UIP conditions from being fully realised.

5.3 Empirical literature on monetary transmission in Monetary Unions

The large body of studies on the monetary policy transmission mechanism, especially at the individual-country level, has motivated extensive review of the empirical literature over the years. However, a significant proportion of these studies focus on work on advanced economies and, to a lesser extent, emerging market economies. Unlike the majority of research papers which have concentrated on individual-country studies, this review attempts to provide an extensive and systematic coverage of the empirical literature on studies on the monetary policy transmission mechanism undertaken within the context of regional monetary and economic integration.[84] This is expected to inform model specification and the empirical methodology employed in this study. To this end, the review focuses on the

[84] Britton and Whitley (1997), Kieler and Saarenheimo (1998), and Altavilla (2000) limit their review of the empirical literature to the EMU.

following current and planned economic and monetary arrangements: European Economic and Monetary Union (EMU); Gulf Cooperation Council (GCC); East African Monetary Union (EAMU); Central African Economic and Monetary Union (CEMAC); and the ECOWAS region, covering the West African Economic and Monetary Union (WAEMU) and the West African Monetary Zone (WAMZ).

5.3.1 European Economic and Monetary Union (EMU)

The monetary transmission mechanism in the EMU has been the subject of substantial research, both prior to and since the formation of the Euro area in 1999. These studies have employed wide-ranging empirical strategies which have evolved over time. The methodologies could be categorized into four broad groups, namely: Single equation models, Small-to-medium sized structural models, Large-scale macroeconometric models, Dynamic Stochastic General Equilibrium (DSGE) models and Structural vector autoregressive (VAR) models.

The single equation model approach involves the estimation of models consisting of a single equation in which the variable representing the policy objective, say output or inflation, is regressed against exogenous explanatory variables, including the policy instrument. Dornbusch et al. (1998) adopted this approach by estimating output equations and central bank reaction functions for Germany, France, Italy, Spain, United Kingdom, and Sweden. They uncovered asymmetries in the impact of the EU-wide policy change on real output and unequal cost of disinflation across the countries. Also, Favero et al. (1999) employed ordinary least squares (OLS) methods, with heteroscedastic-consistent standard errors, to examine possible asymmetries in the monetary transmission mechanism in the EMU. Using micro data obtained from bank balance sheets from a sample of 651 banks from four EU states—France, Germany, Italy and Spain—the study found significant differences across countries and even across banking institutions in their ability to effectively respond to a squeeze in liquidity. The single equation estimation approach adopted in these studies is, however, not appropriate for effectively capturing macroeconomic responses to policy changes over time. It is faced with the daunting problem of improper identification of the monetary policy shock to measure the real impact of policy[85].

[85] Cochrane (1994) presents a detailed critique of this approach.

Small-to-medium-sized macroeconomic models have also been developed to evaluate the effect of policy shocks on the real side of the economies in the EMU. These are structural models with theoretical underpinnings and used to be employed in policy research by central banks including the Bank of England. In their basic form, these models often comprise four equations— money demand, IS curve, uncovered interest rate parity, and Phillips curve— for four key variables (aggregate demand, aggregate supply, the money stock, and the exchange rate). Britton and Whitley (1997) estimated such small structural model for the United Kingdom, France and Germany to investigate possible structural differences in the response of output and prices to changes in monetary policy. The study found no marked differences in the response of output or inflation to a common change in policy interest rates. Similar models are estimated by Coenen and Wieland (2000) and Fagan et al (2001). While this approach has been appealing to policymakers, a major shortcoming is their high level of aggregation that constrain them from effectively capturing cross-country differences in economic structure. In other words, the parsimonious specification of these models in terms of the number of variables might limit their effectiveness in identifying important features at the micro level.

The Large-scale macroeconometric models are built on established economic relationships and involve policy simulations to uncover the monetary transmission mechanism. Two types of these models have often been distinguished[86]: Single-country models and Multi-country models. The single country models are estimated independently at the national level and the results are compared across countries. Smets (1995) reported the outcome of a BIS study on simulations using the single-country models approach to, among others, compare the effects of changes in the short-term nominal interest rates on output and prices in Germany, France, Italy, and the United Kingdom. Almost identical responses to the monetary shock were found in all countries, with the exception of the United Kingdom. A key downside to this approach is the lack of effective comparability given the often-different model specifications across the sample countries. The multi-country model approach, on the other hand, involves applying similar modelling strategy and imposing similar structure across the countries in the sample. Studies in this regard include Els et al. (2001) which examined the effects of common monetary policy using large-scale models at the disposal of the ECB and the National Central Banks (NCBs) of the Eurosystem. The results, among others, uncovered

[86] See Britton and Whitley (1997) and Kieler and Saarenhiemo (1998)

differences in the magnitude and timing of the effects of policy across a sample of twelve euro area economies. Employing the Mark III version of an econometric model of the IMF, the MULTIMOD, Hallett and Piscitelli (1999) found significant asymmetries in the transmission of a common monetary policy across the four main European economies—Germany, France, United Kingdom and Italy.

Researchers have also increasingly utilized Dynamic Stochastic General Equilibrium (DSGE) models[87] to analyze the transmission mechanism in the Euro area and to examine possible asymmetries in the responses to a policy shock. Early research in this regard could be traced back to the work of Smets and Wouters (2002) in the immediate period following the launch of the Euro. Applying a 100-basis point increase in the policy interest rate through a common simulation experiment of 12 EU countries, output and prices contracted at the aggregate level. However, the magnitude and timing of the impacts and the relative contributions of the transmission channels varied across the countries. The SIGMA model of the Federal Reserve Board, the Global Projection model of the IMF, and the EAGLE model at the ECB, are examples of these models (Canova and Ciccarelli, 2013, p. 4). A major downside of these models is that they are built on several restrictions, which are often not in line with the statistical properties of the data. As such, their policy prescriptions are ingrained in the assumptions of the model, and ‘must be considered more as a benchmark than a realistic assessment of the options and constraints faced by policy makers in real world situations’ (Canova and Ciccarelli, 2013 p. 5). Moreover, there are significant challenges in building and executing these macroeconomic models (McAdam and Morgan, 2001), particularly in a developing and open economy context.

A widely employed empirical technique in research aimed at understanding the transmission of monetary policy impulses and identifying possible asymmetries across countries is Vector Autoregressive (VAR) modelling.[88] Several studies prior to and following the inception of the EMU utilized VAR technique, including Ehrmann (1998), Montecelli and Tristani (1999), Peersman and Smets (2001), and Mojon and Peersman (2001). Using either individual-country data or ‘synthetic’ area-wide aggregates, these studies found contrasting

[87] These are microfounded dynamic equilibrium models used to explain aggregate economic phenomena and are built using optimizing agents, often with the assumptions of rational expectations and market clearing.
[88] This is motivated by the seminal work of Sims (1980, 1992) in developing the VAR estimation technique which provides an appropriate framework for investigating the transmission of monetary policy impulses and the response of objective variables to a monetary policy shock.

evidence on the impact of monetary policy on inflation and output in the euro area. More recent application includes Caporale and Soliman (2009) which examined the monetary transmission mechanism in six EU member states—Austria, Denmark, France, Germany, Netherlands, and Italy—and found that a common monetary shock has asymmetric effects on the member states, with differences in terms of the timing and depth of the responses. They also observed that some monetary transmission channels might be more important in some countries relative to others, with smaller countries being more sensitive to monetary policy shocks. Ciccarelli et al. (2013) estimated recursively a VAR model for a panel of 12 Euro area economies and finds that the monetary transmission mechanism has been time-varying and that the impact of monetary policy on aggregate output was stronger during the 2007/08 financial crisis.

Research on the Euro area has explored with variants of the traditional VAR methodology that sought to capture additional elements aimed at improving the model estimation. These procedures have included Factor Augmented VARs (FAVAR), Global VARs (GVAR), and Bayesian VARs (BVAR). The FAVAR, pioneered by Stock and Watson (1999) and later built upon by Bernanke et al. (2005), is an augmentation of the traditional VAR model through the use of factor extracting techniques to reflect additional information from a larger set of time series relevant to the policymaker. This approach is motivated by the view that the traditional VARs do not reflect the depth of information considered by monetary authorities in making policy decisions, thereby rendering measurement of policy innovations flawed. Boivin et al (2008) employed the use of a FAVAR model to examine the evolution of the monetary transmission mechanism in the euro area prior to and since the introduction of the euro in 1999. Utilizing 33 economic variables from the six largest euro area economies, the study uncovered evidence of important heterogeneity in the effect of monetary shocks across countries prior to the introduction of the Euro. However, it observed greater homogeneity of the transmission mechanism across the countries following introduction of the euro. Other studies that have applied the FAVAR approach to understanding the transmission mechanism within the euro area include Blaes B, (2009) and Soares R. (2011). While the FAVAR approach benefits from increased degrees of freedom and estimable impulse responses for a large set of variables, the factors and therefore the estimated system, do not have clear economic interpretation.

The other variant of the traditional VAR, the GVAR, is considered appropriate for examining the impacts of the propagation of shocks within the economic area and the spillovers of these shocks across borders. This involves augmenting the traditional VARs with foreign variables known to exert cross-border influences. Georgiadis (2015), for example, assembled a mixed cross-section global VAR model that incorporates all Euro area economies individually while at the same time modelling their common monetary policy as a function of Euro area aggregate output growth and inflation. The study finds that the transmission of monetary policy across Euro area economies displays asymmetries, and that, in line with economic theory, these are driven by differences in the structural characteristics of the economies. Gross et al. (2016) also applied the GVAR technique to examine the propagation of shocks to bank leverage on real activities within EU member countries; while Jannsen and Klein (2011) investigated the effects of the transmission of euro area monetary policy shocks on other western European countries. A key shortcoming of the GVAR approach is that generated impulse responses are non-orthogonalized and thus economically meaningless, rendering the identified shocks inappropriate for analyzing the impact of macroeconomic responses to policy shocks.

The BVAR employs Bayesian method to address the problem of overfitting in traditional VAR models caused by their often-generous parametrization. This is done by shrinking the parameter space using prior information on VAR coefficients. Ciccarelli and Rebucci (2002) examined the transmission mechanism in the EMS and concludes that there is some degree of heterogeneity in the European transmission mechanism. Mandler et al. (2016) employed a large multi-country BVAR to empirically analyze whether the Eurosystem’s common monetary policy has heterogeneous effects on the four large member countries—France, Germany, Italy, and Spain. The results reveal cross-country differences in the transmission of monetary policy shocks to macroeconomic aggregates, notably output and prices. In the BVAR approach, however, there is no recovery of the structural shocks or dynamics, as the units within the panel are made to respond to innovations in the observables (Pedroni 2013, p. 182).

5.3.2 Gulf Cooperation Council (GCC)

As member states of the GCC work towards forming a monetary union, a handful of recent studies has sought to examine the channels through which monetary policy is transmitted within the Council and the strength of impact of policy actions on aggregate demand. These studies have utilized the structural VAR methodology, including within the panel framework to overcome the unreliability of estimates obtained on the basis of time series of insufficient length.

Espinoza and Prasad (2012) adopted the panel VAR approach to examine the channels of monetary policy transmission in the GCC and estimated the extent of pass-through from policy rates to domestic deposit and lending rates. The study finds that unanticipated changes to broad money impact prices but exert no significant influence on GDP (non-oil). U.S. monetary policy was found to have strong and statistically significant impact on key macroeconomic aggregates in the region, though there are asymmetries in the behaviour of interbank rates in individual GCC countries relative to the US interbank rates. Using the traditional VAR technique, Cevik and Teksoz (2012) investigated the effectiveness of monetary policy transmission in the GCC. The interest rate and the bank lending channels were found to be relatively effective in transmitting monetary policy impulses. Asymmetries were observed across member countries in the response of domestic prices to supply shocks. Given that supply shocks explain a large proportion of the variation in non-hydrocarbon GDP, the study concluded that in order to benefit from monetary integration, the region should ensure a high degree of non-hydrocarbon business cycle synchronization.

5.3.3 East African Monetary Union (EAMU)

A few research studies have been conducted aimed at investigating the strength of monetary policy transmission in the EAC member states in the context of the proposed monetary union. These studies have mainly employed the VAR approach, with some exploring with variants of the technique. One such study is Davoodi et al. (2013) which applied the structural VAR, the BVAR and the FAVAR to examine the monetary policy transmission mechanisms in the partner countries of the EAC. Their findings indicate that the monetary transmission mechanism in these countries is weak and that the transmission channels and their importance differ across countries. In addition, it observed that the instruments often used to conduct monetary policy in the region, reserve money and the policy rate, may have offsetting impacts on inflation and thus underscoring the need for effective harmonization of monetary policy frameworks. Buigit (2009), for its part, used a vector error correction model (VECM) approach to assess the similarity of transmission mechanism in the EAC. The results indicate that the interest rate channel may not be so important, and thus the interest rate mechanism is unlikely to be a source of asymmetry in the proposed monetary union.

5.3.4 Central Africa Economic and Monetary Union (CAEMU)

With monetary policy in the union formulated by a common central bank, BEAC, the impact of the common monetary policy on the real sector of member countries is an important element in policy decision making. A number of studies has been done by the central bank and the IMF examining the channels of monetary transmission and the magnitude and speed of impacts of policy on aggregate demand. Most of these studies employed the structural VAR approach. IMF (2015) examined the effectiveness of monetary policy in the zone by estimating two sets of VARs, using two different policy instruments—the policy rate and the monetary base. The results revealed that the interest rate channel was ineffective, whereas changes to the monetary base significantly impacted inflation. Bikai and Kenkouo (2015), for their part, estimated a VAR model for each country in the CAEMU region and a panel VAR for the region as a whole. Their findings confirm overall weaknesses in the transmission of monetary policy, though there were asymmetries across the member countries.

5.3.5 Economic Community of West African States (ECOWAS)

Empirical research on the ECOWAS, in the context of monetary integration, is scanty and has focused predominantly on the sub-monetary groupings, the WAEMU or the WAMZ. With respect to WAEMU, Kireyev (2015) examined the effectiveness of the channels of monetary transmission applying a Distributed Lag (DL) modelling procedure and a panel interaction VAR approach. The DL sought to establish dynamic causal effects from changes in the policy rate to other interest rates and inflation, whereas the panel interaction VAR examined asymmetries in monetary transmission across member countries by allowing the responses of the inflation rate and the lending rate to vary with the structural characteristics of each country. The results found asymmetries in the size and impact of the policy rate on inflation and the other interest rates across member countries. It attributes the differences in the effectiveness of transmitting monetary impulses to variations in the extent of financial development and the degree of competition in countries' financial sectors.

On the WAMZ, the empirical literature is weak at best, with hardly any studies examining potential asymmetric effects on the member states from a common monetary policy. Instead, the majority of the research has focused on determining whether the zone is an optimum currency area, in line with the traditional theory postulated by Mundell (1961) and his followers. These studies have mostly analysed the extent of macroeconomic convergence within the zone (Balogun, 2009; Cham, 2010; and Asongu, 2014). Harvey and Cushing (2015) investigated the sources of shocks and shock symmetry across five of the six countries in the WAMZ by employing the VAR technique and analyzing the linear dependence and the feedback between the structural shocks. The results suggest that countries in the region do not respond symmetrically to supply, demand and monetary shocks, and as such the study concludes that the region lacks ex-ante convergence to form an optimum currency area.

At the country-specific level, the studies on the monetary policy transmission in the WAMZ reveal that generally the transmission channels are weak, particularly the interest rate channel. The credit channel is found to be most important in transmitting monetary policy impulses to the real economy. In the case of Nigeria, Chuku (2009) employed the SVAR approach to examine the effects of monetary policy innovations on output and prices. Following the recursive identification strategy proposed by Christiano et al. (1998), the study experimented with three alternative policy instruments – broad money, minimum rediscount rate and the real effective exchange rate. The results indicate that the quantity-based nominal anchor (broad money) exerted modest impact on output and prices, whereas the effects of the price-based anchors were neutral. Ndeku (2013), on the other hand, investigated the channels of monetary policy transmission in Nigeria by adopting a VAR with dynamic logarithmic form and OLS methods. The study found that the credit channel in the financial market for credit supply and accessibility to the private sector provide the effect of a linchpin in the process by which monetary policy transmit to the real economy.

On Ghana, Kovanen (2011) investigated the interest rate pass-through of monetary policy in Ghana. Employing regression and VAR approaches, the study analysed the effect of changes in the monetary authorities' interest rate (the prime rate) on short-term wholesale market interest rate and the pass-through to retail deposit and lending interest rates. The responses of changes in the policy interest rate were found to be gradual in the wholesale market, while in the retail market the pass-through to deposit and lending interest rates is protracted and incomplete. An earlier work by Ghartey (2005) examined the impact of monetary policy on the term structure of interest rates in Ghana and reported significant effect on the treasury bills rates.

Ogunkula and Tarawalie (2008) employed the VECM estimation framework to examine the monetary policy transmission mechanism in Sierra Leone using quarterly data covering the period 1990 to 2006. Adopting a recursive identification scheme with the monetary policy variable, i.e. the treasury bills rate, ordered last, the study uncovered a significant impact of monetary policy shock on private sector credit and real output. The finding underscores the importance of the banking lending channel as a conduit for transmitting monetary policy impulses to the real economy. The interest rate channel was found to be ineffective, whereas inflation was significantly impacted by monetary shock via the exchange rate channel.

5.3.6 Summary and Research Implications

As evident from the above review, a significant proportion of the empirical research on the monetary policy transmission mechanism in monetary and economic unions has been undertaken on the EMU, both prior to the establishment of the ECB and since its inception. Various empirical methodologies have been adopted, ranging from large-scale macroeconomic models to the more commonly used VAR technique and its variants (FAVAR, GVAR, and BVAR). The studies have produced contrasting results on the impact of the single monetary policy on member countries, though some evidence point to increasing symmetry of shocks since the inception of the ECB. Studies on other monetary or economic blocks or prospective arrangements are quite limited. In SSA, there are a few recent studies that have assessed the effectiveness of the common monetary policy in the CAEMU and the proposed monetary union in the EAC. In the ECOWAS, a significant gap exists with no evidence of research studies focusing on monetary transmission within the prospective monetary union. The handful of studies have concentrated on the sub-monetary groupings, with some seeking to determine whether the zone is an OCA by examining the degree of macroeconomic convergence.

The review of the empirical literature has highlighted the significant dearth in research in the ECOWAS to support the process of harmonization of monetary policy and inform policy formulation at least at the inception and in the period immediately following establishment of a common central bank. This is in sharp contrast with the EMU whereby a large volume of research was conducted in the run-up to the formation of the ECB and continues to inform policy. The review also revealed that a majority of the studies on the monetary transmission mechanism in the context of monetary integration have employed the VAR modelling technique. This provides some justification for adopting the VAR methodology in this study.

5.4 Methodology, Data and Shock Identification

This section outlines the methodology employed in this study, the selection of sample and the data definitions and sources. It also presents the strategy for identifying the structural shock in the VAR model.

5.4.1 Methodology

Structural VAR modelling has been widely employed in examining the transmission of monetary policy impulses both within economies and across economic borders. The technique has been frequently applied in the context of monetary unions to investigate the existence of asymmetric effects of monetary policy transmission on member countries, as discussed in detail in section 5.3 above. A large proportion of these studies on monetary unions utilize the technique to conduct individual country estimations and compare the estimated coefficients or impulse response functions. Employing such an approach is prone to several downsides that may question the veracity of the results and undermine its relevance for policy purposes. To start with, in instances where the length of the time series data for some countries in the sample is relatively short, applying the structural VAR approach might render the estimation results inconsistent. In addition, as the data for some of the countries in the sample might be noisy or fraught with compilation issues, the individual country estimation approach may also result in unreliable estimates.

To help mitigate these potential challenges, this study adopts a panel structural VAR approach to assess the potential impact of a common monetary policy on the member states of the ECOWAS. The panel structural VAR method is well suited for multi-country estimations given its strength in addressing the problem of inconsistent estimates and potentially misleading inferences that could arise by applying the VAR procedure to individual country time series data of insufficient length. In other words, the panel SVAR approach exploits both the time series and the cross-sectional dimensions of the data thereby allowing for a larger number of observations that ensures consistency.[89] More specifically,

[89] Canova and Ciccarelli (2013) presents a survey of Panel VAR models

this study employs the dynamic heterogeneous panel structural VAR technique developed by Pedroni (2013).[90]

This panel structural VAR technique offers a number of important advantages. To start with, it allows for heterogeneous member country specific dynamics and produces consistent estimates of not only the average dynamic effect of policy shocks but also other moments of distributions of impulse responses, including median and interquartile ranges. Most conventional panel SVAR methods assume homogeneous dynamics among the members of a panel and often proceed using a pooled estimation approach. The problem with these conventional approaches is that the presence of dynamic heterogeneity in the panel units renders the pooled estimator inconsistent owing to fact that the regressors are correlated with the error term (Canova and Ciccarelli, 2013, p.15). Importantly, the Pedroni (2013) panel structural VAR technique exploits the cross-sectional dependencies in the panel series to identify common shocks which affects all the cross sections. By so doing, it determines member specific responses to both common shocks—shocks impacting all member countries—and idiosyncratic shocks—shocks predominantly affecting only a single country. This capability makes the Pedroni (2013) structural VAR technique particularly suited for this study, in view of its overarching objective of investigating the responses of member countries of the prospective monetary union to a common monetary policy shock. Recent application of this technique includes Mishra et al. (2014), Verdugo-Yepes et al. (2015), and Feasal Kumazama (2017).

The empirical strategy involves first, analysing the impulse responses generated from the individual country VAR estimations and assessing their stability to ensure validity of the dynamic responses to the structural shocks. Next, the responsiveness of real GDP and inflation for each member country of the proposed union to a common monetary policy shock is investigated. Lastly, the panel responses to the common monetary policy shock at the level of ECOWAS are examined. In this regard, in addition to the impact of the common shock on aggregate demand as reflected in the objective variables (real GDP and inflation), the viability of the bank lending channel and the exchange rate channel (found to be the more plausible channels of monetary transmission in the region, as discussed in section 5.2 above) is investigated by incorporating the relevant financial transmission variables (bank lending

[90] Recent application of this technique includes Mishra et al. (2014), Verdugo-Yepes et al. (2015), and Feasal Kumazama (2017)

to the private sector and the nominal exchange rate, separately, into the baseline VAR model presented in section 5.4.2.2 below). Robustness of the country-specific impulses responses of the baseline model is tested by applying a viable alternative shock identification strategy based following the short-run recursive scheme. For the panel response estimates, robustness is investigated through alternative model estimations that include a viable alternative ordering of the baseline VAR model and the extended 4-variable VAR model. All impulse response functions are computed over a period of 16 quarters.

5.4.1.1 General VAR model formulation

The standard VAR model provides a systematic framework for capturing the rich dynamics in multiple times series. The model expresses each endogenous variable as a linear function of its own past values, the past values of all other endogenous variables in the model and an error term. The general formulation of a traditional VAR model takes the following form:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + \varepsilon_t \qquad (1)$$

where y_t is a column vector of observations at time *t* on all the endogenous variables in the model and the $A_i s$ are (n x n) coefficient matrices. ε_t is a column vector of random disturbance values, which may be contemporaneously correlated with one another but assumed to be non-autocorrelated over time.

The structural form of the VAR model in equation (1) is represented as follows:

$$A_0 y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + u_t$$

or written more compactly as

$$A_0 y_t = A(L) y_t + u_t \qquad (2)$$

where y_t is the *m x 1* vector of endogenous variables and A_0 is an *n x n* matrix with 1's on the diagonal and contains the structural parameters that capture the contemporaneous relations among the endogenous variables. u_t is the vector of the structural shocks that are independent or orthogonal. u_t has unit variance with corresponding variance-covariance matrix represented as $E[u_t u_t']$. $A(L)$ is the lag operator.

Estimation of the structural model in equation (2) cannot proceed directly given the correlation between the endogenous variables and the error terms. Assuming A_0 is invertible, the structural equation is transformed into reduced form equations that could be estimated by pre-multiplying equation (2) by A_0^{-1}.

$$y_t = B(L)y_t + \varepsilon_t \tag{3}$$

where $B(L) = A_0^{-1}A(L)$ and $\varepsilon_t = A^{-1}u_t$. Matrix A thus relates the forecast errors of the reduced form VAR, ε_t, and the structural shocks, u_t, whereby the forecast errors are linear combinations of the structural shocks.

The elements of $B(L)$ can be estimated consistently using OLS, an estimate of the elements in A_0 is required to map out the effect of the structural shocks on the dynamic responses of the variables in the model. To obtain A_0, the estimate of the variance-covariance matrix of the reduced-form residuals, $\hat{\Omega}$, is needed to provide the required restrictions on the elements of A_0. $\hat{\Omega}$ is an *n x n* symmetric matrix and thus contains $n(n+1)/2$ distinct elements. To estimate all the elements of A_0, the number of restrictions on its n^2 elements should equal the number of restrictions on the elements of $\hat{\Omega}$, implying an additional $n^2 - n(n+1)/2 = n(n-1)/2$ restrictions to ensure proper identification.

5.4.1.2 The dynamic heterogeneous panel structural VAR framework

The panel VAR formulation is derived from the VAR representation in equation 1 above, with an increased cross-sectional dimension, where each cross section is observed over time. The general representation of the panel VAR model is:

$$y_{i,t} = A_{1,i}Y_{t-1} + ... + A_{p,i}Y_{t-p} + \varepsilon_{i,t}, \tag{4}$$

where $y_{i,t}$ represents the K x 1 vector of endogenous variables for country i and $Y_t = (y'_{1,t}, y'_{2,t}, \ldots\ldots, y'_{N,t})'$ denote the (N. K X 1) vector of stacked $y_{i,t}, i = 1, \ldots\ldots, N$.

Drawing from this panel representation, Pedroni (2013) proposed a dynamic heterogeneous approach to estimate the panel structural VAR which accommodates dynamic heterogeneities and cross-sectional dependencies that are characteristic of multi-country panels.[91] The approach exploits the heterogeneity among member countries to model the country-specific dynamic responses to unobserved shocks both at the individual country level and at the regional level. Using orthogonality conditions arising from conventional structural VAR identification, unobserved structural shocks (composite shocks) are efficiently decomposed into shocks that are common to all members of the panel (common shocks) and shocks that are member specific (idiosyncratic shocks). This decomposition allows each member of the panel to respond in its own specific way to the idiosyncratic and common shocks. The common shocks are inferred by using time effects or cross-sectional averages of the member countries in the panel sample. Pedroni (2013) shows that the methodology works quite well in panels comprising units with relatively short time series data and also accommodates unbalanced panels.

In line with Pedroni (2013), the dynamic representation of our model consists of a panel comprising $i = 1, \ldots\ldots, N$ member countries, with each country having M x 1 vector of observed endogenous variables, $y_{i,t}$, for $y_{m,it,} m = 1, \ldots\ldots, M$. Given that the panel series is unbalanced, the variables are observed over the time periods $t = 1, \ldots\ldots, T_i$.

In order to deal with country-fixed effects, the estimation proceeds using demeaned data. The M x 1 vector of demeaned data, $z_{it} = y_{it} - \bar{y}_i$, where $\bar{y}_{m,it} = T_i^{-1} \sum_{t=1}^{T_i} y_{m,it} \forall i, m.$

From the demeaned data, the time effects or cross-sectional averages of the data are computed after differencing the data. That is, $\Delta \bar{Z}_t = N^{-1} \sum_{i=1}^{N_t} \Delta Z_{it}$.

To recover the unobserved common structural shocks, reduced form VARs are first estimated separately for each member country using the computed time effects, such that

91 Traditionally, homogeneity of the parameters is assumed, with the parameters estimated jointly with fixed effects.

$\overline{R}\,(L)\Delta\bar{z}_t = \overline{\mu}_{it}$ where $\overline{R}(L) = I - \sum_{j=1}^{\overline{P}_i} \overline{R}_{ij}^{L}$ is standard polynomial lag operator. The country specific lag truncation, P_i, is fitted to the model using an appropriate information criterion.[92] An appropriate structural shock identification strategy, in line with the SVAR literature (see Kilian, 2011) , is then applied towards obtaining the common structural shock, $\bar{\varepsilon}_{it}$. The short-run recursive identification strategy applied in this study is discussed in detail in section (5.4.3) below.

Next, is the recovery of the unobserved composite structural shock. Following the same procedure as above, the reduced form VAR is estimated for each member country based on ΔZ_{it}, such that $R_i(L)\Delta z_{it} = \mu_{it}$, with $R_i(L) = I - \sum_{j=1}^{P_i} R_{ij}^{L}$ as the polynomial lag operator. An appropriate information criterion is used to specify the lag truncation, Pi, for each member country. By imposing the identification strategy, the composite structural shocks, ε_{it}, are recovered.

Consistent with orthogonality of structural shocks in the SVAR literature and the cross-sectional dependence of the shocks, Pedroni (2013) shows that a common factor representation could be derived, whereby $\varepsilon_{m,it} = \lambda_{m,i}\bar{\varepsilon}_{m,t} + \tilde{\varepsilon}_{m,it} \forall i,t,m$ where $\bar{\varepsilon}_{m,t}$ are the common structural shocks and $\tilde{\varepsilon}_{m,it}$ are the country-specific idiosyncratic shocks. $\lambda_{m,i}$ are the country-specific loading coefficients for the common shocks. In other words,

$$\varepsilon_{it} = \Lambda_i \bar{\varepsilon}_t + \tilde{\varepsilon}_{it} \tag{5}$$

with $\varepsilon_{it} = (\bar{\varepsilon}_t' + \tilde{\varepsilon}_{it}')'$ and Λ_i an M x M diagonal matrix of country specific loadings depicting the relative importance of the common shock for a particular country.

Both Λ_i and $\tilde{\varepsilon}_{it}$ (the idiosyncratic shock) are estimated consistently by OLS individually for each country.

[92] Pedroni (2013) employs the general to specific (GTOS) method that sequentially applies the likelihood ratio (LR) test on the lags until a truncation that is significant and sufficiently large to ensure that μ_{it} is i.i.d white noise is attained.

From the unobserved vector of structural shocks, ε_{it} , a stationary moving average representation could be derived, in line with the Wold decomposition theorem, whereby,

$$\Delta Z_{it} = A_i(L)\varepsilon_{it} \tag{6}$$

where : $A_i(L) = \sum_{j=0}^{Q_i} A_{ij} L^j$ is the member country specific response to the composite shock.

$\overline{A}_i(L) = \sum_{j=0}^{\overline{Q}_i} \overline{A}_{ij} L^j$ is the member country specific response to the common shock**.**

$\widetilde{A}_i(L) = \sum_{j=0}^{\widetilde{Q}_i} \widetilde{A}_{ij} L^j$ is the member country specific response to idiosyncratic shocks.

The above structural impulse responses provide evidence of the magnitude and the duration of impact of monetary policy shocks on the key objective variables, real GDP and inflation. These shocks are either country-specific idiosyncratic shocks or shocks that are common to all member countries. Of particular importance to this study is the latter, i.e $\overline{A}_i(L)$, which represents the response of the ECOWAS member countries to a common monetary policy shock.

Finally, the sample distribution of the estimated impulse responses i.e. $A_i(L)$, $\overline{A}_i(L)$, $\widetilde{A}_i(L)$, are computed to describe the properties of the sample, including the median, mean and the confidence interval quantiles. These moments of the distribution of impulse responses provide an indication of the responses of the ECOWAS member countries as a panel to the unanticipated monetary policy shock.

5.4.2 Data

5.4.2.1 Sample Selection

The study employs quarterly frequency data covering the period 1994Q1 – 2016Q4. The starting point of the data is chosen to mitigate the impact of significant structural breaks in the ECOWAS region that has the propensity to undermine the reliability of the response estimates. Firstly, the late 1980s through to the early 1990s witnessed important monetary structural transformation in the region that entailed a policy shift from direct monetary management to a system of indirect market-based monetary management, with distortionary implications for the monetary policy transmission mechanisms of member countries. Second, the choice of the start date insulates the analyses from the structural break caused by the devaluation of the CFA Franc in January 1994 to correct severe macroeconomic imbalances that had pervaded WAEMU member countries. [93] The end date of 2016 is chosen to maximize data availability for ECOWAS member countries.

The sample consists of a total of twelve (12) member countries of ECOWAS, comprising five (5) countries from the WAMZ—The Gambia, Ghana, Guinea, Nigeria, and Sierra Leone—and seven member countries of the WAEMU—Benin, Burkina Faso, Cote d'Ivoire, Mali, Niger, Senegal and Togo.[94] The WAEMU operates a common monetary policy for all its member countries, whereas WAMZ countries have, since the establishment of the zone, followed a path towards macroeconomic convergence. Given the number of cross-sectional units (12) included in the sample coupled with the timeframe of the data (quarter 1, 1994 – quarter 4, 2016), an appreciable number of observations of up to ninety-two (92) per member country for most data series are obtained ensuring estimation of consistent parameters. The total number of observations for the ECOWAS member countries is 1104 for the 3-variable baseline model and the extended models.

5.4.2.2 Variable selection and Data sources

The selection of variables for estimating the VAR models is informed by the operational framework of monetary policy, discussed in chapter 2 above, reflecting key monetary and macroeconomic indicators targeted by the monetary authorities in the ECOWAS region in formulating and implementing policy. The baseline model is a 3-variable VAR which includes the monetary base (mb), inflation (inf), and real gross domestic product (rgdp). The mb is the policy variable that serves as an indicator of the stance of monetary policy. Within the WAMZ, member countries have, until recently, operated monetary targeting regimes, wherein the monetary base is the operational instrument, regulated on a regular basis through open market operations to achieve an intermediate target assumed to be directly linked to a stipulated ultimate policy goal(s). In Nigeria, monetary aggregates play an important role in the operational monetary policy framework, though the MPR now serves as a nominal

[93] The devaluation coincided with the re-organization of the monetary arrangement in the region that gave birth to the current institutional setting known as WAEMU (see Chapter 2 for details).

[94] Liberia and Guinea Bissau from the WAMZ and WAEMU, respectively, are not included because of data concerns, in respect of quality and length. Cabo Verde which does not belong to either of the sub-groupings is also omitted.

anchor for the other interest rates in the economy and adjusted periodically to reflect the CBN's policy stance. In Ghana, though the inflation targeting framework was formally adopted in 2007 to replace the monetary targeting regime, policy formulation and implementation continue to be informed by developments in monetary aggregates. For the WAEMU sub-region, the conduct of monetary policy by the BCEAO has over the years involved developing a monetary program which incorporates monetary aggregates as an integral part.

The use of the monetary base as the policy instrument is further justified by the fact that, as highlighted in section 5.2 above, practical implementation of policy decisions involves open market operations that alter the monetary base, even where the short-term interest rate is the policy variable. In addition, the choice of the monetary base in this study is consistent with the postulations of Poole (1970) which proposes that in the presence of uncertainty in the measurement of the real interest rate and persistence of shocks to the monetary sector, consideration should be given to the use of a monetary aggregate as an alternative policy instrument. In a similar vein, Taylor (2000) recommends use of a monetary aggregate, such as the monetary base, as the policy instrument once determination of the equilibrium interest rate is uncertain, as an interest rate rule may translate into policy errors.[95] [96]

Inflation (inf) and the real Gross Domestic Product (rgdp) are the policy target variables that reflect the ultimate goals of monetary policy within current operational frameworks, and thus serve as indicators of the authorities' efforts at price and output stabilization within the context of a common monetary policy. The two variables are also the most widely used measures employed to assess the impact of a monetary shock on aggregate demand in an economy. Inf is the annualized log difference of the consumer price index (cpi) and is computed as $\Delta \ln(P_t) = 4*[\ln(P_t) - \ln(P_{t-1})]$ where $\ln(P_t)$ is the logarithm of the consumer price index and Δ is the first difference operator. The rgdp variable is compiled

[95] The monetary base has been employed in empirical studies on advanced countries, including to assess the effects of unconventional monetary policy in the context of zero-lower bound interest rate (Gambacorta, 2012; Peersman, 2011). Mishra et al. (2014) and IMF (2015) have also used the monetary base as the policy variable in research on monetary policy transmission mechanisms.

[96] As highlighted in Chapter 2, in recent years central banks in the ECOWAS are increasingly introducing a policy rate to signal their monetary policy stance, but the series are yet of insufficient length across the member countries. Also, several studies have resorted to using the treasury bills rate as a proxy for the policy variable; but this data is unavailable for some member countries and inadequate in other cases to ensure consistent estimation. Moreover, the use of treasury bills rate as policy variable in the context of a policy framework that is based on monetary targets has been criticized as inappropriate (see Mishra and Montiel, 2012, p. 13).

on an annual basis in member countries and thus the annual series is interpolated to generate quarterly data.[97] A number of approaches has been adopted to obtain quarterly data frequencies from annual data, including Sandee and Lisman (1964) and Chow and Lin (1971). This study uses the Chow-Lin procedure, incorporated in the EViews software version 9.5, as it carries the advantage of matching the quarterly interpolated series with the annual data. As such, the last quarter value of the interpolated series is the same as the annual data, thus preserving the overall trend in real GDP over the sample period.

All the variables in the VAR models are presented in logarithmic form and are seasonally adjusted[98]. All data for the estimations obtained from the IFS of the IMF.[99] Compilation of the data is consistent with statistical manuals in line with international best practices and are verified by the IMF. CPI data is collected at the country level according to the Classification of Individual Consumption by Purpose (COICOP) developed by the United Nations Statistics Division and scrutinized by the IMF before publication, thereby minimizing comparability issues across countries.

The extended 4-variable VAR models consider two financial variables, bank credit to the private sector (bc) and the nominal exchange rate (exr), both in logs. The inclusion of these variables is informed by the review of the channels of monetary transmission and their plausibility in section 5.2 which suggests the bank lending channel and the exchange rate channel are possible viable transmission channels in the ECOWAS region.

5.4.3 Structural shock identification strategy

The identification of structural monetary shock is crucial to ensuring that the analysis is predicated on actual policy shocks with economic meaning, and not merely errors in the model. It helps address potential simultaneity between the policy instrument, in this case the monetary base, and the goal or impact variable(s), i.e. real output and inflation. Proper identification allows the direction of causation to run from the policy instrument to the goal variable(s), and not the reverse. This is accomplished through orthogonalization of the

[97] Several studies on the monetary transmission mechanism in advanced economies (Bernanke et al., 2005) and developing economies (Davoodi et al., 2013) have applied interpolation techniques. The need for high frequency data stems from the fact that using quarterly or even monthly, as opposed to annual, impulse responses are more informative for monetary policy decision making that usually rely on quarterly monetary programs or policy meetings.
[98] The X-13ARIMA-SEATS quarterly seasonal adjustment method by the U.S. Department of Commerce and the U.S. Census Bureau which is embedded in EViews 9.5 software is used.
[99] Data accessed from https://www.imf.org/data on January 10, 2019. The 2010=100 base year quarterly CPI series for Sierra Leone for the period 1994Q1 – 2004Q4 was obtained by Splicing (see Hill and Fox, 1997).

shocks which ensures independence from the variables within the system and allows the impulse response functions generated from the shock to reflect the causal effect of interest.

In the reduced form or unidentified model, the covariance matrix is generally non-orthogonal, as such impulse responses emanating from a shock within the matrix possess little or no economic meaning. To obtain the structural form of the model, additional economic restrictions or assumptions need to be imposed, as discussed in section 5.4.1.1 above.

Several identification strategies have been employed in the VAR literature, key among which are the short-run recursive (Sims, 1980, 1992; Christiano et al. 1998), semi or non-recursive (Bernanke and Mihov, 1998; Blanchard and Perotti, 2002), short and long-run restrictions (Blanchard and Quah, 1988), and sign restrictions (Rubio-Ramirez et al. 2005; Fry and Pagan 2011).

This study proceeds with a short-run recursive identification in the spirit of Christiano et al. (1998), widely employed in empirical studies on the monetary policy transmission mechanism. Variables in the VAR are ordered starting with the goods and services market (slow-moving variables), followed by the monetary policy instrument, and finally the financial markets (fast-moving variables). Essentially, it utilizes a Cholesky decomposition wherein the reduced form innovations and the initial period responses are assumed to be recursive. Restrictions are imposed on matrix A_0 —the matrix of the contemporaneous relationships among the endogenous variables of the structural model, defined in section 5.4.1.1 above—assumed to be lower triangular. This identification strategy implies that the variable ordered first is assumed to have contemporaneous effects on all other variables, whereas the variable ordered last affects the preceding variables with a lag.

In line with this procedure, the variables in the baseline model are ordered as follows:

$$Z_t = [lrgdp_t \;\; inf_t \;\; lmb_t] \tag{7}$$

The ordering of real GDP and inflation is consistent with the nominal rigidity theory which portends persistence in output and inertia in prices following a monetary policy shock (Christiano et al. 2005).

Following the relationship between the forecast errors of the reduced form VAR, ε_t , and the structural shocks, u_t , established in section 5.4.1.1, (i.e. $A\varepsilon_t = u_t \Longrightarrow \varepsilon_t = A^{-1}u_t$), the baseline model is presented in matrix form as follows[100]:

$$\begin{array}{ccc} A_0 & \varepsilon_t & u_t \\ \begin{bmatrix} 1 & 0 & 0 \\ g_{21} & 1 & 0 \\ g_{31} & g_{32} & 1 \end{bmatrix} & \begin{bmatrix} \varepsilon_t^{lrgdp} \\ \varepsilon_t^{\inf} \\ \varepsilon_t^{lmb} \end{bmatrix} = & \begin{bmatrix} u_t^{lrgdp} \\ u_t^{\inf} \\ u_t^{lmb} \end{bmatrix} \end{array} \tag{8}$$

$$\Longrightarrow \begin{array}{ccc} \varepsilon_t & A^{-1} & u_t \\ \begin{bmatrix} \varepsilon_t^{lrgdp} \\ \varepsilon_t^{\inf} \\ \varepsilon_t^{lmb} \end{bmatrix} = & \begin{bmatrix} 1 & 0 & 0 \\ -g_{21} & 1 & 0 \\ -g_{31}+g_{21}g_{32} & -g_{32} & 1 \end{bmatrix} & \begin{bmatrix} u_t^{lrgdp} \\ u_t^{\inf} \\ u_t^{lmb} \end{bmatrix} \end{array} \tag{9}$$

From equation (9), the following relationships are obtained:

$$\varepsilon_t^{lrgdp} = u_t^{lrgdp} \tag{10}$$

$$\varepsilon_t^{\inf} = -g_{21}u_t^{lrgdp} + u_t^{\inf} \tag{11}$$

$$\varepsilon_t^{lmb} = (-g_{31} + g_{21}g_{32})u_t^{lrgdp} - g_{32}u_t^{\inf} + u_t^{lmb} \tag{12}$$

Equation (12) is interpreted as a linear monetary policy reaction function for the central banks in the ECOWAS, with the monetary base, *lmb*, as the policy instrument. It is assumed

[100] In line with the identification condition outlined in section 5.4.1.1 above, i.e. $N(N-1)/2$, the 3-varibale baseline model normally requires 3 restrictions.

that in setting their quarterly monetary operations programs, often consistent with the respective financing programs with the IMF, the Banks respond endogenously to contemporaneous movements in output and inflation.[101] The remaining residual after accounting for all endogenous variations in the monetary base, u_t^{lmb}, represents the exogenous monetary policy shock. In order words, policy reacts to output and inflation within the quarter, as all shock affect the monetary base within that period. However, the policy rate only affects output and inflation with a lag. Consistent with the semi-structural or partial identification proposed by Christiano et al. (1998), the only structural shock of interest in the model is the policy shock, u_t^{lmb}.

The semi-structural model identification technique adopted in this study contrasts the fully-identified recursive VAR approach proposed by Sims (1980, 1992) in that, in the case of the latter, each structural shock is identified. Notably, the ordering of the variables in the VAR differs significantly, with the monetary policy variable ordered first (Sims 1992)[102]. Thus, in the context of this study, the identifying assumptions would be that there is no contemporaneous reaction of monetary policy to innovations in real output and the price level, and that any innovations in the price level do not affect real output contemporaneously.

The Sims identification strategy lacks any strong theoretical foundation and has been considered a 'crude implementation of the Choleski scheme' (Mishra and Montiel, 2012, p. 8). The approach neglects the possibility that innovations in the other non-policy macroeconomic variables (herein, real output and the price level) may be included in the central bank's reaction function or the information set at the disposal of the monetary authorities, and that the policy makers may as a result respond to innovations in these variables contemporaneously.

Following, therefore, in the spirit of the structural identification of Christiano et al. (1998), the extended models to investigate the bank lending channel and the exchange rate channel in the ECOWAS are developed in this study. This involves ordering bank credit to the private

[101] Equations 10 and 11 could be considered aggregate supply and aggregate demand shocks, respectively, but are not of interest in this study.

[102] Sims (1992) employed a VAR ordering starting with the Federal funds rate (ff), the logs of narrow money (lm), the consumer price index (lp), and industrial production (ly). This ordering implies that the policy variable (ff) affects all other variables contemporaneously and that the monetary authorities only observe non-policy variables with a lag. The variable that is affected by all other variables within the period, i.e. the most endogenous variable, is ordered last.

sector and the exchange rate, respectively, after the monetary policy instrument, implying that these financial variables respond to the policy shock contemporaneously within the quarter.[103]

In this regard, equation (7) above is rewritten as follows:

$$Z_t = [lrgdp_t \;\; inf_t \;\; lmb_t \;\; lfv_t] \tag{13}$$

where *lfv* represents the log of the respective financial variable, i.e. bank credit to the private sector and the nominal exchange rate.

To structurally identify the four-variable VAR models recursively, six identifying restrictions are required in line with the $N(N-1)/2$ identification condition. In addition, based on the established relation between the forecast errors of the reduced form VAR, ε_t, and the structural shocks, u_t, (i.e. $A\varepsilon_t = u_t$), the matrices of the extended models are represented thus:

$$\begin{array}{ccc} A_0 & \varepsilon_t & u_t \\ \begin{bmatrix} 1 & 0 & 0 & 0 \\ g_{21} & 1 & 0 & 0 \\ g_{31} & g_{32} & 1 & 0 \\ g_{41} & g_{42} & g_{43} & 1 \end{bmatrix} & \begin{bmatrix} \varepsilon_t^{lrgdp} \\ \varepsilon_t^{\inf} \\ \varepsilon_t^{lmb} \\ \varepsilon_t^{lfv} \end{bmatrix} = & \begin{bmatrix} u_t^{lrgdp} \\ u_t^{\inf} \\ u_t^{lmb} \\ u_t^{lfv} \end{bmatrix} \end{array} \tag{14}$$

Recent application of the short-run recursive identification in the context of a monetary union includes Davoodi et al. (2013) and IMF (2015).[104]

[103] In the context of monetary policy transmission in the Euro area, Peersman and Smets (2001) employed a similar VAR formulation based on quarterly data and imposing Choleski decomposition ordered as real GDP, consumer prices, a domestic nominal interest rate (the monetary policy variable) and the real exchange rate.

[104] Davoodi et al. (2013) focuses on the East African Community (EAC), while IMF (2015) is based on the Central African Economic and Monetary Union (CAEMU).

5.5 Model Estimation and Analyses

Estimation of the model is preceded by an investigation of the statistical properties of the panel data. As highlighted in section 5.4.1.2 above, the Pedroni (2013) panel SVAR technique exploits the existence of cross-sectional dependence across the panel units, together with the orthogonality conditions of the structural shocks, to decompose the unobserved shocks into common and idiosyncratic components. Against this backdrop, the data series across the member countries are tested for the presence of cross-sectional dependences. In addition, panel unit root tests are performed to determine the stationarity of each data series and ensure appropriate data transformation, where necessary, to support stable underlying relationships among the variables in the VAR.

The estimation of the baseline model proceeds with demeaned data to accommodate fixed effects. The identifying restrictions to obtain the unanticipated structural policy shock follow the short-run recursive structural identification scheme, broadly reflecting the institutional framework of monetary policy in the region. Consistent with the objective of the study, the analyses focus on the individual -country impulse responses and the country-specific responses of inflation and real output to common monetary policy shock. The panel responses are also examined to provide an indication of the impact of policy shock and the transmission channels at the level of the proposed union.[105]

5.5.1 Cross-sectional dependence tests

The presence of cross-sectional dependences in the data series across the member countries is investigated using a range of tests for cross-sectional dependence, notably the Breuch-Pagan Lagrange Multiplier (LM) test, the Pesaran Scaled LM test, the Bia Corrected LM test, and the Pesaran CD test, outlined in detail in Chapter 3, section 3.4.2.1. The null hypothesis for these tests is the absence of cross-section dependence, while the alternative confirms the existence of cross-section dependence.

The results, presented in Table 5.1 below, are clearly in agreement across the various of the test procedures. The null of cross-sectional independence for all the series considered—

[105] The study utilizes EViews program of the Pedron (2013) Panel SVAR technique coded by Professor Peter Pedroni and Dr. Xingwei Hu of the IMF Economic Systems Division. An EViews add-in program of the Panel SVAR procedure was recently created in June 2018, but generates only the panel responses to the composite, common and idiosyncratic shocks.

lrgdp, inf, lmb, lbc, and lexr—is strongly rejected at the 1% level of significance. This confirms that the data series are cross-sectionally dependent and thus supports the application of the Pedroni (2013) panel SVAR technique in this study to uncover the common structural shocks.

Table 5.1: Cross-sectional dependence test results

	ECOWAS	
Test	**Statistic**	**P-value**
Variable - LRGDP		
Breusch-Pagan LM	5585.90***	0.000
Pesaran scaled LM	480.45***	0.000
Bias-corrected scaled LM	480.38***	0.000
Pesaran CD	74.66***	0.000
Variable - INF		
Breusch-Pagan LM	1324.03***	0.000
Pesaran scaled LM	109.50***	0.000
Bias-corrected scaled LM	109.43***	0.000
Pesaran CD	25.36***	0.000
Variable – LMB		
Breusch-Pagan LM	5160.26***	0.000
Pesaran scaled LM	443.40***	0.000
Bias-corrected scaled LM	443.33***	0.000
Pesaran CD	71.74***	0.000
Variable - LBC		
Breusch-Pagan LM	5394.18***	0.000
Pesaran scaled LM	463.76***	0.000
Bias-corrected scaled LM	463.69***	0.000
Pesaran CD	73.39***	0.000
Variable - LEXR		
Breusch-Pagan LM	2869.38***	0.000
Pesaran scaled LM	244.00***	0.000
Bias-corrected scaled LM	243.94***	0.000
Pesaran CD	27.59***	0.000

Source: Author's computation

Note: Null hypothesis – No cross-section dependence (correlation)
*** implies rejection of the null hypothesis at the 1% level of significance.
Econometric software employed - EViews 9.5

5.5.2 Panel unit root tests

Determining whether the variables used in the panel estimations are stationary or contain unit root (non-stationary in levels) is an important next step in the analysis. Toward this end, the study employs the Pesaran (2007) CIPS panel unit root test and the Maddala and Wu (1999) panel unit root test, detailed in section 3.4.2.[106] The Maddala and Wu (1999) test is considered a first-generation panel unit root test as it assumes cross-sectional independence. It provides for different lag lengths in the individual ADF regression and combines the p-value from each cross-sectional unit root test. The test accommodates both balanced and unbalanced panels. However, in the presence of cross-sectional dependences in the data that has been confirmed in the preceding section, the Pesaran (2007) CIPS panel unit root test produces more reliable results, as it is robust to the presence of unobserved common factors among the member countries.

The results of the Maddala and Wu (1999) test, presented in Table 5.2a below, are conducted assuming constant only and then incorporating a deterministic trend. Up to four lags of each series is considered given the quarterly data frequencies. Under the deterministic assumption of no trend, the results indicate that LRGDP, LMB, LBC, and LEXR are all non-stationary in levels at all four lags. The INF series is found to be stationary, though its fourth lag is only stationary at the 10% level of significance. However, following first differencing the four non-stationary series become stationary, indicating an order of integration of 1. The outcome of the tests based on the specification that includes a deterministic trend is similar to the model that assumes constant only. The series LRGDP, LMB, LBC and LEXR all exhibited non-stationarity in levels, whereas INF is stationary on all lags. Following first differencing, the series are all rendered stationary.

The results of the Pesaran (2007) CIPS test (Table 5.2b) broadly mimic those of the Maddala and Wu (1999) test to the extent that the series LRGDP, LMB and LBC are found to be nonstationary in levels, while INF is stationary in levels at zero and up to four lags. These results are consistent under both deterministic assumptions without trend and with trend. For the LEXR series, in the absence of a deterministic trend, it appears to be sensitive to the lag truncation. It exhibits non-stationarity at one lag, though stationary at the 10% significance level at zero and all other lags. It is non-stationary in levels on all lags, once a trend

[106] Both PURTs are conducted using the STATA command 'multipurt' that produces the two results

component is incorporated into the specification. First differencing renders all the levels series stationary, with the exception of the fourth lag of LRGDP under a deterministic trend specifications.

From the panel unit root test results, it is evident that the data series LRGDP, LMB, and LBC are non-stationary in levels and INF is stationary. The stationarity properties of LEXR appear to be sensitive to the underlying deterministic assumption. Both the Maddala and Wu (1999) test and the Pesaran (2007) CIPS test are in agreement that with first-differencing all series become stationary. The analyses of the underlying relationships among the variables would thus proceed on the basis of the first-difference transformation of all the variables.

Table 5.2a: Maddala and Wu (1999) PURT Results

		Levels				First Difference			
		Without trend		With trend		Without trend		With trend	
Variable	Lags	Chi_sq	P-value	Chi_sq	P-value	Chi_sq	P-value	Chi_sq	P-value
lrgdp	0	5.04	1.000	8.29	0.999	114.31***	0.000	80.91***	0.000
lrgdp	1	3.27	1.000	40.72**	0.018	135.78***	0.000	101.83***	0.000
lrgdp	2	3.74	1.000	30.98	0.154	171.67***	0.000	139.10***	0.000
lrgdp	3	5.08	1.000	21.56	0.605	203.43***	0.000	177.19***	0.000
lrgdp	4	4.57	1.000	11.28	0.987	59.94***	0.000	39.99***	0.000
inf	0	694.68***	0.000	597.92***	0.000	1156.18***	0.000	855.23***	0.000
inf	1	411.16***	0.000	361.72***	0.000	870.31***	0.000	752.37***	0.000
inf	2	312.73***	0.000	267.06***	0.000	567.17***	0.000	484.68***	0.000
inf	3	250.21***	0.000	216.17***	0.000	572.59***	0.000	491.24***	0.000
inf	4	190.04*	0.080	155.40***	0.000	458.46***	0.000	392.03***	0.000
lmb	0	8.21	0.999	45.54***	0.005	1000.73***	0.000	858.93***	0.000
lmb	1	7.33	1.000	32.77	0.109	502.68***	0.000	433.09***	0.000
lmb	2	6.45	1.000	35.66*	0.059	322.93***	0.000	266.06***	0.000
lmb	3	7.02	1.000	31.13	0.150	302.57***	0.000	250.87***	0.000
lmb	4	7.76	0.999	23.39	0.497	210.73***	0.000	171.24***	0.000
lbc	0	9.80	0.995	33.73*	0.090	941.32***	0.000	826.27***	0.000
lbc	1	9.87	0.995	32.63	0.112	454.27***	0.000	402.37***	0.000
lbc	2	8.38	0.999	21.70	0.597	208.16***	0.000	173.32***	0.000
lbc	3	6.96	1.000	34.94*	0.069	177.78***	0.000	149.60***	0.000
lbc	4	8.79	0.998	30.01	0.185	146.74***	0.000	121.60***	0.000
lexr	0	19.80	0.708	10.73	0.991	682.50***	0.000	592.36***	0.000
lexr	1	17.70	0.818	17.37	0.833	356.22***	0.000	296.87***	0.000
lexr	2	18.52	0.777	20.64	0.660	214.21***	0.000	167.44***	0.000
lexr	3	24.12	0.455	20.17	0.687	262.26***	0.000	210.85***	0.000
lexr	4	19.01	0.752	17.18	0.841	155.11***	0.000	112.11***	0.000

Source: Author's computation

Note: Test assumes cross-section independence
Null hypothesis – Series is I(1).
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed - Stata15

Table 5.2b: Pesaran (2007) CIPS PURT Results

		Levels				First Difference			
		Without trend		With trend		Without trend		With trend	
Variable	Lags	Zt-bar	P-value	Zt-bar	P-value	Zt-bar	P-value	Zt-bar	P-value
lrgdp	0	7.35	1.000	5.000	1.000	-5.70***	0.000	-4.08***	0.000
lrgdp	1	2.11	0.982	-1.05	0.147	-6.54***	0.000	-5.09***	0.000
lrgdp	2	2.46	0.993	-0.01	0.495	-7.82***	0.000	-6.68***	0.000
lrgdp	3	3.01	0.999	1.5	0.933	-8.77***	0.000	-7.87***	0.000
lrgdp	4	4.26	1.000	3.51	1.000	-2.33***	0.000	-0.59	0.279
inf	0	-15.31***	0.000	-15.3***	0.000	-16.74***	0.000	-16.72***	0.000
inf	1	-14.46***	0.000	-14.27***	0.000	-16.74***	0.000	-16.72***	0.000
inf	2	-12.85***	0.000	-12.12***	0.000	-16.03***	0.000	-15.82***	0.000
inf	3	-11.74***	0.000	-10.71***	0.000	-16.30***	0.000	-16.05***	0.000
inf	4	-9.74***	0.000	-8.32***	0.000	-15.53***	0.000	-14.91***	0.000
lmb	0	-1.44*	0.075	-2.02	0.022	-16.71***	0.000	-16.67***	0.000
lmb	1	0.02	0.507	-0.19	0.423	-16.28***	0.000	-16.14***	0.000
lmb	2	0.10	0.541	-0.02	0.492	-13.19***	0.000	-12.18***	0.000
lmb	3	0.51	0.693	0.16	0.565	-11.81***	0.000	-10.82***	0.000
lmb	4	1.02	0.847	1.24	0.892	-8.15***	0.000	-6.95***	0.000
lbc	0	0.93	0.824	0.44	0.668	-16.59***	0.000	-16.47***	0.000
lbc	1	1.00	0.841	0.97	0.833	-14.70***	0.000	-14.64***	0.000
lbc	2	0.56	0.711	0.49	0.689	-10.28***	0.000	-9.66***	0.000
lbc	3	-0.38	0.353	-0.55	0.290	-8.95***	0.000	-8.62***	0.000
lbc	4	-0.03	0.487	-0.19	0.424	-7.23***	0.000	-6.79***	0.000
lexr	0	-1.54	0.062*	0.97	0.833	-15.89***	0.000	-15.57***	0.000
lexr	1	-1.22	0.110	0.97	0.835	-12.96***	0.000	-12.01***	0.000
lexr	2	-1.83	0.033**	-0.28	0.392	-11.75***	0.000	-10.77***	0.000
lexr	3	-1.57	0.058*	0.33	0.629	-10.40***	0.000	-9.34***	0.000
lexr	4	-1.47	0.071*	1.63	0.949	-7.63***	0.000	-6.15***	0.000

Source: Author's computation

Note: Test assumes cross-section dependence is in the form of a single unobserved common factor
Null hypothesis – Series is I(1).
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed - Stata15

5.5.3 Individual member-country SVAR analyses and model diagnosis

As highlighted in section 5.4.1.2 above, as a first step in implementing the Pedroni (2013) panel SVAR technique, an SVAR model is estimated for each of the cross-sectional units, in this case the member countries of the ECOWAS, which allows for obtaining the composite shocks. Of interest in this study is the monetary policy shock defined as an unanticipated positive innovation to the monetary base. In the baseline model, comprising real GDP, Inflation and the monetary base, the exogenous monetary shock is expected to boost aggregate demand thereby increasing the level of prices and real GDP. The structural shocks are identified through the short-run recursive identification scheme proposed by Christiano et al. (1998), discussed in section 5.4.3. To this end, the focus is on the shock to the policy instrument, the monetary base, which impacts real GDP and inflation with a lag. The responses of real GDP and inflation to the unit shock to the monetary base for each member country are depicted in Figure 5.2 (WAMZ countries) and Figure 5.3 (WAEMU countries) below.[107]

For countries within the WAMZ, the responsiveness of real GDP to the positive exogenous shock to the monetary base is generally marginal and exhibits asymmetry across member countries. For The Gambia, Ghana, and Guinea, output expands after the initial quarter, while Nigeria and Sierra Leone recorded a slight output contraction. Given the short-run recursive scheme that orders the policy instrument last, there is no contemporaneous impact on real output and inflation in the first quarter. In The Gambia, the expansion in output peaks in the third quarter and follows a downward trend thereafter before totally dissipating by the eight quarter. Guinea registered a similar magnitude of output response in the third quarter, but contracts by the seventh quarter and thereafter tends towards the origin. In Ghana, the response of output to the monetary shock was only marginal in the second quarter and followed a diminishing trend throughout the rest of the horizon. In Nigeria and Sierra Leone, the slight contraction of output in response to the monetary shock dissipates after the second quarter. For all member countries of the WAMZ, the responses of real GDP to the policy shock are statistically insignificant at the 5% level. In terms in inflation, Ghana records a statistically significant increase in prices in the second quarter in response to the policy shock, though the impact dies out by the fifth quarter. Somewhat of a price puzzle is observed for The Gambia and Guinea, as statistically significant reduction in prices is registered in the second and fourth quarters, respectively. For Nigeria and Sierra Leone, the price responses are characterized by volatility over the first half of the forecast horizon, dissipating thereafter.

In the WAEMU region, the dynamic responses of real GDP and inflation to the monetary policy shock also differed across countries, including in respect of magnitude and duration of impact. In Benin and Mali, output expands immediately after the initial quarter but reverts towards the origin thereafter. In Niger and Senegal, the increase in output was marginal and takes effect only after slight contraction in the second quarter. The impact of the shock varnished in the two countries after eight quarters. The response of real output in Cote

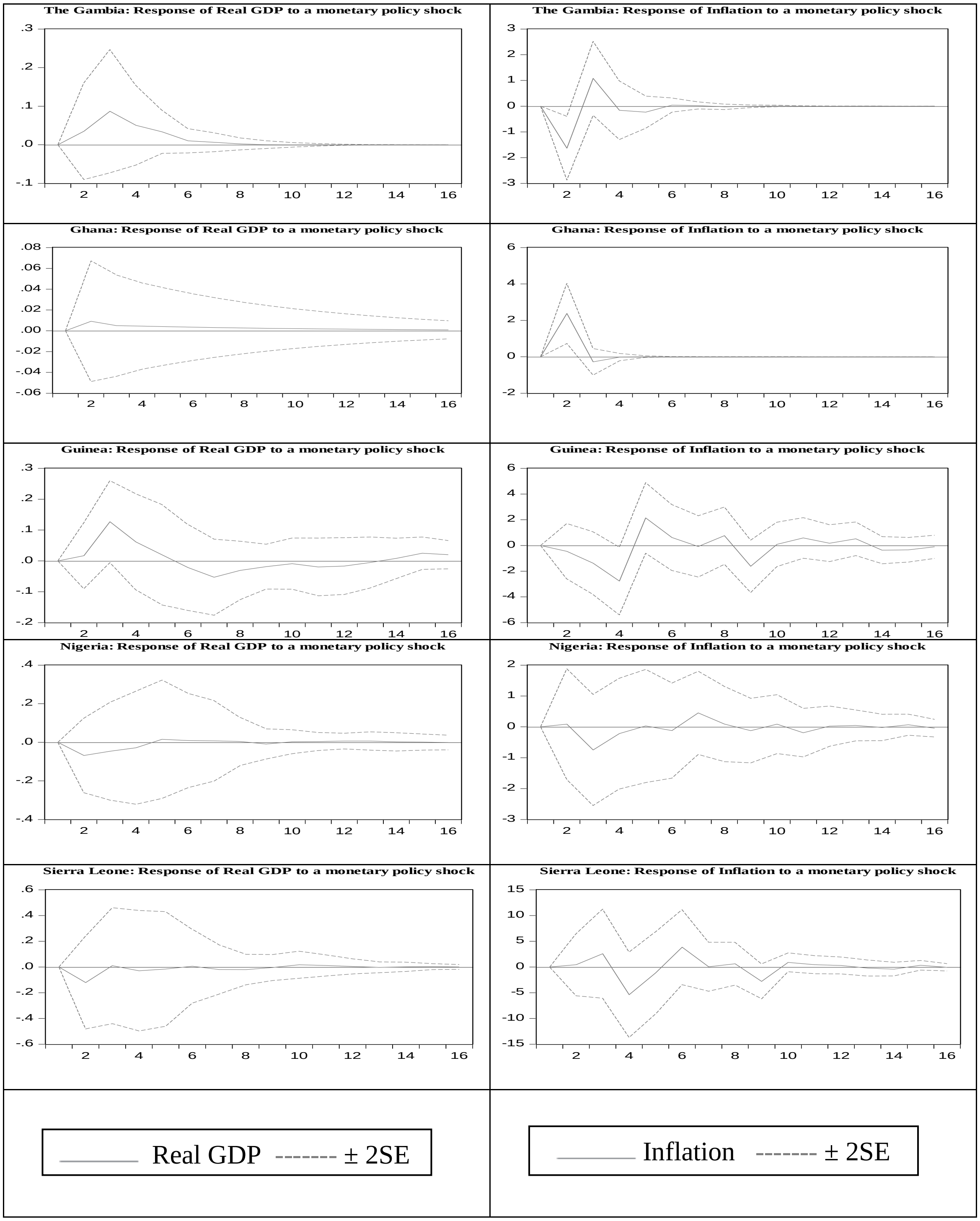
[107] The detailed output for each ECOWAS member country is presented in Appendix A.19 (WAMZ countries) and Appendix A.20 (WAEMU countries).

d'Ivoire and Togo is contractionary in the third quarter but dissipates thereafter. In Burkina Faso, output decreases between the second and the fifth quarters, before expanding slightly up to about the tenth quarter. The responses of real GDP to the monetary shock in all WAEMU member countries are however statistically insignificant. Broadly similar response patterns are recorded for inflation in the region, with statistically insignificant responses for all member countries. For Benin, Cote d'Ivoire, Senegal and Togo, the impact of the policy shock dissipates by the seventh quarter, following fluctuations over the initial period. Mali and Niger exhibited severe volatility in the response of inflation to the policy shock over most of the forecast horizon. All inflation responses for the WAEMU countries are also statistically insignificant at the 5% level.

The residual diagnostic tests performed on the individual VAR estimations are presented with the respective country impulse responses in Appendices A.19 and A.20. The results indicate that the models are all stable and stationary as reflected in the graphs of the inverse roots of the characteristic polynomials which show that none of the roots lie outside the unit imaginary circle. These portend validity of the generated impulse functions and their associated standard errors. Thus, the need for adding say, a time trend, to address potential instability does not arise. There is also no serious problem of serial correlation observed based on the outcomes of the autocorrelation LM tests as the null hypothesis of no serial correlation could not be rejected in most cases for different lag truncation. Similarly, limited evidence of heteroscedasticity exists across the VAR estimates. However, joint normality is rejected for most of the VAR residuals that could be accounted for by outliers in some of the data series.[108]

[108] Normality of the VAR residuals is not a necessary condition for the validity of many of the statistical procedures required for VAR model estimations (Rummel, 2015, pp. 14-15). However, non-normality might affect the validity of standard errors, hence, the confidence intervals, and should thus be treated with caution.

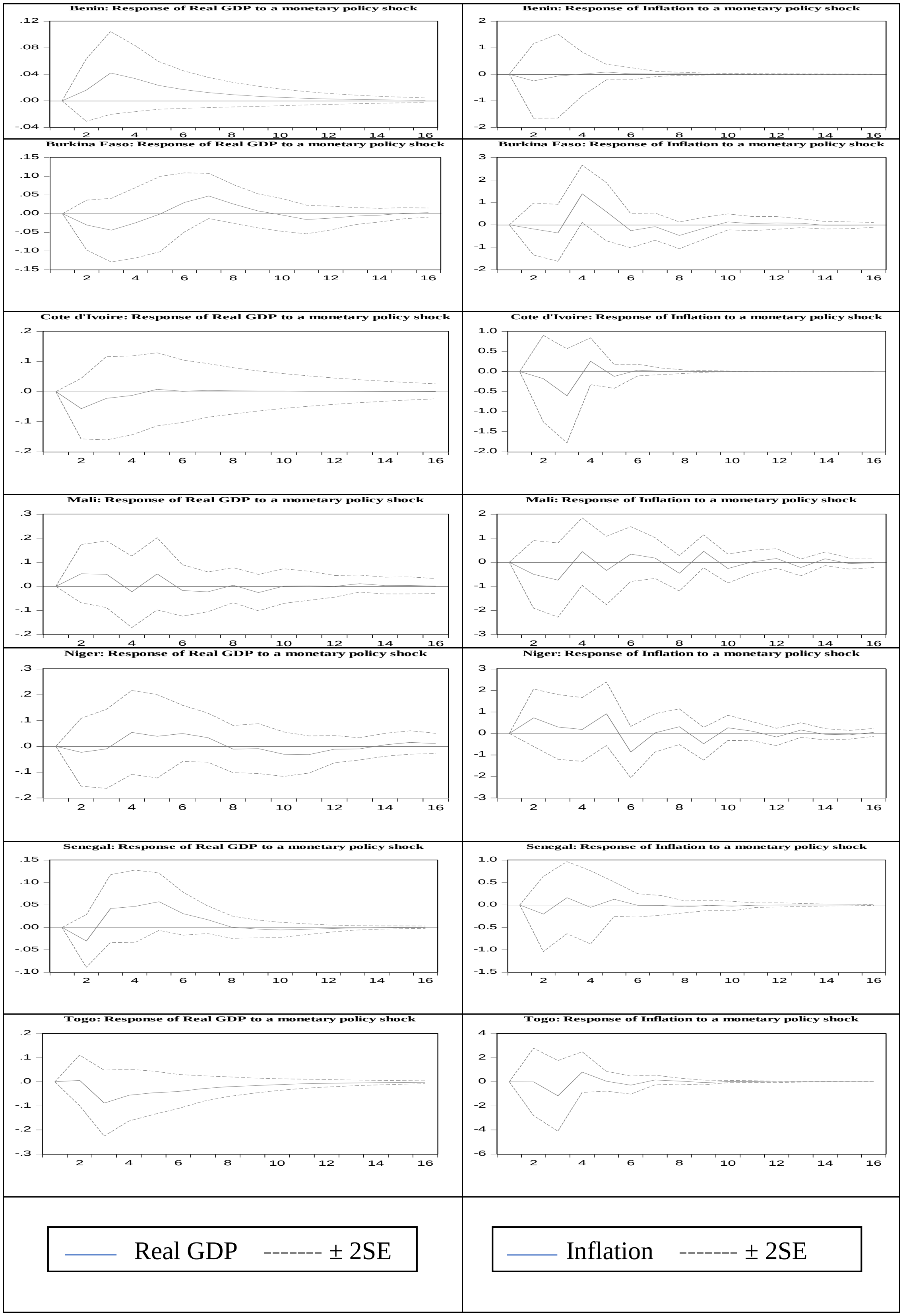
Figure 5.2: WAMZ - Country Responses of Real GDP and Inflation to Monetary Policy Shock



Source: Author's computation

Note: Structural shock identification: Recursive ordering (lrgdp inf lmb) based on Christiano et al. (1998)
Econometric software employed – EViews 9.5

Figure 5.3: WAEMU - Country Responses of Real GDP and Inflation to Monetary Policy Shock



Source: Author's computation

Note: Structural shock identification: Recursive ordering (lrgdp inf lmb) based on Christiano et al. (1998)
Econometric software employed – EViews 9.5

5.5.4 Country-specific responses of Real GDP to a common monetary shock

The impulse responses of member countries of the ECOWAS, depicted in Figures 5.4 below, indicate that the responsiveness of real GDP to a common monetary policy shock, reflected in a positive innovation to the monetary base, is weak and exhibits signs of asymmetry. In fact, for most countries real GDP is generally irresponsive to the shock over much of the 16-quarter horizon considered. The asymmetric responses are reflected even at the level of the sub-monetary groupings—the WAMZ and the WAEMU—which have for most of the sample period worked towards macroeconomic convergence.

With respect to countries in the WAMZ, The Gambia registered a marginal increase of 0.03 percent by the third quarter, though by the sixth quarter the impact virtually varnishes. For Ghana, Guinea and Nigeria, real GDP is largely irresponsive to the common monetary policy shock throughout the 16-quarter horizon. With regards Nigeria, real GDP contracts by a 0.01 percent in the second quarter which dies out thereafter. Similarly, for Sierra Leone, the 0.01 percent contraction in the second quarter could not be sustained and varnishes by the third quarter. These marginal output responses for all the five WAMZ member countries are statistically insignificant at the 5 percent level of significance.

The indications of asymmetry in the output responses demonstrated by the WAMZ member countries is mirrored by countries within the WAEMU. While in Benin, Cote d'Ivoire, Niger and Senegal the response to the common monetary shock was marginally expansionary, it contracted in the case of Togo. Burkina Faso registered episodes of real GDP contraction and expansion over the horizon, whereas output was largely irresponsiveness in the case of Mali. Benin recorded a slight increase in real output in the third quarter which dissipates by the seventh quarter, whereas a similar magnitude of output expansion in Cote d'Ivoire in the second quarter dies out the following quarter. With respect to Niger, following a small initial contraction in the second quarter, output expands marginally between the fourth and seventh quarters. For Senegal, the increase in output was sustained between the second and the eight quarter, peaking at 0.02 percent in the fifth quarter. In the case of Burkina Faso, output initially contracts between the second and fifth quarters before expanding thereafter up to the eighth quarter. Like the impulse responses for member countries in the WAMZ, the responses of real GDP to a common monetary policy shock for WAEMU member countries are all statistically insignificant at the conventional 5 percent level.

5.5.5 Country-specific responses of Inflation to a common monetary shock

The responses of inflation to a common monetary policy shock also reveal evidence of asymmetry across member countries of the ECOWAS, both in terms of magnitude and the duration of impact. These signs of asymmetry are reflected at the level of the WAMZ and the WAEMU, but with no discernible patterns across the sub-groupings. Figure 5.5 below presents the price responses to the common monetary policy shock.

In The Gambia, inflation responds to the common monetary shock with a decrease in the second quarter, followed by a rise the following quarter, with the impact dying out thereafter. In Nigeria, inflation drops moderately in the third quarter and then reverts to its origin for the rest of the horizon. In Ghana, the rise in inflation in the second quarter varnishes the next quarter and throughout the impulse horizon. For Sierra Leone, the responsiveness of prices to a common monetary shock is at best erratic, hovering around zero for most of the impulse horizon. Similarly, in the case of Guinea, inflation is largely irresponsive to the policy shock. These inflation responses to the common monetary shock for the WAMZ member countries are found to be statistically insignificant at conventional levels.

With regards countries within the WAEMU, the responses to the monetary policy shock for Benin, Burkina Faso, Senegal and Togo exhibit a similar initial response, with inflation decreasing in the immediate period after the initial quarter. While Cote d'Ivoire and Niger record decreases in inflation, Mali is largely irresponsive to the policy shock throughout the impulse horizon. In the case of Benin, following the marginal drop in the second quarter, the response dissipates to its origin thereafter, whereas for Senegal and Togo, the initial decrease in inflation is followed by an increase the next quarter which then returns to zero by the sixth quarter. For Burkina Faso, inflation registers a 0.4 percent increase in the fourth quarter but declines afterwards, fully dissipating by the tenth quarter. With respect to Cote d'Ivoire, the initial increase in inflation is not sustained, as it decreases slightly the next quarter before the impact completely phases out by the fifth quarter. For Niger, the response of inflation to the common policy shock is characterised by severe volatility throughout the impulse horizon. As observed in the case of WAMZ member countries, the inflation responses of member countries of WAEMU are statistically insignificant at the 5 percent level.

Figure 5.4: Country-specific responses of Real GDP to a common monetary shock (Baseline model – lrgdp inf lmb)

Source: Author's computation
Note: Total number of observations is 1104
Econometric software employed – EViews 9.5

Figure 5.5: Country-specific responses of Inflation to a common monetary shock (Baseline model – lrgdp inf lmb)

Source: Author’s computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5

5.5.6 Panel responses to a common monetary shock

As highlighted in section 5.4.1.2 above, unlike traditional panel VARs which impose homogeneity in the parameters, the Pedroni (2013) panel SVAR technique accommodates full heterogeneous dynamics in the data.[109] In that regard, the technique allows for the computation of different moments of the distributions of the impulse responses in addition to the average impulse response functions. Thus, in order to examine the panel responses of ECOWAS member states to the common monetary policy shock, the panel estimations report the median, 25th percentiles and 75th percentiles of the impulse responses. The percentiles give an indication of the dynamic behaviour of a subset of countries relative to their median response.

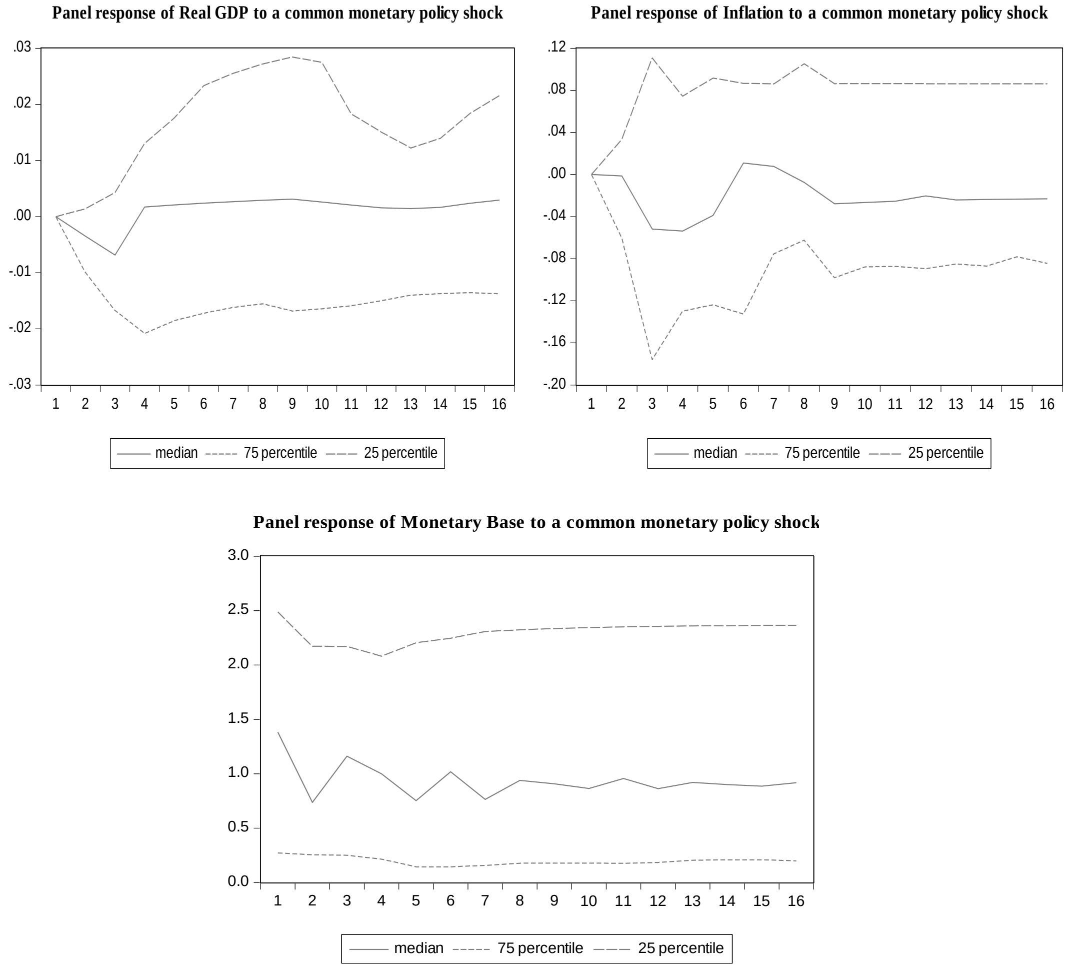
The responses of real GDP and inflation to the common monetary shock of the ECOWAS member countries as a group, based on estimation of the baseline model, are reported in Figure 5.6 below.[110] From the impulse responses in Figure 5.6, the median response of real GDP is shown to be largely irresponsive to the common monetary policy shock. Following a moderate output contraction of less than 0.01 percent, the shock dies out for the rest of the horizon. The 25th and 75th percentiles however reveal heterogeneity in the responses across member countries. For about 25 percent of the member countries, the response of real GDP was marginally positive, peaking at 0.03 percent in the seventh quarter, whereas, for 75 percent of the sample output contracted in response to the shock. The median response of inflation to an unanticipated monetary base expansion exhibited some volatility over the impulse horizon. It decreased by 0.06 percent in the fourth quarter and reverted to its origin before dropping again through the rest of the period. The 25th and 75% percentiles indicate heterogeneity in the country-specific responses, with 25 percent registering a positive marginal inflation response and 75 percent indicating a similar magnitude of negative responses. These results reflect the signs of asymmetry in the country-specific responses to the policy shock

[109]As explained above in section 5.4.1, employing a pooled estimator in the presence of heterogeneity generates inconsistent estimates, as regressors are correlated with the error term (Canova and Ciccarelli, 2013, p.15).

[110] The detailed response estimates of the Composite, Common and Idiosyncratic shocks are presented in Appendix A.20.

uncovered in the preceding sections. The median real output and inflation responses are however not statistically different from zero.[111]

Figure 5.6: ECOWAS - Panel Responses to common monetary policy shock (Baseline model)



Source: Author's computation
Note: Total number of observations is 1104
Econometric software employed – EViews 9.5

To investigate the viability of the two plausible channels of monetary policy transmission in the ECOWAS—the bank lending channel and the exchange rate channel—as informed by the theoretical review in section 5.2.2, the baseline model is extended to include relevant financial variables. Firstly, bank credit to the private sector is incorporated to provide an indication of the strength of the bank lending channel. Next,

[111] The quantiles represent confidence intervals for the median responses relative to the cross-member sample distribution (see Pedroni, 2013, p. 188). Bootstrapped confidence intervals or standard errors are not computed.

the baseline model is augmented with the nominal exchange rate to examine the feasibility of the exchange rate channel in the region. In these expanded VAR models, the financial variable is ordered after the monetary policy variable (the monetary base). The structural VAR model is again identified through short-term recursive approach of Christiano et al. (1998), implying that innovation to the monetary base impacts the financial variable contemporaneously within the quarter, whereas real GDP and inflation respond with a lag.[112]

With regards the bank lending channel, an unanticipated expansion in the monetary base that increases bank reserves is expected to translate into a rise in bank credit to the private sector. From Figure 5.7 below, the median response of bank credit to the common monetary policy shock indicates slight contraction which persists throughout the forecast horizon. The 25th and 75th percentiles confirm the broadly negative response of bank credit to the policy, with about 25 percent of the member countries largely irresponsive while 75 percent recorded an output contraction. The evidence thus points to an inoperable bank lending channel at the level of the ECOWAS.

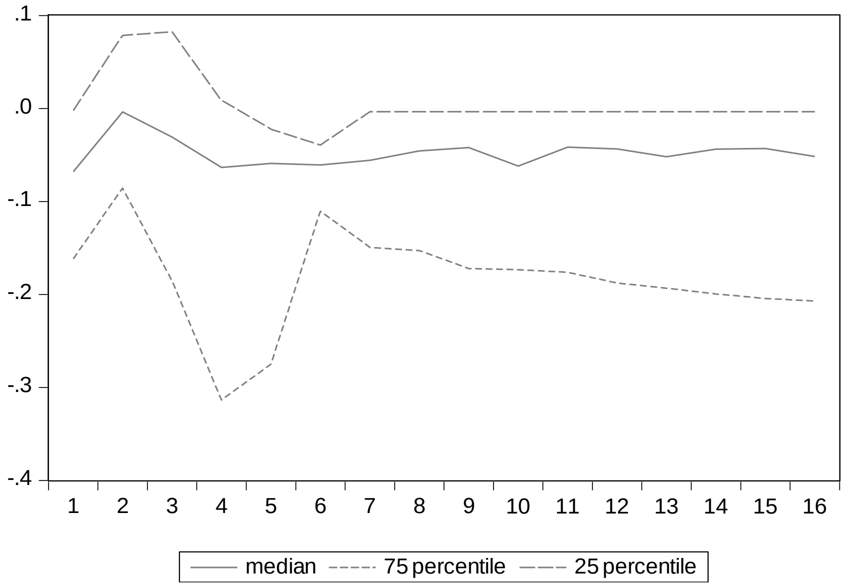
In terms of the exchange rate channel, an exogenous monetary expansion theoretically results in a depreciation of the domestic currency relative to foreign currency either directly or through a reduction in domestic interest rates that renders domestic assets unattractive. Within this context, in the presence of a viable exchange rate channel, a positive monetary shock induces a depreciation in the domestic currency.[113] The median response, presented in Figure 5.7 below, reveals that the nominal exchange rate is irresponsive to the policy shock. For 75 percent of the member countries, an exchange rate appreciation was reported contrary to the a-priori expectation. Only 25 percent of the sample registered a moderate depreciation of the exchange rate which persists throughout the period. The absence of a functional exchange rate channel at the level of ECOWAS may not be surprising given that WAEMU member countries have the domestic currency, the CFA franc, fixed at par with the euro. Movements in the cross-rate between the CFA franc and the U.S. dollar is dictated almost exclusively by developments in the euro-dollar market. Moreover, foreign investment in domestic assets in the ECOWAS region is limited, undermining the responsiveness of the

[112] The detailed response estimates to the common shock for the expanded models are presented in Appendices A.23 and A.24.
[113] The exchange rate is defined in terms of domestic currency per U.S. dollar, thus an increase in the exchange rate represents a depreciation and conversely a decrease in an appreciation.

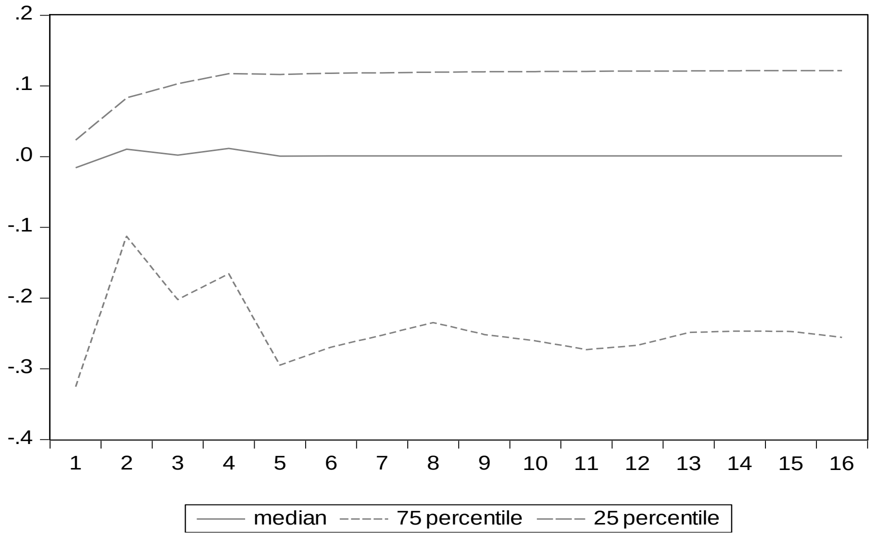
exchange rate to domestic interest rate changes even for countries in the region operating a flexible exchange regime.

Figure 5.7: ECOWAS - Panel Responses to common monetary policy shock (Extended models)

Panel response of Bank Credit to a common monetary policy shock



Panel response of Exchange Rate to a common monetary policy shock



Source: Author’s computation
Note: Total number of observations is 1104
Econometric software employed – EViews 9.5

5.6 Robustness checks

To check the robustness of the estimation results, the country-specific and panel responses to the common monetary policy shock are re-examined. To start with, the country-specific responses to the common shock are re-estimated by adopting a viable alternative ordering of the variables in the baseline model. In this regard, the recursive scheme based on short-run identification is maintained but the ordering of the endogenous variables is inverted to allow for contemporaneous impact of the policy variable on inflation. In other words, the baseline model now follows the following ordering: real GDP (lrgdp), monetary base (lmb), and inflation (inf). The impulse responses generated from this alternative ordering are presented in Figures 5.8 & 5.9 below. The responses of real GDP and Inflation to a positive innovation to the monetary base for the member countries closely mimics that of the original baseline model, in terms of magnitude of impact and statistical significance. While real GDP is largely irresponsive to the common monetary policy shock, inflation is only moderately responsive, though quite volatile in some cases. Both sets of responses appear to be asymmetric, including at the level of the WAMZ and the WAEMU.

The robustness of the panel response estimates to the common monetary policy shock is investigated through alternative model estimations adopting the viable alternative ordering of the baseline VAR model as above and then extending the model to include bank credit to the private sector in the expanded 4-variable VAR model. The panel responses of real GDP and inflation under these various scenarios are depicted in Figure 5.10 below and they present a remarkably similar outcome to that of the baseline model. The median response reveals the irresponsiveness of Real GDP to the policy shock over most of the impulse horizon. Similarly, the median inflation outcome indicates a moderate though volatile response to the unanticipated shock.[114] Both median responses under the three scenarios are not statistically different from zero. Importantly, both the responses of real GDP and inflation uncovered indications of heterogeneity across member countries under the various scenarios, as reflected in the 25th and 75th percentiles.

[114] Incorporating petroleum price index (average of Dated Brent, West Texas Intermediate and the Dubai Fateh, 2016=100: IMF data) as exogenous variable to account for monetary policy implications arising from the oil importing status of most ECOWAS member countries did not alter the median responses.

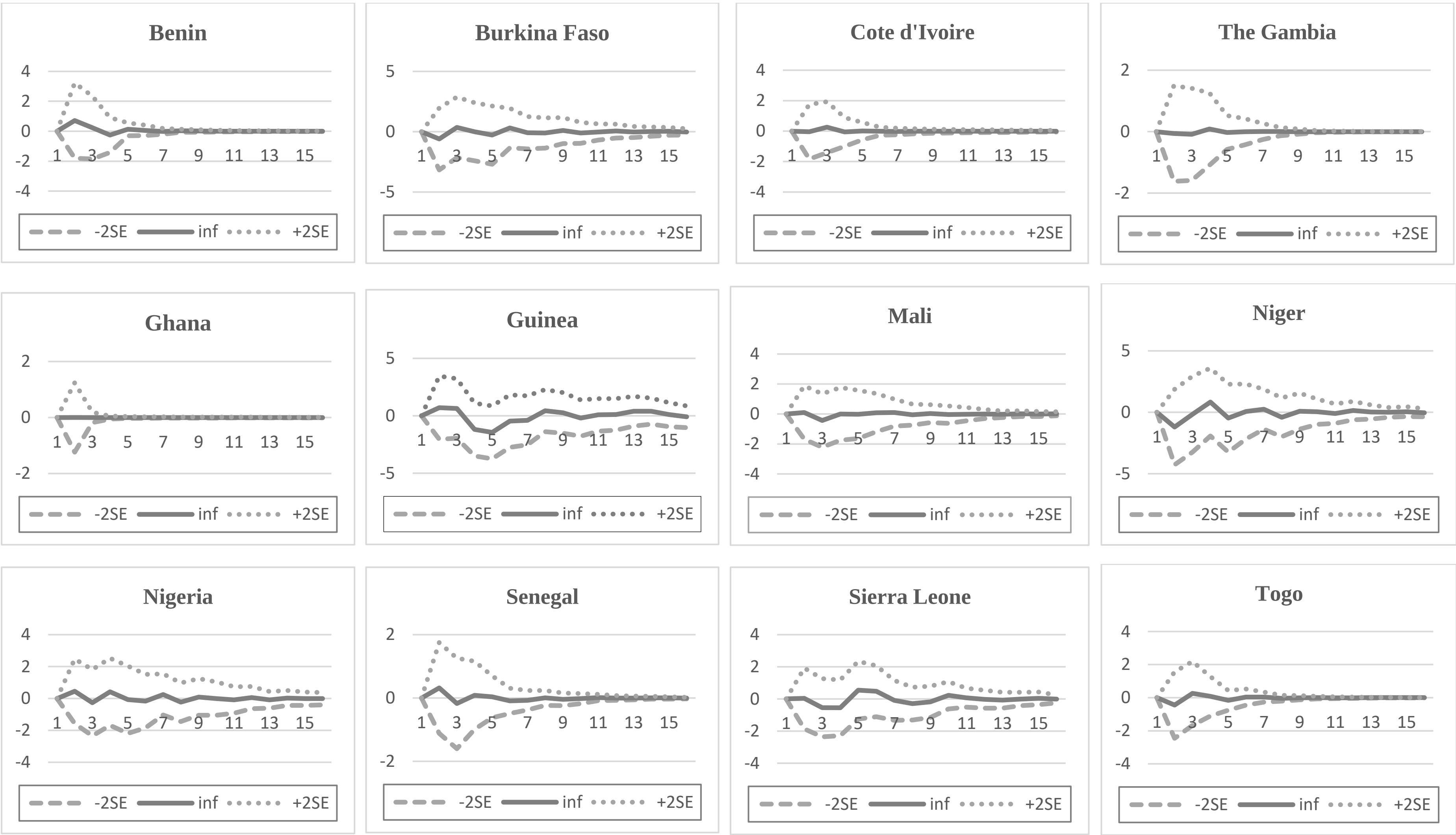
Figure 5.8: Country-specific responses of Real GDP to a common monetary shock (VAR ordering lrgdp lmb inf)

Source: Author’s computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5

Figure 5.9: Country-specific responses of Inflation to a common monetary shock (VAR ordering lrgdp lmb inf)



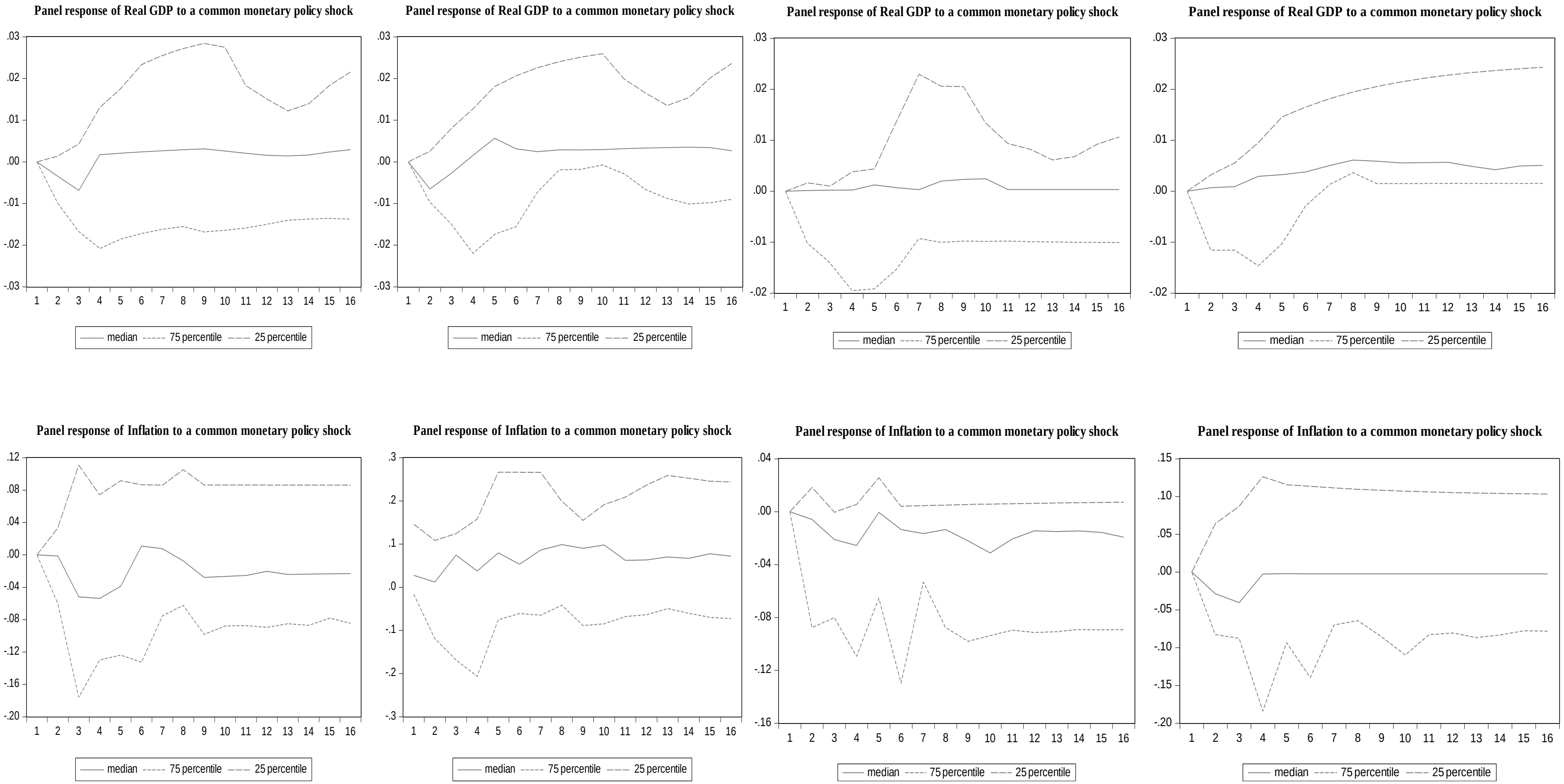
Source: Author's computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5

Figure 5.10: Robustness Check of Panel Responses to Common Monetary Shock

Baseline Model (lrgdp inf lmb) | **Alternate Ordering (lrgdp lmb inf)** | **Extended Model (lrgdp inf lmb lbc)** | **Extended Model (lrgdp inf lmb lexr)**



Source: Author's computation
Note: Total number of observations is 1104
Econometric software employed – EViews 9.5

5.7 Summary and Conclusion

This study has examined the transmission of monetary policy in the ECOWAS as the region works toward establishing a monetary union characterized by a common central bank and a single currency, the Eco. It has sought to investigate the effectiveness of monetary policy in the region and the existence of potential asymmetries in the impact of a common monetary policy on the real economy of member states. A review of the operational frameworks of monetary policy and the established channels of monetary transmission revealed that most of the traditional channels of monetary transmission may be inoperable in ECOWAS member countries and other SSA countries on account of the existing policy and institutional framework, characterized by underdeveloped financial markets, limited monetary policy instruments and low central bank policy credibility, among others. The interest rate channel, other asset price channel and expectations channel are determined to be either considerably weak or non-existent.

The study employed the dynamic heterogeneous panel structural VAR technique developed by Pedroni (2013) which, unlike conventional panel methods, allows for heterogeneous member country specific dynamics. In addition, the technique exploits the cross-sectional dependencies in the panel framework to identify common shocks which affects all the cross sections and uncover member specific responses to both common shocks—shocks impacting all member countries—and idiosyncratic shocks—shocks predominantly affecting an individual country. Within the estimation framework, the individual country impulse responses were examined. Monetary policy in the ECOWAS region was found to be ineffective in output stabilization. Inflation was also either irresponsive or quite volatile in response to unanticipated monetary policy action, with the exception of Ghana which registered theoretically-expected positive and statistically significant response to the policy shock. The findings of statistically insignificant responses to a monetary policy shock are consistent with notable studies on the SSA region (see Mishra and Montiel, 2012, pp. 12-15). As discussed in section 5.2.2, these outcomes could be attributed to the weak policy and institutional framework, underpinned by underdeveloped financial markets and low central bank policy credibility, that generally characterize these economies.

The Pedroni (2013) panel technique produces consistent estimates of the average dynamic effect of policy shocks and other moments of the distribution of impulse responses, including median and interquartile range. From the panel results, real GDP was found to be largely irresponsive to a common monetary policy shock for most member countries, irrespective of the sub-grouping, i.e. WAMZ or WAEMU. While inflation was slightly more responsive, it exhibited severe volatility in most instances. These country-specific responses exhibit asymmetry, though statistically insignificant at the 95% confidence interval. Based on the panel estimates, the median plot of real GDP for ECOWAS member countries was largely irresponsive to the unanticipated expansion of the monetary base, whereas inflation responded marginally but with some volatility. The median responses are not statistically different from zero. The 25th and 75th percentiles of both the output and inflation responses also indicate the potential existence of heterogeneity among the member countries. There is however no discernible systematic pattern in the variations in the impulse responses across member countries.

Analyses of the two plausible monetary transmission channels—the bank lending channel and the exchange rate channel—show that both channels are dysfunctional at the level of ECOWAS. The inoperability of the bank lending channel could be attributed to the thin formal financial sector, highly concentrated banking systems, and limited access to formal financial services, particularly bank loans. The exchange rate channel, for its part, is constrained by the fixed parity between the CFA franc and the Euro for WAEMU member countries, the imperfect international financial integration of regional financial institutions, and thus low foreign participation in the domestic financial markets.

The results of both the country-specific responses and the panel responses are robust to both a plausible alternative recursive identification scheme and an extended 4-variable VAR model that incorporates a financial variable, notably bank credit to the private sector.

The uncovering of potential asymmetries across member countries of the ECOWAS is largely reflective of the findings on similar current and prospective monetary unions in the SSA region. On the proposed EAMU, Davoodi et al. (2013) found weak transmission channels, with differing importance across partner countries. And similarly, for CAEMU, Bikai and Kenkouo (2015) confirmed overall weaknesses in the transmission of monetary policy that exhibited asymmetries across member countries. This study’s outcomes are also in line with Kireyev (2015) which discovered asymmetries in the size and impact of monetary policy across WAEMU countries.

Chapter 6 Overall Summary, Conclusion and Policy Implications

6.1 Overview

Implementation of the EMCP has spanned over three decades since its inception in 1987. While some progress has been accomplished in the harmonisation of macroeconomic policies and practices, including in the areas of trade integration, financial sector policies, exchange rate regimes, and monetary policy frameworks, performance in respect of the stipulated macroeconomic convergence criteria has been broadly inconsistent and lacklustre. The adoption by ECOWAS authorities in 2014 of a single-track approach to monetary integration by the year 2020 and the formal adoption in June 2019 of the 'Eco' as the name for the single currency under the proposed ECOWAS monetary union underscore the authorities' determination to forge ahead with establishment of the monetary union.

The process of instituting the requisite policy and institutional frameworks continue unabated but has been underpinned by limited research to inform policy decisions during this preparatory phase and the take-off period of the proposed monetary union. With the dearth of empirical studies even more pronounced in the area of monetary policy, this thesis has attempted to close the gap by investigating three issues of policy relevance to the monetary integration process, namely:

(i) The stability of the money multiplier and monetary targeting as a viable policy framework for conducting common monetary policy in the proposed ECOWAS monetary union;

(ii) The demand for money in ECOWAS and its implications for the conduct of a common monetary policy;

(iii) The effectiveness of monetary policy transmission in ECOWAS member countries and the existence of potential asymmetries across countries.

6.2 Summary of Results

A summary of the findings from these research studies and their conclusions are presented below.

- The first essay investigated the viability of monetary targeting as an operational monetary policy framework the proposed ECOWAS monetary union by applying panel data estimation techniques. The first part of the study assessed the stability of the conventional money multiplier from two angles. First, by determining the stationarity of the money multiplier using panel unit root tests, and second, by investigating the existence of a long-run cointegrating relationship between the broad money supply and the monetary base. Here, the analyses are conducted at the regional ECOWAS level and at the level of the sub-regional monetary arrangements—the WAEMU and the Non-WAEMU countries. For the ECOWAS region, the results of the second-generation Pesaran (2007) CIPS panel unit root test which accommodates cross-sectional dependence and the range of first-generation panel unit root tests—LLC, IPS, ADF-Fisher and PP-Fisher—reveal that the broad money multiplier has been non-stationary over the research period. Similar outcomes were reported for the WAEMU and the Non-WAEMU sub-monetary groupings. In investigating the existence of cointegration between the broad money and the monetary base, the Pedroni (2004) residual-based cointegration test and the Westerlund (2007) error-correction-based cointegration tests were employed, both of which accommodate cross-sectional dependence. These tests for cointegration fail to reject the null hypothesis of no cointegration, indicating the absence of long-run association between broad money and the monetary base for the panel of countries in the ECOWAS region. This outcome is also replicated at the level of the WAEMU and the Non-WAEMU groups. To ascertain the robustness of the results to structural breaks, the Westerlund and Edgerton (2008) panel cointegration test was applied, and it confirmed the instability of the money multiplier in the region over the research period. These results render the viability of monetary targeting as a framework for conducting monetary policy in the proposed ECOWAS monetary union questionable.

In the second part of the study, drawing from the endogenous money theory, the causal relationships between key monetary aggregates and bank credit were investigated using the dynamic panel Granger-non-causality test developed by Dumitrescu and Hurlin (2012). The results of the tests indicate that causality runs from bank credit to the monetary base. This outcome is consistent with the accommodationist view that the central bank fully accommodates demand for monetary reserves from the commercial banks to meet credit demand of economic agents. However, the tests could not confirm the expected bidirectional relationships between the broad money supply and bank credit, and the broad money multiplier and bank credit, espoused by structuralists. These results point to the significant contribution of the non-bank private sector to the process of money creation in the region through their demand for bank loans.

- The second essay examined the demand for money in the ECOWAS region and its determinants within a dynamic panel framework over the period 1980 to 2016. Based on the theoretical literature, the long-run money demand function for the ECOWAS was specified to include the log of real broad money balances as the dependent variable, with the log of real GDP, the rate of inflation, and the log of the nominal exchange rate as regressors. The parsimonious model formulation excluded the exchange rate, limiting its potential distortions emanating from the different exchange rate regimes existing in the region.

  The statistical properties of the data series were investigated using a combination of first-generation panel unit test (Maddala and Wu, 1999) and second-generation CIPS panel unit root test (Pesaran, 2007). The Maddala and Wu (1999) panel test revealed that the log of real broad money and the log of real GDP were non-stationary in levels but integrated of the order one. Inflation and the log of the nominal exchange rate were found to be stationary at levels. These outcomes were confirmed by the Pesaran (2007) CIPS test which, unlike the Maddala-Wu test procedure, accommodates cross-sectional dependence. With the combined presence of stationary and non-stationary I(1) variables, a panel ARDL model formulation was considered to be appropriate to obtain the parameter estimates.

  The application of the PMG, MG and DFE estimators revealed the existence of a long-run cointegrating relationship among the variables, as reflected by negative and highly statistically significant coefficients of the error correction terms in all panel models. The results indicate that the level of income impacts positively on the demand for real money balances over the long run and the relationship is highly statistically significant. There is also consensus among the estimators that inflation exerts a negative influence on money demand, with the results of the PMG and the DFE estimators statistically significant. The exchange rate impacts negatively on the demand for money, though statistically insignificant, with the exception of the PMG estimator which is only marginally significant at conventional levels. The parsimonious model reproduces highly significant coefficients on income and inflation, indicating that the level of income and inflation are potentially the key determinants of the desire hold money balances in the region.

The validity of these outcomes was confirmed by the CCEMG dynamic panel estimator which accommodates cross sectional correlation by augmenting the panel ARDL formulation with cross-sectional averages of the dependent variables and the regressors. The level of income and inflation were established as the driving forces of money demand in the ECOWAS over the long run. Robustness tests conducted using the AMG estimator, an alternative measure of inflation expectations and by applying the CCEMG on high frequency quarterly data confirm the estimated relationships. The stability of the long-run money demand function was investigated by estimating the model over different sample periods to examine changes in the parameter estimates. The results uncovered evidence of instability in the coefficients of the money demand model, with the income elasticity of money demand registering different magnitudes over the two sub-periods and inflation exerting conflicting impacts on money demand, both in terms of sign and statistical significance. Under these circumstances, the effectiveness of the broad money aggregate as an effective policy anchor for inflation is weakened.

- The third essay examined the transmission of monetary policy in the ECOWAS. It has sought to investigate the effectiveness of monetary policy in the region and the existence of potential asymmetries in the impact of a common monetary policy on the real economy of member states. A review of the operational frameworks of monetary policy and the established channels of monetary transmission revealed that most of the traditional channels of monetary transmission may be inoperable in ECOWAS member countries and other SSA countries, particularly the interest rate channel, other asset price channel and expectations channels.

  The study employed the dynamic heterogeneous panel structural VAR technique developed by Pedroni (2013) which allows for heterogeneous member country specific dynamics and exploits the cross-sectional dependencies in the panel framework to identify common shocks—shocks impacting all member countries—and idiosyncratic shocks—shocks predominantly affecting an individual country. The approach produces consistent estimates of the average dynamic effect of policy shocks and other moments of the distribution of impulse response such as median and interquartile range. The results indicate that the real GDP is largely irresponsive to a common monetary policy shock for most member countries, irrespective of the sub-grouping, i.e. WAMZ or WAEMU. While inflation is slightly more responsive, it exhibits severe volatility in most instances. These country-specific responses exhibited asymmetry, though statistically insignificant at the 95% confidence interval. From the panel estimates the median plot of real GDP was largely irresponsive to an unanticipated expansion of the monetary base and inflation marginally responsive though volatile. These median impulse responses are not statistically different from zero. The 25th and 75% percentiles of both the output and inflation responses revealed evidence of potential heterogeneity among the member countries. Analyses of the two plausible monetary transmission channels—the bank lending channel and the exchange rate channel—indicate that both channels are weak at the level of ECOWAS.

Robustness checks using a plausible alternative recursive identification scheme and an extended 4-variable VAR model that incorporates a financial variable ascertained both the country-specific responses and the panel responses to the common monetary policy shock.

6.3 Conclusion

The outcome of the first essay reveals that the money multiplier has been unstable, both at the level of ECOWAS and the two sub-monetary groupings, the WAEMU and WAMZ. On the basis of the panel unit root tests the broad money multiplier was found to be non-stationary, while the panel cointegration tests fail to reject the null of no cointegration between broad money and the monetary base. With regards the postulates of the endogenous money theory, the panel Granger-non-causality test shows strong causality that runs from bank credit to the monetary base. From the second essay, real income and inflation were established as the key determinants of the demand for money in the region, with positive income elasticity of money demand that is close to unity while the semi-elasticity of inflation was negative. The demand for money function was however found to be unstable over the long run. Under these circumstances, monetary targeting is considered inappropriate as a framework for the common monetary policy. The final essay shows that the transmission of monetary policy has been ineffective in the ECOWAS member countries and the conventional channels of monetary transmission either weak or inoperable. The study also uncovered evidence of asymmetries in the country-specific responses to the common monetary policy shock, though no discernible systematic pattern in the variations in the impulse responses across member countries could be identified.

6.4 Policy Implications

The findings of this study bring into question the suitability of monetary targeting as a framework to conduct monetary policy in the proposed ECOWAS monetary union. An important building block for monetary targeting is the stability and predictability of the conventional money multiplier, which enables the monetary authorities achieve their programmed money supply target by effectively adjusting the central bank's operational instrument, the monetary base. Under this circumstance, assuming a direct and positive relationship between the money supply and inflation, the central bank's ability to attain its primary objective of price stability is enhanced. The results of the study undermine the credibility and operability of the assumption of stable money multiplier and thus its predictability. Given this outcome, any decision by the common central bank to predicate policy actions primarily on monetary targeting is bound to culminate in persistent and significant breaches of its monetary target and constrain its ability to keep inflation within programmed limits. The central bank's credibility will be further weakened and its efforts at anchoring inflation expectations rendered even more challenging.

The inappropriateness of monetary targeting as an effective framework for conducting a common monetary policy is further reinforced by the evident instability in the demand for money in the ECOWAS over the long run. Under a stable money demand environment, the monetary authorities are better positioned to address monetary disequilibrium induced by an excess supply of money over demand that has the propensity to heighten inflationary pressures. With the determinants of the demand for money well defined, a path to restoring equilibrium could be properly calibrated. Thus, in the presence of instability in the money demand function, the expected relationship between money and the real sector breaks down. The setting of realistic targets on monetary variables becomes challenging and the ability of the central bank to effectively monitor progress towards achieving policy goals or to establish a credible disinflation path is compromised.

The study also provides an insight into the money creation process that has important implications for the conduct of monetary policy in the ECOWAS region. Traditional monetary theory, which has formed the theoretical foundation for monetary policy in the region, has perceived the money supply as exogenously determined by the central bank through its monopoly on monetary reserves. The central bank's regulation of the quantity of reserves placed at the disposal of the banking system determines the commercial banks' ability to issue loans to the private sector. In that context, to address over-heating of the economy, the central bank can withhold reserves, including by raising the required reserves ratio of the commercial banks, thereby constraining credit availability to market participants. Similarly, monetary expansion to support output growth is initiated by increased supply of monetary reserves by the central bank. This study finds weak evidence of the effectiveness of this exogenously-determined monetary base in stimulating commercial bank credit to the private sector.

On the other hand, the contrasting economic perspective of endogenous money espoused by Post Keynesians, built on the premise that credit is primarily demand-driven and reflective of the economy's productive capacity, obtains some empirical support from this study. The strong causality running from bank credit to the monetary base implies that a significant portion of monetary reserves injected by central banks in the region has been in a bid to accommodate commercial banks' requests for reserves to support the demand for bank loans. In this context, commercial banks undertake liabilities management including by adjusting their loan portfolios thereby influencing the credit money creation process. The perceived direct central bank control over the money supply through changes in the monetary base may have either been overstated or has waned over the years. This finding appears to be in line with the growing acknowledgement, including by the Bank of England, that money is created through demand for bank credit and not the traditional textbook narrative of the money multiplier (see Goodhart, 2017; McLeay et al., 2014). Under this circumstance, a more potent policy instrument for the central bank to influence monetary conditions would be the setting of the short-term interest rates.

The ineffectiveness of monetary policy in achieving price and output stabilisation in individual ECOWAS member countries and the fact that the two plausible channels of monetary policy transmission in the region—the bank lending channel and the exchange rate channel—are found to be either weak or inoperable, could undermine the effective conduct of a common monetary policy under the proposed monetary union. There is a critical need to enhance the transmission of monetary policy impulses in the region. Against this backdrop, the ongoing process of harmonisation of institutional and operational mechanisms of monetary policy should be expedited. More importantly, over and above harmonisation, deliberate effort should be made both by member countries and at the regional level to institute far-reaching financial sector reforms. Financial markets should be deepened and the array of policy instruments at the disposal of the monetary authorities broadened. It is apparent from Chapter 2 of this thesis that financial markets in ECOWAS countries are shallow, the formal financial sector narrow, and the financially-excluded population substantial. While noting recent initiatives to modernize monetary policy frameworks in some member states, including introducing policy rates and standing facilities to steer other rates in the money market, more needs to be done to amplify the transmission of monetary policy impulses. The inter-bank markets should be strengthened, and banks encouraged to trade amongst themselves by imposing punitive rates in the discount window at the central bank. Reduction of the huge stock of excess liquidity in the banking system which has over the years inhibited the effective transmission of monetary policy actions should be treated with utmost priority.

The existence of asymmetries in the impact of monetary policy has far-reaching implications for the institutional framework of the decision-making process within a common central bank. It informs the extent to which national data is factored into the design of monetary policy, as opposed to only averages or union-wide aggregates. Similarly, it helps determine whether econometric modelling should be based on multi-country approach that incorporates models of national central banks or whether to adopt a union-wide approach. While there are indications of heterogeneities in monetary policy transmission across ECOWAS member countries, there are no discernible systematic patterns in the variations across member countries. Identification of any policy-relevant sources of heterogeneities is constrained by the fact that monetary policy in the region has been evidently ineffective. In the absence of precise estimates of the differential impacts on monetary policy across member countries, an institutional and policy framework that takes into account developments at national levels may be appropriate at the inception of the common central bank.

As already established, a monetary targeting regime for the proposed monetary union may not be appropriate for the conduct of the single monetary policy. Exclusive reliance on monetary aggregates as operating and/or intermediate targets to attain policy objectives would be counterproductive. Policy makers should consider adopting a monetary policy framework that relies less on the assumed monetary relationships but more on price signalling to achieve the ultimate target of stable inflation. One option would be an exchange rate targeting regime that would entail maintaining the peg to the euro in the context of a wider ECOWAS monetary union or to determine another appropriate anchor currency. The former arrangement is however likely to be unfeasible as the historical and cultural ties between WAEMU countries and France which is the basis on which the current monetary arrangement is built may not apply to the wider ECOWAS union. Moreover, the desire to achieve stability in the exchange rates of member countries as reflected in the macroeconomic convergence criteria points to the fact that the regional authorities intend utilizing the exchange rate as an adjustment mechanism in the face of adverse external shocks.

An inflation-targeting (IT) regime whereby the central bank works towards achieving its set inflation target but allows some flexibility in terms of strict adherence to its attainment could serve as a viable framework for conducting the common monetary policy. However, the necessary pre-requisites for a successful IT, notably policy credibility of the central bank, robust inflation forecasting models, and sound communications strategies, coupled with reasonably developed financial markets, are generally absent in the region. To this end, consideration should be given to adopting an IT Lite regime as an initial policy framework for a common central bank, and as the financial markets develop and the requisite institutional structures are established, a full-fledged IT regime could be adopted.

Finally, the study revealed that the existence of dual exchange rate regimes across member states distorts the influence of the exchange rate on economic agents' desire to hold money balances in the region. The fact that two-thirds of the countries in the research sample (WAEMU countries and Cabo Verde) have their currencies fixed at par to the euro limits variability of their domestic currencies (CFA Franc and Escudo, respectively) to the United States dollar. Moreover, WAEMU countries' access to contingent credit line from the French Treasury provides foreign reserves assurances to defend the peg with the euro. Under such a circumstance of inflexibility in the exchange rate, the exchange rate could not serve as a prime determinant of the demand for money. Moreover, the exchange rate channel of monetary policy transmission is inoperable in the WAEMU region. On the other hand, the exchange rate is an important policy variable in the other Non-WAEMU countries operating flexible exchange rate regimes. The adoption of a fully flexible exchange rate regime under the ECOWAS monetary union would enhance the relevance of the exchange rate in the conduct of a common monetary policy, as a potential monetary transmission channel and an important determinant of the demand for money balances in the region.

6.5 Study Limitations and Opportunities for Future Research

i. The overarching aim of the Thesis is to inform the monetary integration process in the ECOWAS, particularly in respect of a new monetary policy architecture. While it may also provide useful information for formulating monetary policy decisions in the immediate period following establishment of the common central bank, the study is cognisant of potential changes to parameter estimates over time. As argued by the Lucas (1976) critique, regime changes, like the formation of a monetary union, impact on the expectations formulation mechanism which may later alter the monetary transmission mechanism. However, as it takes time for economic agents to form expectations and for these expectations to be entrenched, knowledge of the transmission mechanism may remain policy-relevant for some time following establishment of the common central bank.
ii. The study is constrained by data limitation. Consistent series of appreciable length were unavailable for other potentially relevant variables, especially at higher frequencies. As a result, quarterly data on GDP used in the essays were obtained through interpolation as compilation in ECOWAS member countries is done on an annual basis. Also, the study on the demand for money would have benefitted from consistent data across member countries on money market interest rates as opportunity cost of money or return on alternative assets. Similarly, investigating the monetary policy transmission mechanism using an alternative policy instrument, such as a short-term interest rates, may be insightful.
iii. Formal tests for parameter stability in dynamic panel data methodologies would help enhance the robustness of the results. The absence of a formal test of parameter stability in heterogeneous panel data setting meant that this study follows other recent published research papers investigating the stability of the money demand function by re-estimating the model recursively or over different sample periods. Further advancement in panel data methods in the area of parameter stability would be helpful.
iv. As aggregate union-wide data of sufficient length are only available several years following establishment of the common central bank, the models could be re-estimated to determine whether the estimated parameters have varied over time. Similarly, the common monetary policy shock could be better identified based on

the actual monetary policy instrument employed under a common monetary policy framework. This would provide greater insight into the monetary transmission mechanism in the region and determine the extent of asymmetries in the impact of a policy shock across ECOWAS member countries.

References

Adam, C. and Kessy, P. 2010. Assessing the stability and predictability of the money multiplier in the EAC: the case of Tanzania. International Growth Centre, London, UK. Available at: http://eprints.lse.ac.uk/36392/

Ahmad, N. and Ahmed, F. 2006. The long-run and short-run endogeneity of money supply in Pakistan: An empirical investigation. *SBP-Research Bulletin*, 2(1), 267-278.

Ahn, S. K. 1993. Some tests for unit roots in autoregressive-integrated-moving average models with deterministic trends. *Biometrica*, Vol. 80, pp. 855–868.

Akinlo, A. E. 2006. The Stability of Money Demand in Nigeria: An Autoregressive Distributed Lag Approach. *Journal of Policy Modelling*, 28, pp. 445-452.

Albuquerque, B., Baumann, U. and Krustev, G. 2014. Has US household deleveraging ended? A model-based estimate of equilibrium debt. *Working Paper Series* 1643, European Central Bank.

Altavilla, C. 2000. Measuring Monetary Policy: Asymmetries across EMU countries. Center for Economic Studies Discussions Paper Series (DPS) 00.22. September. www.econ.kuleuven.be/ces/discussiopapers/default.htm

Amsler, C. and Lee, J. 1995. An LM test for a unit root in the presence of a structural break. Econometric Theory, Vol. 11, pp. 359–368.

Angelini, P., Del Giovane, P., Siviero, S. and Terlizzese, D. 2002. Monetary Policy Rules for the Euro Area: What Role for National Information? Temi di discussion, No.457, Banca d'Italia, December.

Angeloni, I., Kashyap, A. K. and Mojon, B. 2003. Monetary policy transmission in the Euro area: a study by the Eurosystem. Cambridge University Press, 2003.

Arnone, M., Laurens, B. J. and Segalotto, J. F. 2006. Measures of Central Bank Autonomy: Empirical Evidence for OECD and Developing Countries, and Emerging Market Economies. IMF Working Paper 06/228.

Arellano, M. and Bond, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58 pp. 277–297.

Arestis, P. 1997. PKE theoretical aspects of money and finance, in: P. Arestis (Ed) Money, Pricing, Distribution and Economic Integration (London, Macmillan), pp. 9–33.

Arnold, I. J. and Roelands, S. 2010. The Demand for Euros. Journal of Macroeconomics, Elsevier, 32(2), 674–684. http://dx.doi.org/10.1016/j.jmacro.2010.01.001.

ASEA. 2016. 2016 Annual Report of ASEA. www.african-exchanges.org.

Asongu, S. A. 2014. Are Proposed African Monetary Unions Optimal Currency Areas? Real Monetary and Fiscal Policy Convergence Analysis. *African Journal of Economic and Management Studies*, 5(1), 9-29.

Atkeson, A. and Ohanian, L. E. 2001. Are Phillips Curves Useful for Forecasting Inflation? *Federal Reserve Bank of Minneapolis Quarterly Review*, 25(1): 2–11.

Bahmani-Oskooee, M., Chang, T. and Hung, K. 2013. Revisiting purchasing power parity in Latin America: sequential panel selection method, *Applied Economics*, 45, 4584–90.

Bahmani-Oskooee, M. and Hegerty, S. 2009. Purchasing power parity in less-developed and transition economies: a review paper, *Journal of Economic Surveys*, 23, 617–58.

Baghestani, H. and Mott, T. 1997. A Cointegration Analysis of the U.S. Money Supply Process. *Journal of Macroeconomics*. Spring 1997, Vol. 19, No. 2, pp. 269-283

Bai, J. and Ng S. 2004. A PANIC attack on unit roots and cointegration. Econometrica 72, 1127–1177

Ball, L. 2001. Another look at long-run money demand. *Journal of Monetary Economics*, 47, 31–44.

Balogun, E. D. 2009. Inflation differential in the West African Monetary Zone (WAMZ) area: Implication for unionization, *Munich Personal RePEc Archive Paper* No. 13045.

Baltagi, B. H., Feng, Q. and Kao, C. 2012. A Lagrange Multiplier Test for Cross-sectional Dependence in a Fixed Effects Panel Data Model. *Journal of Econometrics*, 170, 164-177.

Baltagi, B. H., Griffin, J. and Xiong, W. 2000. To Pool or Not to Pool: Homogeneous Versus Heterogeneous Estimators Applied to Cigarette Demand. *Review of Economics and Statistics*, 82: 117-126.

Baltagi, B. H. and Levin, D. 1986. Estimating Dynamic Demand for Cigarettes Using Panel Data: The Effects of Bootlegging, Taxation and Advertising Reconsidered. *The Review of Economics and Statistics,* MIT Press, vol. 68(1), pages 148-155, February.

Banerjee, A. 1999. Panel Data Unit Root and Cointegration: an Overview. *Oxford Bulletin of Economics and Statistics*, Special Issue, 607-629.

Banerjee, A., Dolado, J. and Mestre, R. 1998. Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of Time Series Analysis* 19:267–283.

Baumol, W.J. 1952. The Transactions Demand for Cash: An Inventory Theoretic Approach. *The Quarterly Journal of Economics*. Vol. 66, No. 4 pp. 545-56.

Bernanke, B. S. and Blinder, A. S. 1992. The Federal Funds Rate and the Channels of Monetary Transmission. *American Economic Review*, September, 82, 901–21

Bernanke, B. S., Boivin, J. and Eliasz, P. 2005. Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. *The Quarterly Journal of Economics*. pp. 387.422.

Bernanke, B. S. and Gertler, I. 1995. Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspectives*, Volume 9 Number 4, Pages 27–48.

Bernanke B. S. and Mihov I. 1998. Measuring monetary policy. *Quarterly Journal of Economics*. CX111. 315-334.

Bikai, J. L. and Kenkouo, G.A. 2015. Analysis and evaluation of the transmission channels of monetary policy in the CEMAC: An SVAR and SPVAR approach. *BEAC Working Paper,* BWP No. 02/15.

Blackburne III, E. and Frank, M. 2007. Estimation of nonstationary heterogeneous panels. *The Stata Journal* 7(2), 197 –208.

Blaes, B. 2009. Money and monetary policy transmission in the euro area: evidence from FAVAR and VAR approaches. *Discussion Paper Series* 1, No. 18. Deutsche Bundesbank System.

Blanchard, O. and Perotti R. 2002. An empirical characterization of the dynamic effects of changes in government spending and taxes on output. *The Quarterly Journal of Economics*, pp. 1329-68.

Blanchard, O. and Quah D. 1989. The dynamic effects of aggregate demand and supply disturbances. *American Economic Review*, 79, pp. 655-673.

Blundell, R. and Bond, S. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*, 115–143.

Boivin, J., Giannoni, M. and Mojon, B. 2008. How has the euro changed the monetary transmission mechanism? *National Bureau of Economic Research Working Paper*, No. 14190

Breusch, T. S. and Pagan, A. R. 1980. The lagrange multiplier test and its applications to model specification in econometrics. *Review of Economic Studies*, 47, 239-253.

Britton, E. and Whitley J. 1997. Comparing the monetary transmission mechanism in France, Germany and the United Kingdom: some issues and results. *Bank of England Quarterly Bulletin*, May, Vol. 32 No. 2

Brown, R. L., Durbin, J. and Evans, J. M. 1975. Techniques for testing the constancy of regression relationships over time, *Journal of the Royal Statistical Society*, 37, 149–92.

Brunner, K. 1961. A Schema for the Supply Theory of Money. *International Economic Review*. January, pp. 79 – 109.

Brunner, K. and Metzler, A. H.1964. Some further investigations of demand and supply functions for money. *Journal of Finance*, 19. 240 – 283.

Buigut, S. 2009. Monetary Policy Transmission Mechanism: Implications for the Proposed East African Community (EAC) Monetary Union. mimeo. Available at: www.csae.ox.ac.uk/conferences/2009-EDiA/papers/300-Buigut.pdf

CBN. 2012. Monetary Sector Model for Nigeria. Research Department, Central Bank of Nigeria

Cagan, P. 1965. Determinants and Effects of Changes in the Stock of Money, 1875-1960. New York: Columbia University Press for NBER

Calvo, G. and Reinhart, C. 2002. Fear of Floating. *The Quarterly Journal of Economics*, 117 (2), pp. 379-408, May.

Canac, P., Shirvani, H. and Wilbratte, B. 2009. The Stability of the Demand for Money in Monetary Unions: Some Empirical Evidence from WAEMU. *International Economic Journal*. ISSN: 1016 –8737.

Canning, D. and Pedroni, P. 2008. Infrastructure, long-run economic growth and causality tests for co-integrated panels. *The Manchester School* 76 (5): 504–527.

Canova, F. and Ciccarelli, M. 2013. Panel Vector Autoregressive Models: A Survey. *ECB Working Paper Series*. No. 1507, January.

Carpenter, S. and Demiralp, S. 2012. Money, reserves, and the transmission of monetary policy: Does the money multiplier exist? *Journal of Macroeconomics*, 34 (1), 59 - 75.

Caporale, G. and Soliman, A. 2009. The Asymmetric Effects of a Common Monetary Policy in Europe. *Journal of Economic Integration*, 24(3), September 2009; 455-475

Carrera, C. 2016. Long-run Money Demand in Latin American Countries: A Nonstationary Panel Data Approach. Monetaria, Centro de Estudios Monetarios Latinoamericanos, vol. 0 (1), pp 121 – 152.

Cecioni, M. and Neri, S. 2010. The monetary transmission mechanism in the euro area: has it changed and why? *Banca D'Italia Working Papers*. Temi di Discussione, Number 808.

Cevik, S. and Teksoz, K. 2012. Lost in Transmission? The Effectiveness of Monetary Policy Transmission Channels in the GCC Countries. *IMF Working Paper* WP/12/191.

Cham, T. 2010. Is WAMZ an Optimum Currency Area (OCA)? *Journal of Monetary and Economic Integration*. Vol 9, No. 2.

Choi, I. 2001. Unit Root Tests for Panel Data. *Journal of International Money and Banking* 20, 249-272.

Chortareas, G. and Kapetanios, G. 2009. Getting PPP right: identifying mean-reverting real exchange rates in panels. *Journal of Banking and Finance*, 33, 390–404.

Chow, G. C. 1960. Tests of equality between sets of coefficients in two linear regressions. *Econometrica*, 28, 591–605.

Chow, G. and Lin, A. 1971. Best Linear Unbiased Interpolation, Distribution, and Extrapolation of Time. *The Review of Economics and Statistics*, Volume 53, Issue 4 (Nov.), 372-375.

Christiano, L. J., Eichenbaum, M. and Evans, C. 1998. Monetary Policy Shocks: What we have learned and to what end. *National Bureau of Economic Research Working Paper*, No. 6400, February 1998.

Christiano, L. J., Eichenbaum, M. and Evans, C. 2005. Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy. *Journal of Political Economy,* 113 (1): 1 – 45.

Chu, K. H. 2006. Reserve Requirements and Money Multiplier Predictability: The Canadian Experience. *Banks and Bank Systems* (open-access), 1(3).

Chudik, A. and Pesaran, M. H. 2015. Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors, *Journal of Econometrics*, 188, 393 –420.

Chudik, A., Pesaran, M. H., and Tosetti, E. 2011. Weak and strong cross section dependence and estimation of large panels. *The Econometrics Journal*. 14, C45–C90.

Chuku, A. C. 2009. Measuring the effects of monetary policy innovations in Nigeria: A Structural Vector Autoregressive (SVAR) Approach. *African Journal of Accounting, Economics, Finance and Banking Research*, Vol. 5, No. 5.

Ciccarelli, M., Maddaloni, A. and Peydró, J. 2013. Heterogeneous transmission mechanism: monetary policy and financial fragility in the euro area. *ECB Working Paper Series.* No. 1527, March.

Ciccarelli, M. and Rebucci, A. 2002. The transmission mechanism of European monetary policy: Is there heterogeneity? Is it changing over time? *IMF Working Papers* WP/02/54.

Cochrane, J. 1994. [What Ends Recessions?]: Comment. *NBER Macroeconomics Annual*. Vol. 9. pp. 58-74.

Coenen, G. and Wieland, V. 2000. A Small Estimated Euro Area Model with Rational Expectations and Nominal Rigidities. *ECB Working Paper Series*, No. 30. September.

Corden, W. 1972. Monetary Integration, Essays in International Finance. International Finance Section No. 93, Princeton University.

Dagher, J. and Kovanen, A. 2011. On the Stability of Money Demand in Ghana: A Bounds Testing Approach. *IMF Working Paper*, WP/11/273. (Washington: International Monetary Fund).

Darbha, G. 2002. Testing for long-run stability—an application to money multiplier in India. *Applied Economics Letters.* Vol. 9 (No. 1), p. 33–37.

Davoodi, H., Dixit, S. and Pinto G. 2013. Monetary Transmission Mechanism in the East African Community: An Empirical Investigation. IMF Working Paper

de Brouwer, Gordon, Irene Ng, and Robert Subbaraman. 1993. The demand for money in Australia: new tests on an old topic. *Research Discussion Paper,* No. 9314, Sydney: Reserve Bank of Australia.

De Grauwe, P. and Mongelli, F. P. 2005. Endogeneities of optimum currency areas: What brings countries sharing a single currency closer together? *European Central Bank Working Paper Series*, No. 468/April 2005

De Grauwe, P. 2014. The Economics of Monetary Union, 10th Ed., New York: Oxford University Press.

Dickey, D.A. and Fuller, W.A. 1979. Distribution of the estimators for auto regressive time series with a unit root. *Journal of American Statistics Association,* 74, 427-31.

Dobnik, F. 2013. Long-run money demand in OECD countries: what role do common factors play? *Empirical Economics*, 45:89–113.

Dornbush R., Favero C. and Giavazzi F. 1998. Immediate challenges for the ECB: issues in formulating a single monetary policy. *Economic Policy*. No. 26

Downes, D., Moore, W. and Jackson, D. 2006. Financial Liberalization and the Stationarity of Money Multiplier. *International Economic Journal*, 20, pp. 227-260.

Dreger, C. and Wolters, W. 2010. Investigating M3 Money Demand in the Euro Area. *Journal of International Money and Finance*. Elsevier, 29(1), 111–122. http://dx.doi.org/10.1016/j.jimonfin.2009.02.002

Dumitrescu, E. and Hurlin, C. 2012. Testing for granger non-causality in heterogeneous panels. *Economic Modelling* 29: 450–1460.

Eberhardt, M. 2011. Panel time-series modeling: New tools for analyzing xt data, United Kingdom Stata Users' Group Meetings 2011 22, Stata Users Group, URL http://ideas.repec.org/p/boc/usug11/22.html.

Eberhardt, M. 2012. Estimating panel time-series models with heterogeneous slopes. *The Stata Journal* 12, Number 1, pp. 61 – 71.

Eberhardt, M. and Teal, F. 2010. Productivity analysis in global manufacturing production. University of Oxford, *Economics Series Working Papers* 515.

Eberhardt, M. and Teal, F. 2011. Econometrics for Grumblers: A New Look at the Literature on Cross-Country Growth Empirics. *Journal of Economic Surveys* 25(1):109–155.

ECOWAS Commission. 2017. 2016 ECOWAS Convergence Report.

ECOWAS Decision A/DEC.5/6/83 of June 1983 on Creation of an ECOWAS Monetary Zone.

ECOWAS Decision A/DEC.2/7/87 of 9 July 1987 on Introduction of the ECOWAS Monetary Cooperation Programme (EMCP).

ECOWAS Decision A/DEC.17/12/99 of 10 December 1999 on Adoption of Macroeconomic Convergence Criteria for implementation of the EMCP.

ECOWAS Decision A/DEC.17/12/01 of 21 December 2001 on Creation of the Mechanism for Multilateral Surveillance.

ECOWAS Decision, Convergence Council Meeting of 25 May 2009 on Adoption of the Roadmap for the ECOWAS single currency in 2020.

ECOWAS Decision of the Authority of Heads of State and Government at the 45th Ordinary Session of 10 July 2014 on Adoption of a single tracked approach to monetary integration.

ECOWAS Decision of the Authority of Heads of State and Government at the 55th Ordinary Session of 29 June 2019 on Naming the proposed single currency 'ECO'.

ECOWAS Protocol A/P.1/7/93 of 24 July 1993 on Establishment of the West African Monetary Agency (WAMA).

ECOWAS Supplementary Act A/SA.4/06/12 of 29 June 2012 on Establishment of the Macroeconomic Convergence and Stability Pact.

ECOWAS Supplementary Act A/SA.01/12/15 of 16 December 2015 on Rationalization of the Macroeconomic Convergence Criteria.

Ehrmann M. 1998. Will EMU generate Asymmetry? Comparing Monetary Policy Transmission across European Countries. *European University Institute Working Paper*. No. 98/28.

Els, P., Locarno, A., Morgan, J. and Villetelle, J. P. 2001. Monetary policy transmission in the Euro Area: what do aggregate and national structural models tell us? *ECB Working Paper* No. 94.

Engle, R. F. and Granger, C.W.J. 1987. Co-integration and Error-Correction: representation, Estimation, and Testing. Econometrica, Vol. 55, Issue 2, pp. 251-276.

Ericsson, N. R. 1998. Empirical modelling of money demand. Empirical Economics 23, 295–315.

Espinoza, R. and Prasad, A. 2012. Monetary Policy Transmission in the GCC Countries. *IMF Working Paper* WP/12/132

Everaert, G. and Groote, T. 2015. Common Correlated Effects Estimation of Dynamic Panels with Cross-Sectional Dependence. *Economic Review* 35, 428–463.

Fagan, G., Henry J. and Mestre R. 2001. An Area-Wide Model (AWM) for the Euro Area. *ECB Working Papers* No. 42.

Favero C., Giavazzi F. and Flabbi L. 1999. The Transmission Mechanism of Monetary Policy in Europe: Evidence from Banks' Balance Sheets. *NBER Working Paper*, No.7231

Feasel, E. M. and Kumazama, D. 2017. On the Importance of Export-led Growth: Panel Time Series Evidence. Paper prepared for the 13th Annual Liberal Arts Macroeconomics Conference, Davidson College, August 1-3.

Fisher, R. A. 1932. Statistical Methods for Research Workers. 4th edition. London: Oliver and Boyd.

Fleming, J. M. 1962. Domestic Financial Policies Under Fixed and Floating Exchange Rates. *IMF Staff Papers*, Vol. 9 (November) pp. 369–79.

Fontana, G. 2003. Post Keynesian approaches to endogenous money: a time framework explanation, *Review of Political Economy*, 219-314

Fontana, G. and Setterfield. M. eds. 2008. Macroeconomic theory and macroeconomic pedagogy. Palgrave MacMillan

Ford, J. L. and Morris, J. L. 1996. The Money Multiplier, Simple Sum, Divisia and Innovation-Divisia, Monetary Aggregates: Cointegration Tests for the United Kingdom. *Applied Economics*, 28, pp. 705-714.

Foresti P, and Napolitano O. 2014. Money demand in the Eurozone: Do monetary aggregates matter? *Inzinerine Ekonomika-Engineering Economics*, 2014, 25(5), 497–503.

Frankel, J. and Rose, A., 1998. The endogeneity of the optimum currency area criteria. *Economic Journal* 108, 1009–1025.

Frankel, J. and Rose A. 1997. Is EMU more justifiable ex post than ex ante? *European Economic Review*, 41, pp. 753-760.

Friedman, M. 1956. The quantity theory of money: a restatement. In: Friedman, M. (Ed.), Studies in the Quantity Theory of Money. University of Chicago Press, Chicago.

Friedman, M. and Schwartz, A. J. 1963. A Monetary History of the United States, 1867-1960, Princeton, Princeton University Press for NBER

Fry, R. and Pagan, A. 2011. Sign restrictions in structural vector autoregressions: A critical review. *Journal of Economic Literature*, 49, pp. 938-60.

Garcia-Hiernaux, A. and Cerno, L. 2006. Empirical Evidence for a Money Demand Function: A Panel Data Analysis of 27 Countries in 1988–98. Applied Econometrics and International Development. *Euro-American Association of Economic Development*, vol. 6(1).

Gambacorta, L., Hofmann, B. and Peersman, G. 2012. The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis. *BIS Working Papers*, No. 384. August 2012.

Georgiadis, G. 2015. Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global VAR model. *European Economic Review*, 75, 195 – 215.

Ghartey, E. E. 2005. Monetary Policy on Ghana's Term Structure of Interest Rates: Effects and Implications. No. 8, Institute of Economic Affairs, Accra, Ghana.

Goldfeld, S. M. 1973. The Demand for Money Revisited. Brookings Paper on Economic Activity. Vol. 3 (1973), pp. 577-646.

Goldfield, S. and Sichel, D. 1990. The Demand for Money. In: Benjamin Friedman and Frank Hahn, Handbook of Monetary Economics, Amsterdam: North-Holland.

Goodfriend, M. 1985. Reinterpreting Money Demand Regressions. Carnegie-Rochester Conference Series on Public Policy, Vol. 22 pp. 207-242

Goodhart, C. A. E. 1989. The conduct of monetary policy. *The Economic Journal*, 99, pp. 239-346.

Goodhart, C. A. E. 2017. The determination of the money supply: Flexibility versus Control. *The Manchester School* Vol. 85. No. S1

Granger, C.W. J. 1969. Investigating causal relations by econometric models and cross-spectral Methods. *Econometrica* 37 (3): 424–438.

Granger, C.W. J. 1988. Some recent development in a concept of causality. *Journal of Econometrics*, Elsevier, 39(1-2): 199-211.

Gregory, A. W. and Hansen, B. E. 1996a. Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics*, 70, 99-126.

Gregory, A. W. and Hansen, B.E. 1996b. Tests for cointegration in models with regime and trend shifts. *Oxford Bulletin of Economics and Statistics*, 58(3) 555-559.

Gross, M., Christoffer, K. and Zochowski, D. 2016. The Impact of Bank Capital on Economic Activity - Evidence from a Mixed-Cross-Section GVAR Model. *ECB Working Paper* No. 1888.

Hallett A. and Piscitelli L. 1999. EMU in reality: the effect of a common monetary policy on the economies with different Transmission Mechanisms. *Empirica* 26: 337 – 358.

Hamori, S. 2008. Empirical Analysis of the Money Demand Function in Sub-Saharan Africa. *Economics Bulletin*, 15(4), 1–15.

Hamori, S. and Hamori, N. 2008. Demand for Money in the Euro Area. Economic Systems, Elsevier, 32(3), 274–284, September. http://dx.doi.org/10.1016/j.ecosys.2008.03.001

Hansen, B. E. 1992. Testing for parameter instability in linear models. *Journal of Policy Modelling*, Elsevier, vol. 14(4), pp. 517-533, August.

Harb, N. 2004. Money demand function: a heterogeneous panel application. *Applied Economics Letters*, 11(9):551–555.

Harvey, S. K. and Cushing J. C. 2015. Is West Africa n Monetary Zone (WAMZ) a common currency area? *Review of Development Finance*, pp. 53-63.

Hauner, D. and Di Bella, G. 2005. How Useful Is Monetary Econometrics in Low-Income Countries? The Case of Money Demand and the Multipliers in Rwanda. *IMF Working Paper* WP/05/178.

Hendry, D. F. and Ericsson, N. R. 1991. Modelling the Demand for Narrow Money in the United Kingdom and the United States. *European Economic Review*, 35, 833–886.

Hill, R. J. and Fox, K. J. 1997. Splicing Index Numbers. *Journal of Business & Economic Statistics*, Vol. 15, 3(July 1997), pp. 387 – 389.

Hicks, J. R. 1936. The General Theory: A First Impression. In J. R. Hicks (1982), Money, Interest and Wages, Oxford: Basil Blackwell, pp. 83 – 99.

Honohan, P. 1994. Inflation and the Demand for Money in Developing Countries. *World Development*, Vol. 22, No. 2 (February), pp. 215–23.

Howells, P. 1995. The Demand for Endogenous Money. *Journal of Post Keynesian Economics, Fall*, 18 (1), 89 – 106.

Hurlin, C. and Venet, B. 2008. Testing for Granger non causality in heterogeneous panel. Document de Recherche LEO.

Im, K. S., Pesaran, M. H. and Shin, Y. 2003. Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53–74

Im, K. S., Pesaran M. H, and Shin Y. 1997. Testing for Unit Root in Heterogeneous Panels. *DAE Working Paper Series* 9526, University of Cambridge.

IMF. 2003. WAEMU: Recent Economic Developments and Regional Policy Issues; and Public Information Notice on the Executive Board Discussion. IMF Country Report No. 03/70. March 2003.

IMF. 2009. Regional Economic Outlook for Sub-Saharan Africa. October 2009.

IMF. 2012. The Eastern Caribbean Economic and Currency Union - Macroeconomics and Financial Systems, Edited by Alfred Schipke, Aliona Cebotari, and Nita Thacker.

IMF. 2014. Staff Report on West African Economic and Monetary Union. IMF Country Report No. 14/84, pp. 46 – 55. March 2014.

IMF. 2015. Macrofinancial linkages and the effectiveness of monetary policy. In Central African Economic and Monetary Community (CEMAC) selected Issues. IMF Country Report No. 15/308. pp. 21 – 27.

IMF. 2016. Liberia: Staff Report on 2016 Article IV Consultation. IMF Country Report No. 16/238. July 2016.

IMF. 2018a. West African Economic and Monetary Union. Common Policies for Member Countries. IMF Country Report No. 18/106. April 2018.

IMF. 2018b. Regional Economic Outlook for Sub-Saharan Africa. April 2018.

IMF. 2018c. Liberia: Staff Report on 2018 Article IV Consultation. IMF Country Report No. 18/172. June 2018.

IMF. 2018d. Nigeria: Selected Issues. IMF Country Report No. 18/64. March 2018.

IMF. 2018e. The Gambia: Second Review under the Staff-Monitored Program (Country Report No. 18/197), June 28, 2018.

IMF. 2019a. The Gambia: Request for a Staff-Monitored Program. IMF Country Report N0. 19/128.

IMF. 2019b. Guinea: Second Review of the Arrangement under the Three-Year Extended Credit Facility (ECF) Arrangement. IMF Country Report No. 19/30.

Ishiyama, Y. 1975. The Theory of Optimum Currency Areas: A Survey. *IMF Staff Papers*, 22, pp. 344-83.

Jakab, Z. and Kumhof, M. 2015. Banks Are Not Intermediaries of Loanable Funds – And Why This Matters. *Bank of England Working Paper* No. 529, May.

Jannsen, N. and Klein, M. 2011. The International Transmission of Euro Area Monetary Policy Shocks. *Klein Working Paper No. 1718*, July 2011. Klein Institute for the World Economy.

Jayaraman, T. K. and Ward, B. D. 2003. Is Money Multiplier relevant in a small, open economy? Empirical evidence from Fiji. University of South Pacific Working Paper No. 2003/3.

Johansen, S. 1992. Determination of co-integration rank in the presence of a linear trend. *Oxford Bulletin of Economics and Statistics* 54, pp. 383–397.

Johansen, S. 1988. Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, Vol. 12, issue 2-3, pp. 231-254.

Johansen, S. 1992. Testing Weak Exogeneity and the Order of Cointegration in UK Money Demand Data. *Journal of Policy Modelling*, Vol. 14, No. 3 (June), pp. 313-34.

Johansen, S. and Juselius, K. 1990. Maximum Likelihood estimation and Inference on Cointegration – With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52 (May), 169-210.

Khan, M. A. 2010. Testing of money multiplier model for Pakistan: Does monetary base carry any information. *Economic Analysis Working Papers*. Volume 9, No. 2.

Kaldor, N. 1970. The new monetarism. *Lloyds Bank Review*, 97: 1 – 17.

Kaldor, N. 1982. The Scourge of Monetarism, Oxford, OUP.

Kamin, S. B., Turner, P. and Van 't dack, J .1998. The transmission of monetary policy in emerging market economies: an overview. *BIS Policy Papers*, no 3, Bank for International Settlements.

Kapetanios, G., Pesaran, M. H. and Yagamata, T. 2011. Panels with nonstationary multifactor error structures. *Journal of Econometrics*, 160, 326–348.

Kenen, P. 1969. The Theory of Optimum Currency Areas: An Eclectic View. In: R. Mundell and A. Swoboda (eds.), Monetary Problems of the International Economy, Chicago: University of Chicago Press.

Keynes, J. M. 1930. A Treatise on Money, London, Macmillan.

Keynes, J. M. 1936. The General Theory of Employment, Interest and Money. London and New York: Macmillan, 1936.

Kieler, M. and Saarenhiemo, T. 1998. Differences in Monetary Policy Transmission? A case not closed.

Kilian, L. 2011. Structural Vector Autoregressions. University of Michigan, Department of Economics, Ann Arbor, Michigan.

Kireyev, A. 2015. How to Improve the Effectiveness of Monetary Policy in the West African Economic and Monetary Union. *IMF Working Paper* WP/15/99.

Kovanen, A. 2011. Monetary Policy Transmission in Ghana: Does the Interest Rate Chanel Work? *IMF Working Paper*, WP/11/275

Kumar, S., Chowdhury, M. and Rao, B. B. 2010. Demand for Money in the Selected OECD Countries: A Time Series Panel Data Approach and Structural Breaks. MPRA Paper No. 22204, University Library of Munich, Germany.

Kumar, S. and Rao, B. B. 2012. Error-Correction Based Panel Estimates of the Demand for Money of Selected Asian Countries with the Extreme Bounds Analysis. Economic Modelling 29 (2012) 1181–1188.

Lavoie, M. 1992. Jacques Le Bourva's theory of endogenous credit-money. *Review of Political Economy*, 4(4), 436-446.

Levin, A., Lin C.F. and Chu C. 2002. Unit Root Test in Panel Data: Asymptotic and Finite Sample Properties. *Journal of Econometrics*, 108: 1 - 4.

Lopez, L and Weber, S. 2017. Testing for Granger causality in panel data. *IRENE Working Papers*, 17-03, IRENE Institute of Economic Research.

Lopreite, M. 2014. The Endogenous Money Hypothesis: An Empirical Study of the Euro Area (1999 – 2010). *Journal of Knowledge Management, Economics and Information Technology*, Vol. IV, Issue 4.

Lovrero, E. S. and Deleidi, M. 2017. The money creation process: A theoretical and empirical analysis for the US. *MPRA Paper*, No. 81970

Lucas, R. 1976. Econometric Policy Evaluation: A critique. Carnegie-Rochester Conference Series on Public Policy 1, 16-46.

Maddala, G. S. and Wu, S. 1999. A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics*. 61, 631–652.

Majone, G. 2012. Rethinking European Integration after the Debt Crisis. *The European Institute Working Paper*. No. 3/2012.

Mancini-Griffoli, T. and Pauwels, L. L. 2006. Is There a Euro Effect on Trade? An Application of End-of-Sample Structural Break Tests for Panel Data. *HEI Working Papers* 04-2006.

Mansaray, M. and Swaray, S. 2013. Financial Liberalization, Monetary Policy and Money Demand in Sierra Leone. *Journal of Monetary and Economic Integration*, Vol. 12, No. 2.

Mandler, M., Scharnagl, M. and Volz, U. 2016. Heterogeneity in euro-area monetary policy transmission: results from a large multi-country BVAR model. *Deutsche BundesBank Eurosystem Discussion Paper*. No. 03/2016.

Mark, N.C. and Sul, D. 2003. Cointegration vector estimation by panel DOLS and long-run money demand. *Oxford Bulletin of Economics and Statistics*, 65, 5 (2003) 0305-9049

McAdam P. and Morgan J. 2001. The Monetary Transmission Mechanism at the Euro-Area Level: Issues and Results using structural macroeconomic models. *ECB Working Paper Series*. No. 93, December

McKinnon, R. 1963. Optimum Currency Area. *American Economic Review*, September 1963, pp. 717-725.

McKinnon, R. 1973. Money and Capital in Economic Development. Washington: The Brookings Institution.

McLeay, M., Radia, A. and Thomas, R. 2014. Money creation in the modern economy. *Bank of England Quarterly Bulletin*, 2014 Q1.

Meyer, B. H. and Pasaogullari, M. 2010. Simple Ways to Forecast Inflation: What Works Best? *Federal Reserve Bank of Cleveland Economic Commentary*, No. 2010-17.

Minsky, H.P. 1982. Can "It" Happen Again? Essays on Instability and Finance, Armonk, NY, M.E. Sharpe

Mishra, P. and Montiel, P. 2012. How Effective Is Monetary Transmission in Low-Income Countries? A Survey of the Empirical Evidence. *IMF Working Paper*, No. 12/143.

Mishra, P., Montiel P., Pedroni, P. and Spilimbergo, A. 2014. Monetary policy and bank lending rates in low-income countries: Heterogeneous panel estimates. *Journal of Development Economics*, 111, pp. 117-131.

Mishra, P., Montiel, P. and Spilimbergo, A. 2012. Monetary transmission in low-income countries: effectiveness and policy implications. *IMF Economic Review*, 60 (2012), pp. 270-302

Mishkin, F. S. 1995. Symposium on the Monetary Transmission Mechanism. *Journal of Economic Perspectives*, Vol. 9, no.4, pp. 3-10

Modigliani, F. and Miller, M. H. 1958. The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, 261-296.

Mojon, B. and Peersman, G. 2001. A VAR description of the effects of the monetary policy in the individual countries of the euro area. *ECB Working Paper Series*. No. 92, December.

Monticelli C. and Tristani, O. 1999. What does the single monetary policy do? A SVAR benchmark for the European Central Bank. *ECB Working Paper Series*. No. 2, May.

Moon, R. and Perron, B. 2004. Testing for a unit root in panels with dynamic factors. *Journal of Econometrics*, 122, 81–126.

Moore, B. J. 1983. Unpacking the Post Keynesian black box: Bank lending and the money supply. *Journal of Post Keynesian Economics*, 5(4), 537-556.

Moore, B. J. 1988. *Horizontalists and Verticalists: The Macroeconomics of Credit Money*, Cambridge: Cambridge University Press.

Mundell, R. 1961. A Theory of Optimum Currency Areas. *American Economic Review*, pp. 657-665.

Mundell, R. 1963. Capital Mobility and Stabilization Policies Under Fixed and Flexible Exchange Rates. *Canadian Journal of Economics and Political Science*, Vol. 29 (November), pp. 475-85.

Munroo, M.H. 2015. Theory of Optimum Currency Areas: A Literature Survey. *Review of Market Integration*. 7(2) 87-116.

Narayan, P. K. 2010. Modelling money demand for a panel of eight transitional economies. Applied Economics, 42:25, 3293-3305.

Nautz, D. and Rondorf, U. 2011. The (in)Stability of Money Demand in the Euro Area: Lessons from a Cross Country Analysis. *Empirica, Spinger*, 38(4), 539–553. http://dx.doi.org/10.1007/s10663-010-9139-y

Nayan, S., Kadir, N., Abdullah, M. S., and Ahmad, M. 2013. Post Keynesian endogeneity of money supply: Panel evidence. *Procedia Economics and Finance*, 7, 48-54.

Nchor, D. and Adame, V. 2016. Investigating the Stability of Money Demand in Ghana. Paper presented at the 19th International Conference Enterprise and Competitive Environment 2016, ECE 2016, 10–11 March 2016, Brno, Czech Republic.

Ndanshau, M. O. 2005. The determinants of money multiplier in Tanzania. *Tanzanian Economic Trends*, Vol. 18, No. 2.

Ndekwu, E. C. 2013. An Analysis of the Monetary Policy Transmission Mechanism and The Real Economy in Nigeria. *CBN Occasional Paper*, No. 43.

Neal, T. 2014. Panel cointegration analysis with xtpedroni. *The Stata Journal*, vol 14, no.3, pp. 684-692.

Nell, K.S. 1999. The Endogenous/Exogenous Nature of South Africa's Money Supply Under Direct and Indirect Monetary Control Measures. *Department of Economics Discussion Paper*. University of Kent, No. 9912.

Nyong, M. O. 2014. The Demand for Money, Structural Breaks and Monetary Policy in The Gambia. *Developing Country Studies*, Vol. 4, No.19.

Nyumuah, F. S. 2017. An Investigation into the Interest Elasticity of Demand for Money in Developing Countries: A Panel Data Approach. *International Journal of Economics and Finance*, Canadian Center of Science and Education, vol. 9(3), pages 69-80, March.

Olawale-Ogunkula, E. and Tarawalie, A. B. 2008. Monetary policy transmission mechanism in Sierra Leone: A Vector Error Correction (VEC) Approach. *Journal of Political Economy*, 207-37.

Ongan, S. and Gocer, I. 2019. Revisiting the Stability of Money Multiplier on Determination of Money Supply: Evidence from Canada. *Economics Bulletin*, Volume 39, Issue 2, pages 1621-1628

Palley, T. I. 1996. Accommodationism versus structuralism: time for an accommodation. *Journal of Post Keynesian Economics*, 18(4), pp. 585–594.

Panagopoulos, Y. and Spiliotis, A. 1998. The determinants of commercial banks' lending behaviour: some evidence for Greece. *Journal of Post Keynesian Economics*, 20(4), 649-672.

Panagopoulos, Y and Spiliotis, A. 2008. Alternative Money Theories: A G7 Testing. *Journal of Post Keynesian Economics*, Vol. 30, No. 4 (Summer, 2008), pp. 601-622. Published by: Taylor & Francis, Ltd.

Pedroni, P. 1999. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economic and Statistics*. 61, 653–678.

Pedroni, P. 2000. Fully modified OLS for heterogeneous cointegrated panels. *Advances in Econometrics*, vol 15. Emerald (MCB UP), Bingley, pp. 93–130

Pedroni P. 2001. Purchasing Power Parity tests in cointegrated panels. *The Review of Economics and Statistics*, 83(4):727–731

Pedroni, P. 2004. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory*, Vol. 20, No. 03, pp. 597-625.

Pedroni, P. 2013. Structural Panel VARs. *Econometrics*. 2, 180-206

Peersman, G. and Smets, F. 2001. The Monetary Transmission Mechanism in the Euro Area: More Evidence from VAR Analysis. *ECB Working Paper Series*. No.91, December.

Peersman, G. 2011. Macroeconomic Effects of Unconventional Monetary Policy in the Euro Area. *CESifo Working Paper Series* 3589, CESifo Group Munich.

Perron, P. 1990. Testing for a unit root in a time series with a changing mean. *Journal of Business and Economic Statistics*, 8, pp. 153–162.

Perron, P. and Vogelsang, T. 1992. Nonstationarity and level shifts with an application to purchasing power parity, *Journal of Business and Economic Statistics*, 10, pp. 301–320.

Pesaran, M. H. 1999. Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association* 94: 621- 634.

Pesaran, M. H. 2001. Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289 – 326.

Pesaran, M. H. 2004. General Diagnostic Tests for Cross Section Dependence in Panels. *CESifo Working Paper Series* No. 1229; IZA Discussion Paper No. 1240.

Pesaran, M.H. 2006. Estimation and inference in large heterogeneous panels with a multi-factor error structure. *Econometrica*, Vol.74, pp. 967-1012.

Pesaran, M. H. 2007. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics* 22, 265 –312.

Pesaran, M. H. and Smith, R. P. 1995. Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, 68: 79 – 113.

Pesaran, M. H., Shin, Y. and Smith, R. P. 1997. Estimating long-run relationships in dynamic heterogeneous panels. *DAE Working Papers Amalgamated Series* 9721.

Pesaran, H., Shin, Y. and Smith, R. 1999. Pooled mean group estimation of dynamic heterogenous panels, *Journal of the American Statistical Association*, 68, 621-634.

Pesaran, M. H. and Tosetti, E. 2011. Large panels with common factors and spatial correlations. *Journal of Econometrics*, 161, 182–202.

Phillips, C. A. 1920. Bank Credit. New York, Macmillan.

Phillips, P. C. B. and Perron, P. 1988. Testing for Unit Roots in Time Series Regression. *Biometrika*, 75, 335-346.

Pigou, A. C. 1917. The Value of Money. *The Quarterly Journal of Economics*. Vol. 37 (November 1917), pp. 38-65

Poole, W. 1970. Optimal Choice of Monetary Policy Instrument in a Simple Stochastic Macro Model. Quarterly Journal of Economics, 84, pp 197-216

Rao, B. B. and Kumar, S. 2009. A panel data approach to the demand for money and the effects of financial reforms in the Asian countries. *Economic Modelling* 26 (2009) 1012 - 1017

Rao, B. B., Tamazian, A. and Singh, P. 2009. Demand for Money in the Asian Countries: A Systems GMM Panel Data Approach and Structural Breaks. *MPRA Paper* 15030, University Library of Munich, Germany.

Rubio-Ramirez, J., Waggoner D. and Zha T. 2005. Markov-Switching Structural Vector Autoregressions: Theory and application. *Federal Reserve Bank of Atlanta Working Paper*. 27.

Rummel, O. 2015. Subset VAR, SVAR and VECM modelling, Economic Modelling and Forecasting. Centre for Central Banking Studies, Bank of England.

Rusuhuzwa, T. K. 2015. Monetary and financial innovations and stability of money multiplier in Rwanda. *Issues in Business Management and Economics*, Vol. 3 (1), pp. 1-8, January 2015.

Sacerdoti, E. 2005. Access to Bank Credit in Sub-Saharan Africa: Key Issues and Reform Strategies. *IMF Working Paper 05/166* (Washington, DC: International Monetary Fund).

Saikkonen, P. 1991. Asymptotically efficient estimation of cointegration regressions. Econometric Theory, Vol. 7, pp. 1–21.

Salisu, A., Ademuyiwa, I. and Fatai, B. 2013. Modelling the Demand for Money in Sub-Saharan Africa (SSA). *Economics Bulletin*. Vol 33. Issue 1.

Sandee, J. and Lisman, J.H.C. 1964. Derivation of Quarterly Figures from Annual Data. *Applied Statistics*. 13, No. 2. pp. 87 – 90.

Sanya, O. and Awe, A.A. 2014. Impact of Financial Liberalisation on the Stability of Nigerian money demand function. *International Journal of Economics*, *Business and Finance*, vol. 2, No. 1, pp. 1 – 18

Sawyer, M. C. 1996. Money, finance and interest rates, in: P. Arestis (Ed) Keynes, Money and the Open Economy: essays in honour of Paul Davidson (Cheltenham, Edward Elgar), vol. 1, pp. 50–68.

Saxegaard, M. 2006. Excess Liquidity and Effectiveness of Monetary Policy: Evidence from Sub-Saharan Africa. *IMF Working Paper 06/115* (Washington, DC: International Monetary Fund).

Schmidt, P. and Phillips, P. C. B. 1992. LM tests for a unit root in the presence of deterministic trends. *Oxford Bulletin of Economics and Statistics*, Vol. 54, pp. 257–287.

Seck, D. 2013. Fifteen Years of WAEMU: Results and Strategies for the Future. In: Ayuk, E. T. and Kaboré, S. T. (eds.) Wealth through integration: Regional integration and poverty-reduction strategies in West Africa. Insight and Innovation in International Development, pp.19-42.

Setzer, R. and Wolff, G. B. 2013. Money demand in the euro area: new insights from disaggregated data. *Journal of International Economic Policy* (2013) 10: 297-315 Paper No. 17483

Sheard, P. 2013. Repeat After Me: Banks Cannot And Do Not ‘Lend Out’ Reserves. *Standard & Poor’s Economic Research*, August 13, 2013

Shin, Y, Yu, B. and Greenwood-Nimmo, M. 2014. Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications, Eds. by R. Sickels and W. Horrace: Springer, 281-314.

Sim, C. A. 1980. Macroeconomics and Reality. *Econometrica*. 48(1) pp.1-48

Sim, C. A. 1992. Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy. *European Economic Review*, 36. pp. 975-1011.

Sims, C. A., Stock, J. H. and Watson, M.W. 1990. Inference in linear time series models with some unit roots, Econometrica 58, 113-144.

Smeekes, S. 2010. Bootstrap sequential tests to determine the stationary units in a panel. Maastricht University, RM/11/003.

Smets, F. 1995. Central bank macroeconometric models and the monetary policy transmission mechanism, in BIS, Financial Structure and the Monetary Policy Transmission Mechanism. Basle: BIS, pp. 225-66

Smets, F. and Wouters, R. 2002. An Estimated Stochastic Dynamic General Equilibrium Model of the Euro Area. *European Central Bank Worker Paper*. No. 171.

Soares, R. 2011. Assessing Monetary Policy in the Euro Area: A Factor-Augmented VAR Approach. *Banco de Portugal Working papers*. 11.

Sriram, S. 1999. Survey of Literature on Demand for Money: Theoretical and Empirical Work with Special Reference to Error-Correction Models. *IMF Working Paper* WP/99/64.

Sriram, S. 2009. The Gambia: Demand for Broad Money and Implications for Monetary Policy Conduct. *IMF Working Paper* WP/09/192.

Stock, J. H. and Watson, M. W. 1993. A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica*, Vol. 61, pp. 783–820.

Stock, J. H. and Watson, M.W. 1999. Forecasting Inflation. *National Bureau of Economic Research*. Working Paper 7023.

Taylor, J. B. 1995. The Monetary Transmission Mechanism: An Empirical Framework. *Journal of Economic Perspectives*. Vol. 9. No. 4, pp. 11 – 26.

Taylor, J. B. 2000. Using Monetary Policy Rules in Emerging Market Economies. Paper presented at the 75th Anniversary Conference "Stabilization and Monetary Policy: The International Experience", November 14 – 15, 2000, at the Bank of Mexico.

Tobin, J. 1956. The Interest Elasticity of Transactions Demand for Cash. *The Review of Economics and Statistics*, Vol. 38, No. 3 pp. 241 -247

Tobin, J. 1958. Liquidity Preference as Behaviour Towards Risk. *The Review of Economic Studies*, Vol. 25, No. 67 pp. 65 – 86.

Tobin, J. 1969. A General Equilibrium Approach to Monetary Theory. *Journal of Money, Credit and Banking*, 1(1): 15-29.

Toda, H.Y. and Phillips, P.C.B. 1993. Vector auto regressions and causality. *Journal of Econometrics* 61: 1367–93.

Tucker, J. A. 2003. The stability of money demand in the West African Monetary Zone: implications for the conduct of a single monetary policy. *West African Journal of Monetary and Economic Integration* (ISSN 0855-594X). Volume: 3. Issue: 1. Period: 1st half.

Tule, K. M. and Ajilore, O. T. 2016. On the stability of the money multiplier in Nigeria: Cointegration analyses with regime shifts in banking system liquidity. *Cogent Economics and Finance*, 4: 1187780

UNECA. 2015. ECOWAS at 40: An Assessment of Progress Towards Regional Integration in West Africa

Valadkhani, A. 2008. Long- and short-run determinants of the demand for money in the Asian-Pacific countries: An empirical panel investigation. *Annals of Economic and Finance*, 9-1, 77–90.

Verdugo-Yepes, C., Pedroni, P. and Hu, X. 2015. Crime and the Economy in Mexican States: Heterogeneous Panel Estimates (1993-2012). *IMF Working Paper*, WP/15/12.

WAMA. 2013. The Demand for Money in ECOWAS countries. Paper presented at the WAMA end-of-year statutory meetings in Abuja, Nigeria from January 11-18, 2013 (Unpublished).

WAMA. 2017. 2016 Report on Financial Sector Developments and Stability in ECOWAS www.amao-wama.org

WAMI. 2016. Annual Report and Statement of Accounts for the Year Ended 31st December 2016. http://www.wami-imao.org/?q=annualreport

WAMZ Agreement ECW/AGR/WAMZ/1 of 20 April 2000 on Formation of the West African Monetary Zone (WAMZ).

Weintraub, S. 1978. Keynes, Keynesians, and Monetarists (Philadelphia, University of Pennsylvania Press)

Westerlund, J. 2007. Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, 69: 709–748.

Westerlund, J. and Edgerton, D. L. 2008. A simple test for cointegration in dependent panels with structural breaks. *Oxford Bulletin of Economics and Statistics*, 70(5), 665–704.

World Bank. 2016. World Development Indicators 2016.

Wray, L.R. 1995. Keynesian Monetary Theory: Liquidity Preference or Black Box Horizontalism. *Journal of Economic Issues*, 29(1), 273-282.

Zaki, M. 1995. Forecasting the money multiplier and the control of money supply in Egypt. *The Journal of Development Studies*, 32:1, 97-111.

Appendices

Appendix A.1: ECOWAS Primary Convergence Criteria

1.1: Ratio of budget deficit to GDP

Countries	2012	2013	2014	2015	2016	2012-2016
Benin	0.4	2.6	1.9	8.0	6.2	**3.8**
Burkina Faso	3.1	3.6	1.9	2.0	3.1	**2.7**
Cabo Verde	12.4	8.8	7.2	3.9	3.5	**7.2**
Cote d'Ivoire	3.2	2.2	2.2	2.9	3.9	**2.9**
The Gambia	4.6	8.7	9.6	6.3	9.5	**7.7**
Ghana	5.7	8.6	6.4	4.8	10.9	**7.3**
Guinea	-3.2	2.0	3.6	6.9	-0.1	**1.8**
Guinea Bissau	2.1	3.4	2.6	2.7	4.0	**3.0**
Liberia	-7.5	0.5	-0.2	-1.6	-2.2	**-2.2**
Mali	0.1	2.2	3.8	1.8	3.9	**2.4**
Niger	1.1	2.6	8.1	9.0	6.1	**5.4**
Nigeria	1.4	1.3	1.0	1.5	2.2	**1.5**
Senegal	5.8	5.5	5.2	4.8	4.2	**5.1**
Sierra Leone	5.2	1.6	3.3	4.1	6.4	**4.1**
Togo	5.8	4.6	3.4	6.3	8.5	**5.7**
No. of Countries that met the criteria	**5**	**8**	**6**	**6**	**6**	**7**

1.2: Average annual inflation rate

Countries	2012	2013	2014	2015	2016	2012-2016
Benin	6.8	1.0	-1.1	0.3	-0.8	**1.2**
Burkina Faso	3.8	0.5	-0.3	0.9	-0.2	**0.9**
Cabo Verde	2.5	1.5	-0.2	0.1	-1.4	**0.5**
Cote d'Ivoire	1.3	2.6	0.4	1.2	0.7	**1.2**
The Gambia	4.3	5.7	6.9	6.8	7.9	**6.3**
Ghana	9.1	11.7	17.0	17.2	17.5	**14.5**
Guinea	15.2	11.9	9.7	8.2	8.2	**10.6**
Guinea Bissau	2.1	0.7	-1.0	1.4	1.5	**0.9**
Liberia	6.9	7.6	9.8	7.8	8.8	**8.2**
Mali	5.3	-0.6	0.9	1.5	-1.8	**1.1**
Niger	0.5	2.3	-0.9	1.0	0.2	**0.6**
Nigeria	12.2	8.5	8.0	9.0	15.7	**10.7**
Senegal	1.4	0.7	-1.1	0.1	0.8	**0.4**
Sierra Leone	12.9	10.4	7.2	8.1	10.8	**9.9**
Togo	2.6	1.8	0.2	1.8	0.9	**1.5**
No. of Countries that met the criteria	**12**	**12**	**14**	**14**	**12**	**12**

Source: ECOWAS Commission

1.3: Central bank financing of the Budget Deficit

Countries	2012	2013	2014	2015	2016	2012-2016
Benin	0.0	0.0	0.0	0.0	0.0	**0.0**
Burkina Faso	0.0	0.0	0.0	0.0	0.0	**0.0**
Cabo Verde	0.0	0.0	0.0	0.0	0.0	**0.0**
Cote d'Ivoire	0.0	0.0	0.0	0.0	0.0	**0.0**
The Gambia	0.4	0.0	40.8	41.5	33.1	**23.2**
Ghana	25.4	12.3	13.7	4.1	0.0	**11.1**
Guinea	0.0	0.0	0.0	0.3	0.0	**0.1**
Guinea Bissau	0.0	0.0	0.0	0.0	0.0	**0.0**
Liberia	0.0	0.0	0.0	0.0	0.0	**0.0**
Mali	0.0	0.0	0.0	0.0	0.0	**0.0**
Niger	0.0	0.0	0.0	0.0	0.0	**0.0**
Nigeria	0.0	0.0	0.0	0.0	0.0	**0.0**
Senegal	0.0	0.0	0.0	0.0	0.0	**0.0**
Sierra Leone	-37.7	1.7	7.2	-0.7	33.1	**0.7**
Togo	0.0	0.0	0.0	0.0	0.0	**0.0**
No. of Countries that met the criteria	**14**	**14**	**13**	**14**	**13**	**13**

1.4: Gross external reserves (in months of Imports)

Countries	2012	2013	2014	2015	2016	2012-2016
Benin	5.3	4.7	5.0	5.0	4.4	**4.9**
Burkina Faso	5.3	4.7	5.0	5.0	4.4	**4.9**
Cabo Verde	4.0	4.9	5.4	6.4	6.6	**5.5**
Cote d'Ivoire	5.3	4.7	5.0	5.0	4.4	**4.9**
The Gambia	4.8	4.6	3.7	2.5	2.4	**3.6**
Ghana	3.0	3.1	3.0	2.6	2.8	**2.9**
Guinea	2.4	2.9	3.2	2.2	1.4	**2.4**
Guinea Bissau	5.3	4.7	5.0	5.0	4.4	**4.9**
Liberia	2.8	2.8	2.5	2.3	3.3	**2.7**
Mali	5.3	4.7	5.0	5.0	4.4	**4.9**
Niger	5.3	4.7	5.0	5.0	4.4	**4.9**
Nigeria	8.5	8.9	6.0	8.2	5.8	**7.5**
Senegal	5.3	4.7	5.0	5.0	4.4	**4.9**
Sierra Leone	3.4	3.2	3.6	3.8	4.7	**3.7**
Togo	5.3	4.7	5.0	5.0	4.4	**4.9**
No. of Countries that met the criteria	**13**	**13**	**14**	**11**	**12**	**12**

Source: ECOWAS Commission

Appendix A.2: ECOWAS Secondary Convergence Criteria

2.1: Ratio of Total public debt to GDP

Countries	**2012**	**2013**	**2014**	**2015**	**2016**	**2012-2016**
Benin	26.8	25.4	30.9	42.4	49.4	35.0
Burkina Faso	28.0	28.6	30.8	32.8	34.2	30.9
Cabo Verde	91.1	102.5	115.0	126.1	128.6	112.7
Cote d'Ivoire	34.2	34.0	36.9	40.8	42.1	37.6
The Gambia	78.0	88.1	104.1	101.1	117.3	97.7
Ghana	47.8	56.8	70.2	73.2	73.1	64.2
Guinea	42.2	44.5	73.5	43.3	43.1	49.3
Guinea Bissau	52.4	52.6	53.3	46.8	46.1	50.2
Liberia	34.1	30.5	37.9	32.0	36.7	34.2
Mali	24.3	26.0	27.1	30.8	36.0	28.8
Niger	18.8	23.1	25.6	36.0	39.7	28.6
Nigeria	12.6	12.4	12.5	12.6	17.1	13.4
Senegal	36.7	30.7	35.4	29.1	55.7	37.5
Sierra Leone	36.7	30.8	35.4	29.1	55.7	37.5
Togo	44.0	45.3	66.9	76.8	79.4	62.5
No. of Countries that met the criteria	**13**	**13**	**11**	**11**	**11**	**13**

2.2: Nominal exchange rate variation

Countries	**2012**	**2013**	**2014**	**2015**	**2016**	**2012-2016**
Benin	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
Burkina Faso	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
Cabo Verde	-4.0	4.1	0.1	-9.3	0.5	**-1.7**
Cote d'Ivoire	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
The Gambia	-4.5	-10.3	-16.5	4.9	-3.3	**-5.9**
Ghana	-4.4	-7.4	-31.5	-15.7	-4.2	**-12.6**
Guinea	-2.5	2.1	-1.5	2.2	-16.4	**-3.2**
Guinea Bissau	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
Liberia	1.3	-4.1	-9.0	7.2	-8.4	**-2.6**
Mali	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
Niger	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
Nigeria	0.7	2.1	-1.9	-1.9	-23.5	**-4.9**
Senegal	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
Sierra Leone	3.3	1.1	-4.0	-3.1	-19.1	**-4.4**
Togo	-4.8	4.1	0.1	-9.3	0.5	**-1.9**
No. of Countries that met the criteria	**15**	**14**	**13**	**14**	**12**	**14**

Source: ECOWAS Commission

Appendix A.3: ECOWAS - Overall Convergence Performance (2012-2016)

Countries	2012	2013	2014	2015	2016	2012-2016
Benin	6.0	6.0	6.0	5.0	5.0	**5.6**
Burkina Faso	5.0	5.0	6.0	6.0	5.0	**5.4**
Cabo Verde	4.0	4.0	4.0	4.0	4.0	**4.0**
Cote d'Ivoire	5.0	5.0	6.0	6.0	5.0	**5.4**
The Gambia	4.0	3.0	2.0	2.0	2.0	**2.6**
Ghana	4.0	3.0	1.0	1.0	2.0	**2.2**
Guinea	4.0	4.0	4.0	4.0	4.0	**4.0**
Guinea Bissau	6.0	5.0	6.0	6.0	5.0	**5.6**
Liberia	4.0	5.0	5.0	5.0	5.0	**4.8**
Mali	6.0	6.0	5.0	6.0	5.0	**5.6**
Niger	6.0	6.0	5.0	5.0	5.0	**5.4**
Nigeria	5.0	6.0	6.0	6.0	4.0	**5.4**
Senegal	5.0	5.0	5.0	5.0	5.0	**5.0**
Sierra Leone	4.0	5.0	5.0	5.0	2.0	**4.2**
Togo	5.0	5.0	5.0	4.0	4.0	**4.6**
No. of Countries attaining all 6 criteria	**4**	**4**	**5**	**5**	**0**	**0/4.7**

Source: ECOWAS Commission

Appendix A.4: Selected Financial Soundness Indicators in WAEMU

	2012	2013	2014	2015	2016
Capital Adequacy Ratio (CAR) ≥ 8%					
Benin	7.9	7.2	7.1	5.2	8.5
Burkina Faso	11.1	9.6	9.8	10.4	10.8
Cote d'Ivoire	8.8	8.6	8.7	7.1	7.2
Guinea Bissau	21	16.1	18	13.3	19.7
Mali	12.3	13.5	11.7	16	13.1
Niger	17.5	15.7	14.4	7.7	14.4
Senegal	17	17.9	16.4	16.3	14.3
Togo	11.8	12.6	12.5	8	4.4
Asset Quality (NPLs)) ≤ 10%					
Benin	18.6	21.2	21.5	22.1	21.8
Burkina Faso	10.3	9.9	8.6	8.9	9.7
Cote d'Ivoire	15.5	12.3	10.6	10.4	10.9
Guinea Bissau	24.1	31	43.4	8.4	8
Mali	21	19.3	17	14.5	16.6
Niger	17.1	16.4	17.6	15.5	17.2
Senegal	16.4	17.5	18.6	19.3	19
Togo	11.7	12.8	15.6	16.8	20.2
Return on Assets (ROA)					
Benin	0.4	0.1	0.9	0.3	0.4
Burkina Faso	1.9	1.9	1.5	1.3	1.6
Cote d'Ivoire	1.1	1.2	1.5	1.4	1.4
Guinea Bissau	0	-0.4	-1.4	6.4	1.5
Mali	1.3	1.2	1.5	1.5	1.4
Niger	1.8	1.7	1.8	2.5	2
Senegal	1.3	1.3	0.3	0.8	0.8
Togo	1.2	1.2	0.7	0.6	0.8
Return on Equity (ROE)					
Benin	5.44	2.21	14.38	4.87	7.16
Burkina Faso	22.13	25.93	19.42	17.52	20.96
Cote d'Ivoire	15.63	17.36	24.43	24.53	22.11
Guinea Bissau	0.14	-2.9	-13.6	46.3	9.9
Mali	13.37	14.07	19.66	17.09	16.94
Niger	16.2	16.01	20.5	26	20.84
Senegal	12.62	12.47	3.61	9.03	8.37
Togo	15.69	14.36	11.93	11.68	12.66

Source: WAMA 2017

Appendix A.5: Selected Financial Soundness Indicators in the WAMZ

	2012	**2013**	**2014**	**2015**	**2016**
Capital Adequacy Ratio (CAR) ≥ 8%					
Gambia	28	28	30	37.6	35
Ghana	14.6	14.7	17.9	17.7	17.8
Guinea	11.6	11.8	18.2	11.5	13.5
Liberia	22.8	2.9	20.6	21.9	23.8
Nigeria	18.3	17.1	17.2	16.1	13.9
Sierra Leone	41.5	41.6	30.2	33.9	30.7
Asset Quality (NPLs) ≤ 10%					
Gambia	22	22	7	6.5	9.3
Ghana	12.5	12	11.3	14.9	17.4
Guinea	4.8	6.5	4.1	6.2	9.4
Liberia	14.5	14.4	19.2	24.4	14.8
Nigeria	3.7	3.4	2.9	5.3	14
Sierra Leone	22.5	22.4	33.4	31.7	22.6
Return on Assets (ROA)					
Gambia	2	2	11	2	2
Ghana	6.2	6.2	6.4	4.6	3.8
Guinea	0.02	0.02	0.02	0.02	0.01
Liberia	-0.7	-0.7	-0.6	-0.86	-0.9
Nigeria	2.2	2.3	2.5	2.5	0.16
Sierra Leone	2	2.1	2.7	3.2	3.2
Return on Equity (ROE)					
Gambia	15	16	77	15.8	12.2
Ghana	31	31.1	32.3	22.1	18
Guinea	28.8	27.8	21.2	27.4	13.3
Liberia	-5.3	-5.4	-4.5	-6.9	-7
Nigeria	19.5	19.8	21.2	19.7	10.0
Sierra Leone	9.8	9.9	14.9	18.3	18.3

Source: WAMA 2017
Note: Data for Nigeria in 2015 and 2016 are obtained from the 2019 IMF Article IV Consultation Report (Country Report No. 19/92, p. 49).

Appendix A.6: Stock Market Capitalisation as a % of GDP

		2014	2015	2016
	Year Established	Market Capitalization as % of GDP		
BRVM	1998	25.9	23.7	22.7
Bolsa CV	2005	36.1	38.3	41.6
NSE	1960	10.4	10.5	9.1
GSE	1989	41.5	41.7	32.7
SSE	2009	-	-	-
Advanced Economies	-	110.2	114.8	118.8

Source: WAMA 2017

Appendix A.7: Matrix of Studies on the Money Multiplier

Publication	Sample Country/s	Econometric Methodology	Model properties (Variables, Data frequency etc.)	Main findings
Goodhart (2017)	US, Japan, UK, Eurozone	Theoretical/Trend analyses	Broad money (M2), Monetary Base, Money Multiplier **Frequency:** Annual 2009 - 2014	The causal relationship underpinning the money multiplier works in reverse direction. The traditional multiplier does not exist in theory and in principle
Lovrero and Deleidi (2017)	United States of America	VAR, VECM, Causality test	**Variables:** Demand deposits, Bank Credit, Monetary base **Frequency:** Monthly – 1959:1 – 2016:9	Causality runs from bank loans to bank deposits and then to the monetary base, in line with Post-Keynesian postulation
Jahad and Kumhof (2015)	United States Data	DSGE/Calibration Financing through money creation (FMC) model; Intermediation of loanable funds (ILF) model	**Variables:** Microeconomic/ Sectoral data **Frequency:** Monthly 1999:2 – 2010:12	In the real world, there is no deposit multiplier mechanism that imposes quantitative constraints on banks' ability to create money

Lopreite (2014)	Euro Area	VAR, Johansen Cointegration, Granger Causality	**Variables:** Loans, Narrow money (M1), Broad money (M2, M3), Monetary base **Frequency:** Monthly 1999:2 – 2010:12	Bidirectional causality between loans and M1 both in the short and long run. Loans cause variations in M2 mainly in the short run
Sheard (2013)	United States	Banking system balance sheet analyses	**Variables:** Balance sheet identities	Monetary reserves do not support bank lending, contrary to the conventional multiplier postulate
Carpenter and Demiralp (2012)	United States	Vector Autoregressive model (VAR) Panel VAR	**Variables:** Loans, M1, M2, M3, Monetary Base **Frequency:** Monthly 1999:2 – 2010:12 **Frequency –** Monthly – 1990:1 – 2007:6 **Variables:** FFR, CPI, Bank loans, Total deposits, Bank securities, and the unemployment rate.	The relationship implied by the money multiplier does not exist in the data for the most liquid and well-capitalized banks. Changes in reserves are unrelated to changes in lending.
Panagopoulos and Spiliotis (2008)	G7 (United States, United Kingdom, Germany, Italy, Japan, Canada, and France)	Johansen (1988) cointegration/ Error correction/ VAR Causality	**Frequency -** Quarterly **- 1994**Q1-2007Q2 **Variables:** Short-term interest rate, real Industrial production, inflation, exchange rate, Information variable	The ‘multipliers’ are not so operative in the G7 economies, with some sporadic exemptions

Baghestani and Mott (1997)	United States	Engle-Granger (1988) Cointegration test, Error – Correction Modelling	**Variables:** Nominal GDP, Monetary Base, M1, M2, Total bank credit, Money multipliers **Frequency:** Quarterly 1980:1 – 2003:4	A long-run equilibrium relation exists among M1, the monetary base, and the market-deposit interest rate. Predictable relation between monetary base and M1
Ford and Morris (1996)	United Kingdom	Johansen and Juselius (1990) Cointegrating technique	**Variables:** Monetary Base, Narrow Money M1, Market Interest rate **Frequency:** Monthly 1971:04 **-** 1990:06	Cointegrating vector between the monetary aggregates and high-powered money. Policy should be based on monetary base targeting
Zaki (1995)	Egypt	Box-Jenkins ARIMA modelling approach	**Variables:** Monetary aggregates, High- powered money, and money multiplier **Frequency:** Annual 1977 - 1994	Aggregate forecasting approach produces satisfactory results. Predictability and stability of the multipliers to increase under market-determined system
Chu (2006)	Canada	Holt-Winters exponential smoothing technique	**Variables:** Monetary Base, M1, M2, and components **Frequency:** Quarterly 1980:1 – 1993:4	All money multipliers, with the exceptions of M1 multiplier, have become less volatile, notwithstanding the zero-reserve requirement

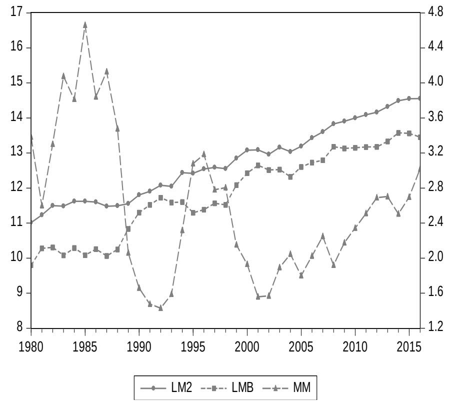
Downes et al. (2006)	Barbados, Belige, The Bahamas, Trinidad and Tobago, Jamaica, and Guyana	ADF, PP, BG, KPSS, Perron mean switching test, PV test	**Variables:** M1, M2 **Frequency:** Monthly 1979:1 – 2002:12	Using standard unit root tests, money multiplier found to possess stochastic trend. When test allows for structural break, multiplier becomes stationary
Darbha, G (2002)	India	Residual-based co-integration tests of Gregory and Hansen (with regime shifts) ADF test for unit roots	**Variables:** Monetary Base, M1, M2, M3, M2+, and Money market financing rate **Frequency:** Monthly 1970:1 – 2004:12	There exists a stable, but time varying, long-run relationship between monetary aggregates (M1 and M3) and adjusted reserve money
Jayaraman and Ward (2003)	Fiji	Johansen Cointegration, Error correction, and Granger causality	**Variables:** Broad money (M2) and the monetary base (MB) **Frequency:** Quarterly 1980:1 – 2001:3	Bi-directional long-run relationship between broad money and the monetary base
Nell (1999)	South Africa	Auto regressive distributed lag (ARDL) and Granger causality	**Variables:** Broad money (M3), Monetary base (MB), and Bank credit **Frequency:** Quarterly 1966:Q1 – 1997:Q4	Unidirectional causality from bank credit to the money multiplier

Hauner and Di Bella (2005)	Rwanda	OLS on multipliers and their components. ARIMA models to assess forecast power of multiplier and the component ratios synchronized shift in monetary policy (1992 monetary tightening)	**Variables:** Narrow money (M1), Broad money (M3), Adjusted reserve money (H) **Frequency:** Monthly 1978:4 – 1996:6	Money multiplier found to be volatile arising mainly from the reserve ratio component.
Rusuhuzwa (2015)	Rwanda	Engle and Granger cointegration/Greg ory – Hansen/ Hansen (1992) techniques	**Variables:** M1, M2, and components **Frequency:** Monthly 1995:1 – 2003:12	The money multiplier is stable even with a structural shift in the relationship.
Tule and Ajilore (2016)	Nigeria	Gregory and Hansen (1996) Cointegration with regime shift	**Variables:** Broad money (M3) and Base money (B) **Frequency:** Monthly – 2003(1) – 2015(8)	Existence of a stable long run relationship between M2 and MB
Adam and Kessy (2010)	Tanzania	Johansen Cointegration test; ARIMA Models	**Variables:** Broad money (M2), Base money (MB), Component ratios of the money multiplier **Frequency:** Monthly – 2002(1) – 2009(12)	Strong evidence of M2 money multiplier stability over the long run

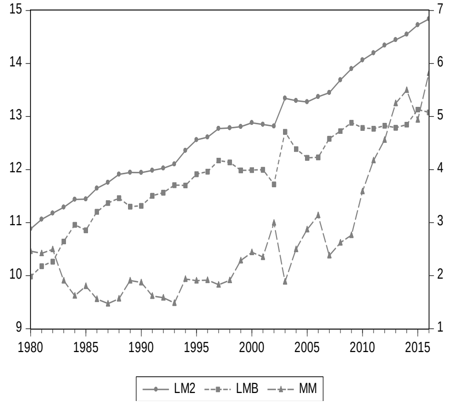
Ndanshau (2005)	Tanzania	OLS regression analysis, Chow breakpoint test and CUSUM stability test	**Variables:** Broad money, Narrow money, and the monetary base **Frequency:** Quarterly – 1986:2 – 2005:1	Money supply functions unstable prior to indirect monetary management but stable afterwards

Appendix A.8: WAEMU – Trends in Broad money, Monetary base and the Multiplier (1980–2016)

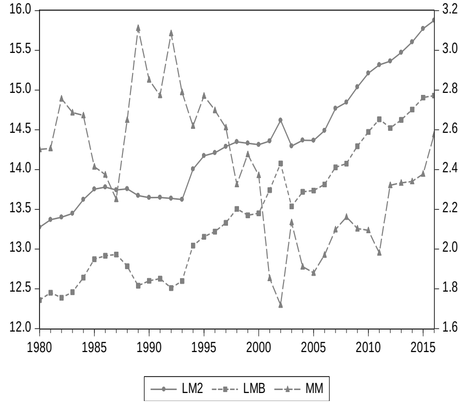
Benin



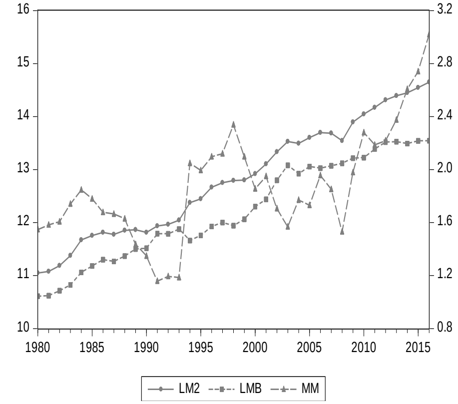
Burkina_Faso



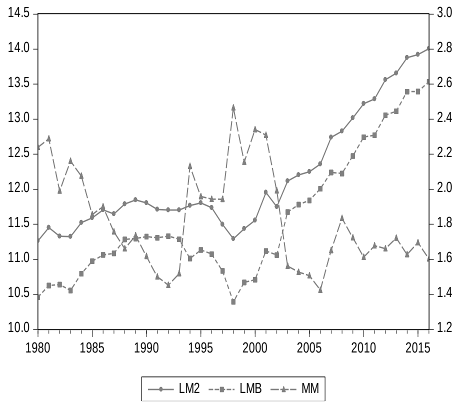
Cote d'Ivoire



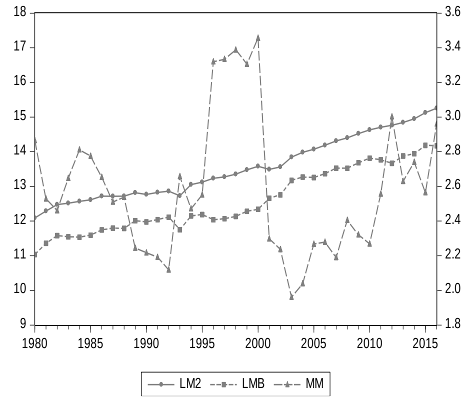
Mali



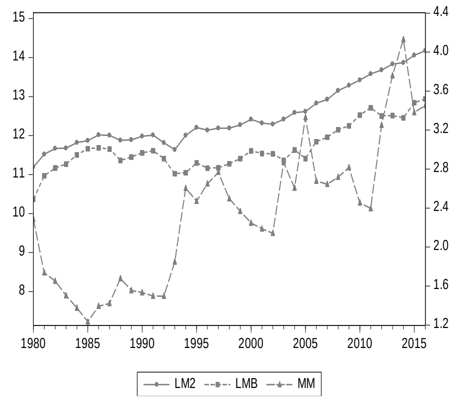
Niger



Senegal



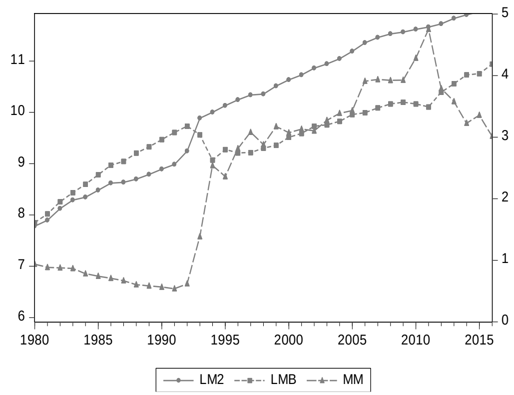
Togo



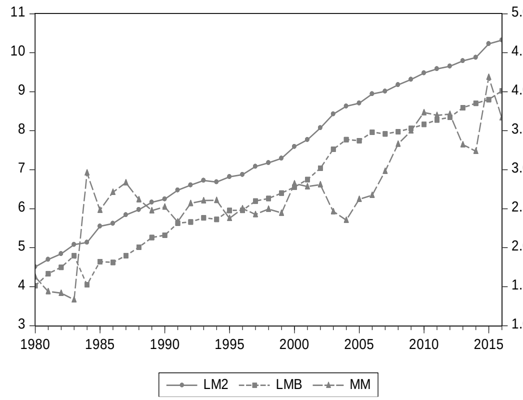
Note: MM is on the right axis

Appendix A.9: Non-WAEMU – Trends in Broad money, Monetary base and the Multiplier (1980–2016)

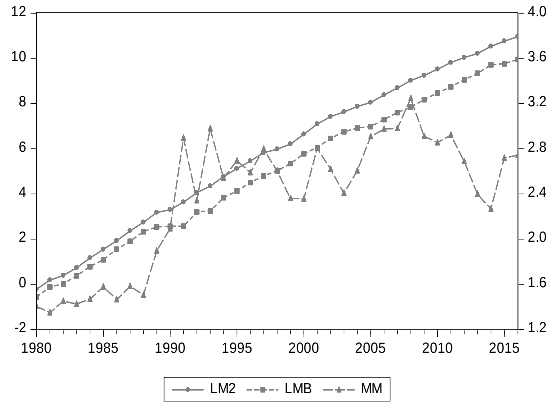
Cabo Verde



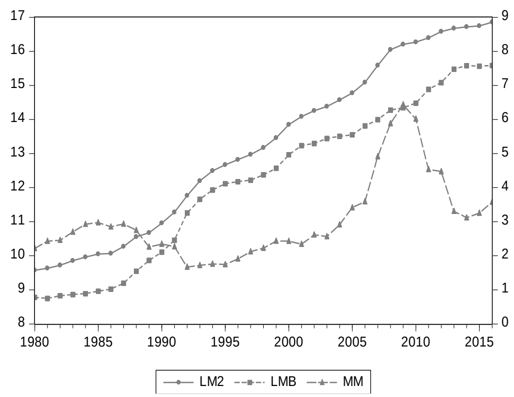
Gambia



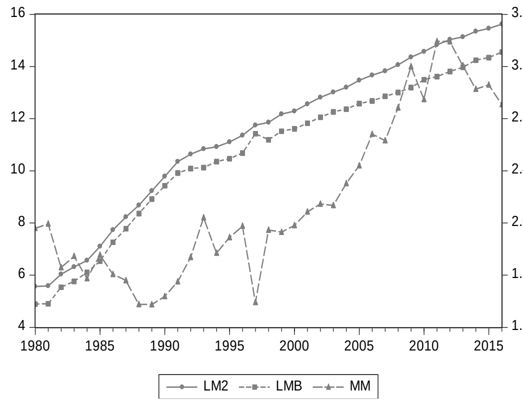
Ghana



Nigeria



Sierra Leone



Note: MM is on the right axis

Appendix A.10: Data Definition and Sources

Data Definition	Source
Broad money (M2) - sum of narrow money (M1) plus quasi-money (mainly comprising savings and time deposits), where M1 is currency in the hands of the non-bank public and demand deposits of commercial banks (Millions)	International Financial Statistics (IFS) of the IMF. *IFS Classification* – Monetary and Financial Accounts, Broad Money, Domestic Currency
Monetary Base (MB) – comprises mainly currency in circulation, i.e. currency held by the non-bank public, commercial banks' deposits at the central bank and deposits of other institutions held at the central bank (Millions)	International Financial Statistics (IFS) of the IMF. *IFS Classification* – Monetary and Financial Accounts, Central Bank, Monetary Base, Domestic Currency
Bank Credit (BC) – Commercial banks' credit to the non-bank private sector (Millions)	International Financial Statistics (IFS) of the IMF. *IFS Classification* – Monetary and Financial Accounts, Other Depository Corporations, Claims on Other Sectors, Claims on Private Sector, Domestic Currency
Nominal exchange rate – represents the official bilateral exchange rate of the domestic currency against the U.S. dollar at the end of the period	International Financial Statistics (IFS) of the IMF. *IFS Classification* – Exchange Rates, National Currency per U.S. Dollar, End of Period, rate
Consumer price index – measures changes in the prices of goods and services purchased, or otherwise acquired by households, calculated as weighted averages of the percentage changes for a basket of consumer goods with weights reflecting their relative importance in household consumption (Base year 2010=100)	International Financial Statistics (IFS) of the IMF. *IFS Classification* – Prices, Consumer Price Index, All Items
Real Gross Domestic Product (GDP) – sum of consumption expenditure (of households, Non-profit institutions serving households (NPISHs), and general government), gross fixed capital formation, changes in inventories, and exports of goods and services, less the value of imports of goods and services, adjusted for price changes (Millions)	International Financial Statistics (IFS) of the IMF. *IFS Classification* – National Accounts, Expenditure, Gross Domestic Product, Real, Domestic Currency

Source: https://www.imf.org/data

Note: Data for *M2, MB* and *BC* from 2001 are based on the standardized report form (SRF) in line with concepts and definitions of the IMF's Monetary and Financial Statistics Manual (MFSM), 2000. Data covering earlier period are consistent with the non-standardized IFS presentation, with *M2, MB* and *BC* corresponding to lines 35L...ZK, 14…ZK, and 22D…ZF. The dates of data access are indicated in the respective empirical chapters.

Appendix A.11: Results of Panel Unit Root Tests

ECOWAS

	Levin, Lin & Chu		**Im. Pesaran and Shin W-stat**		**ADF – Fisher Chi-Square**		**PP – Fisher Chi-square**	
	Intercept	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Intercept**	**Intercept & Trend**
Levels								
LM2	-3.33***(0.001)	2.014 (0.978)	3.20 (0.999)	3.164 (0.999)	29.24 (0.211)	10.90 (0.990)	44.84***(0.006)	9.294 (0.997)
LMB	-2.49***(0.007)	-0.17 (0.434)	2.33 (0.990)	-0.86 (0.196)	13.64 (0.954)	30.90 (0.157)	17.75 (0.815)	25.73 (0.367)
LMM	-0.50 (0.307)	-1.64** (0.050)	-0.54 (0.296)	-2.08** (0.019)	28.00 (0.260)	36.17*(0.053)	21.93 (0.584)	27.53 (0.280)
LBC	-0.08 (0.467)	2.65 (0.996)	6.70 (1.000)	4.50 (1.000)	9.62 (0.996)	6.72 (1.000)	13.47 (0.958)	3.38 (1.000)
1st Difference								
LM2	-15.15***(0.000)	-13.47***(0.000)	-14.91***(0.000)	-14.58***(0.000)	223.11***(0.000)	201.89***(0.000)	219.67***(0.000)	258.73***(0.000)
LMB	-17.98***(0.000)	-17.43***(0.000)	-17.16***(0.000)	-16.93***(0.000)	257.68***(0.000)	248.49***(0.000)	282.19***(0.000)	481.61***(0.000)
LMM	-17.95***(0.000)	-16.38***(0.000)	-18.28***(0.000)	-17.09***(0.000)	276.16***(0.000)	251.64***(0.000)	275.23***(0.000)	494.52***(0.000)
LBC	-14.74***(0.000)	-13.17***(0.000)	-13.62***(0.000)	-13.78***(0.000)	203.04***(0.000)	192.10***(0.000)	211.47***(0.000)	194.87***(0.000)

WAEMU

	Levin, Lin & Chu		**Im. Pesaran and Shin W-stat**		**ADF – Fisher Chi-Square**		**PP – Fisher Chi-square**	
	Intercept	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Intercept**	**Intercept & Trend**
Levels								
LM2	2.47 (0.993)	1.81 (0.965)	6.11 (1.000)	2.13 (0.983)	0.37 (1.000)	6.13 (0.963)	0.32 (1.000)	6.26 (0.960)
LMB	-0.23 (0.410)	0.28 (0.611)	2.45 (0.993)	-0.81 (0.208)	4.68 (0.990)	20.20 (0.124)	6.69 (0.946)	15.10 (0.371)
LMM	0.19 (0.579)	-0.71 (0.238)	-0.86 (0.195)	-1.51* (0.065)	20.29 (0.121)	20.49 (0.116)	15.14 (0.368)	16.53 (0.282)
LBC	6.41 (1.000)	2.25 (0.988)	8.87 (1.000)	4.92 (1.000)	0.068 (1.000)	1.49 (1.000)	0.084 (1.000)	1.33 (1.000)
1st Difference								
LM2	-13.28***(0.000)	-12.61***(0.000)	-13.01***(0.000)	-12.55***(0.000)	150.97***(0.000)	132.59***(0.000)	152.19***(0.000)	168.71***(0.000)
LMB	-13.89***(0.000)	-13.14***(0.000)	-13.10***(0.000)	-12.84***(0.000)	152.21***(0.000)	140.22***(0.000)	174.93***(0.000)	370.56***(0.000)
LMM	-13.49***(0.000)	-12.32***(0.000)	-13.38***(0.000)	-12.46***(0.000)	155.80***(0.000)	133.80***(0.000)	164.04***(0.000)	374.63***(0.000)
LBC	-12.41***(0.000)	-13.28***(0.000)	-10.88***(0.000)	-11.57***(0.000)	122.73***(0.000)	120.95***(0.000)	125.02***(0.000)	120.94***(0.000)

Appendix A.11(cont.) – Results of Panel Unit Root Tests

Non-WAEMU

	Levin, Lin & Chu		Im. Pesaran and Shin W-stat		ADF – Fisher Chi-Square		PP – Fisher Chi-square	
	Intercept	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Intercept**	**Intercept & Trend**
Levels								
LM2	-4.72^{***} (0.000)	1.14 (0.873)	-2.05^{**} (0.020)	2.37 (0.991)	28.87^{***}(0.001)	4.77 (0.906)	44.52^{***}(0.000)	3.03 (0.981)
LMB	-2.61^{***} (0.005)	-0.46 (0.324)	0.71 (0.761)	-0.36 (0.358)	8.96 (0.536)	10.70 (0.382)	11.06 (0.352)	10.63 (0387)
LMM	-0.77 (0.220)	-1.60^{*} (0.055)	0.18 (0.573)	-1.43^{*} (0.076)	7.72 (0.656)	15.69 (0.109)	9.78 (0.746)	11.00 (0.358)
LBC	-3.37^{***}(0.000)	1.50 (0.933)	0.078 (0.531)	1.21 (0.887)	9.55 (0.481)	5.23 (0.875)	13.38 (0.203)	2.046 (0.996)
1st Difference								
LM2	-8.22^{***}(0.000)	-6.57^{***}(0.000)	-7.72^{***}(0.000)	-7.82^{***}(0.000)	72.14^{***}(0.000)	69.30^{***}(0.000)	67.47^{***}(0.000)	90.02^{***}(0.000)
LMB	-11.44^{***}(0.000)	-11.51^{***}(0.000)	-11.08^{***}(0.000)	-11.04^{***}(0.000)	105.46^{***}(0.000)	108.27^{***}(0.000)	107.25^{***}(0.000)	111.05^{***}(0.000)
LMM	-11.76^{***}(0.000)	-10.78^{***}(0.000)	-12.49^{***}(0.000)	-11.73^{***}(0.000)	120.37^{***}(0.000)	117.84^{***}(0.000)	120.46^{***}(0.000)	119.89^{***}(0.000)
LBC	-8.10^{***}(0.000)	-4.62^{***}(0.000)	-8.26^{***}(0.000)	-7.83^{***}(0.000)	80.31^{***}(0.000)	71.15^{***}(0.000)	86.45^{***} (0.000)	73.93^{***}(0.000)

Source: Author's computation

The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Econometric software employed: EViews 9.5

Appendix A.12: Pedroni (2004) and Westerlund (2007) Panel Unit Root Test Results

Pedroni (2004) Panel Unit Root Test Results

	LMB and LBC		**LM2 and LBC**		**LMM and LBC**	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
Trend Assumption - No Deterministic Trend						
Within-dimension						
Panel v-Statistic	1.944**	0.026	1.979**	0.024	3.108***	0.001
Panel rho-Statistic	-1.187	0.882	-1.371	0.915	-2.373	0.991
Panel t-Statistic	-0.926	0.823	-1.196	0.884	-2.199	0.986
Panel ADF-Statistic	-0.406	0.658	-0.974	0.835	-2.231	0.987
Between-dimension						
Group rho-Statistic	-0.633	0.737	-0.918	0.821	-1.168	0.879
Group t-Statistic	-0.983	0.837	-1.440	0.925	-1.801	0.964
Group ADF-Statistic	-0.955	0.830	-1.124	0.870	-2.374	0.991
Trend Assumption - Deterministic Intercept and Trend						
Within-dimension						
Panel v-Statistic	2.302**	0.011	3.742***	0.000	0.797	0.213
Panel rho-Statistic	-2.045	0.980	-1.578	0.943	-1.901	0.971
Panel t-Statistic	-3.066	0.999	-2.329	0.990	-2.857	0.998
Panel ADF-Statistic	-2.986	0.999	-2.192	0.986	-3.316	1.000
Between-dimension						
Group rho-Statistic	-0.410	0.659	-0.145	0.558	-0.506	0.694
Group t-Statistic	-2.252	0.988	-1.638	0.949	-2.224	0.987
Group ADF-Statistic	-2.647	0.996	-1.939	0.737	-3.095	0.999

Source: Author's computation

Note: Data has been time-demeaned to correct for simple cross section correlation. The test is undertaken in Stata using the 'xtpedroni' command and p-values are computed for a one-tailed test.

All test statistics are distributed N(0,1), under a null of no cointegration.

***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.

Econometric software employed: Stata 15

Appendix A.12 (cont.)

Westerlund (2007) Panel Unit Root Test Results

	LMB and LBC		LM2 and LBC		LMM and LBC	
Statistic	Value	Robust P-value	Value	Robust P-value	Value	Robust P-value
			Deterministic specification: constant only			
Gt	-1.527	0.732	-1.890	0.393	-2.210	0.114
Ga	-6.915	0.279	-11.421***	0.001	-8.816*	0.068
Pt	-4.257	0.583	-3.577	0.740	-7.141**	0.044
Pa	-4.897	0.188	-5.378	0.145	-7.584**	0.024
			Deterministic specification: constant and trend			
Gt	-2.817	0.168	-3.382**	0.026	-2.696	0.312
Ga	-12.416	0.162	-13.137*	0.098	-10.961	0.424
Pt	-8.469	0.180	-9.078*	0.073	-8.403	0.209
Pa	-9.570	0.283	-10.723	0.190	-9.910	0.237

Source: Author's computation

Note: The Westerlund test is conducted using the Stata command 'xtwest' and assumes a null hypothesis of no cointegration. The test is fitted with a constant only and a constant and trend and the lags and leads are determined using the Bayesian information criteria. The kernel bandwidth is set according to the rule $4(T/100)^{2/9}$. The robust p-values are for a one-sided test based on 799 bootstrap replications.
***, ** and * reject the null at the 1%, 5% and 10% significance levels, respectively.
Econometric software employed: Stata 15

Appendix A.13: Matrix of Panel Studies on Demand for Money

Sample Country/s	Publication	Econometric Methodology	Model properties (Variables, Data frequency etc.)	Main findings
11 EMU countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain)	Foresti and Napolitano (2014)	Panel Dynamic Ordinary Least Squares (DOLS) estimator (Mark & Sul, 2003) Panel URTs – IPS, ADF_F, and PP_F	**Variables:** Income, Short-term interest rate, and Inflation **Frequency:** Monthly 1991:1 – 2012:3	Stable money demand, but degree of stability depends on aggregate chosen. M2 more stable and thus better target for monetary policy in EMU.
11 OECD countries (Austrialia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, and the United States)	Dobnik (2013)	Panel cointegration test (Gengenbach et al 2006 – involves Bai and Ng (2004) PANIC methodology) Mean Group FMOLS and Mean Group DOLS (Pedroni 2000, 2001); PMG estimator (Pesaran et al. (1999) Panel URTs – LLC, ADF-Fisher, PP-Fisher	**Variables:** Real M1, Real GDP, Nominal 3-month interbank rate, REER, Real stock prices, CPI **Frequency:** Seasonally adjusted quarterly data – 1983:Q1 to 2006:Q4	Cross-member cointegration exists, thus the need for distinction between common and idiosyncratic factors. Common international rather than national stochastic trends responsible for non-stationarity in money and its determinants.

12 Euro countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, and Spain.	Setzer and Wolff (2013)	Panel cointegration DOLS.	**Variables:** Real M3, Real GDP, Short-term interest rate, Long term interest rate, Spread between short and long-term rates (All variables in deviation from the euro area average) **Frequency:** Quarterly – 2001Q1 – 2008Q3	Coefficients of a conventional money demand equation specified in national deviations from the euro area average are stable.
10 Euro Area Countries	Arnold and Roelands (2010)	Panel DOLS	**Variables:** Monetary aggregates, Real GDP, CPI, Interest rates, Wealth and uncertainty variables **Frequency:** Annual 1970 – 2005	Measure of wealth in the euro area are relevant to understanding demand for euros, thus needs consideration by policy makers.
14 Asian countries (Bangladesh, Indonesia, India, Iran, Korea, Malaysia, Myanmar, Nepal, Philippines, Pakistan, Papua New Guinea, Singapore, Sri Lanka, Thailand)	Rao and Kumar (2009)	Pedroni (2004) Fully Modified OLS (FMOLS), Panel DOLS (Mark and Sul (2003), and Two-step procedure of Breitung (2006) Panel URTs – LLC, Breitung, IPS, ADF_Fisher, PP_Fisher, Hadri	**Variables:** Real M1, Real GDP, and Nominal Short-term **Frequency:** Annual 1970 – 2005	No evidence long-run money demand unstable. No significant effects of financial reforms on stability

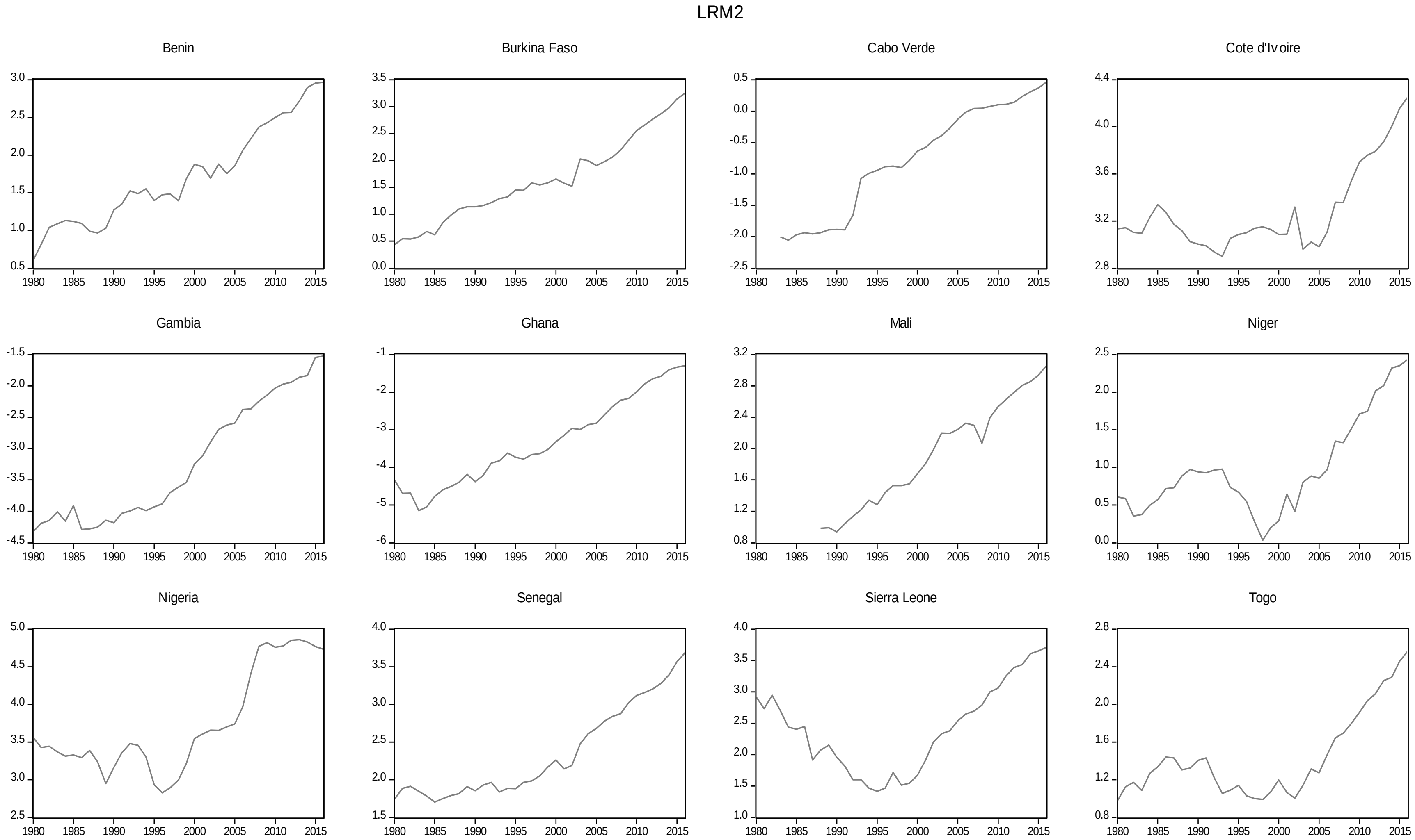
11 EU countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherlands, Portugal, and Spain)	Hamori and Hamori (2008)	Residual-based panel cointegration (Pedroni 1999), Johansen-type panel cointegration (Maddala and Wu, 1999), FMOLS (Pedroni 2001) Panel URTs – IPS (2003), LLC (2002)	**Variables:** M1, M2, M3, Overnight call rate, CPI, and Industrial Production **Frequency:** Monthly – 1999:1 – 2006:4	Stability of money demand functions, M1, M2, & M3
11 OECD countries (Australia, Canada, Japan, Korea, Italy, Mexico, Norway, Spain, Sweden, Switzerland, and USA)	Kumar, Chowdhury, and Rao (2010)	FMOLS (Pedroni 1999); Westerlund (2006) Structural break tests Panel URTs – LLC, Breitung, IPS, ADF, PP, Hadri	**Variables:** Real M1, Real GDP, REER, Savings deposit rate, and Inflation (GDP Deflator), **Frequency –** Quarterly – 1975:1 – 2008:4	Some indications of instability in money demand caused by financial reforms. When structural changes allowed, pre and post-reform sub-samples indicate stability
35 Sub-Saharan African countries	Hamori (2008)	Residual-based cointegration (Pedroni, 1999, 2004), Residual-based cointegration (Kao, 1999), Johansen-type panel cointegration test (Maddala and Wu) FMOLS (Pedroni, 2001) Panel URTs – LLC, IPS, ADF-Fisher, ADF_Choi	**Variables:** Real M1, Real M2, Real GDP, Interest rate **Frequency:** Annual – 1980 - 2006	Money demand functions M1, M2 stable for the region

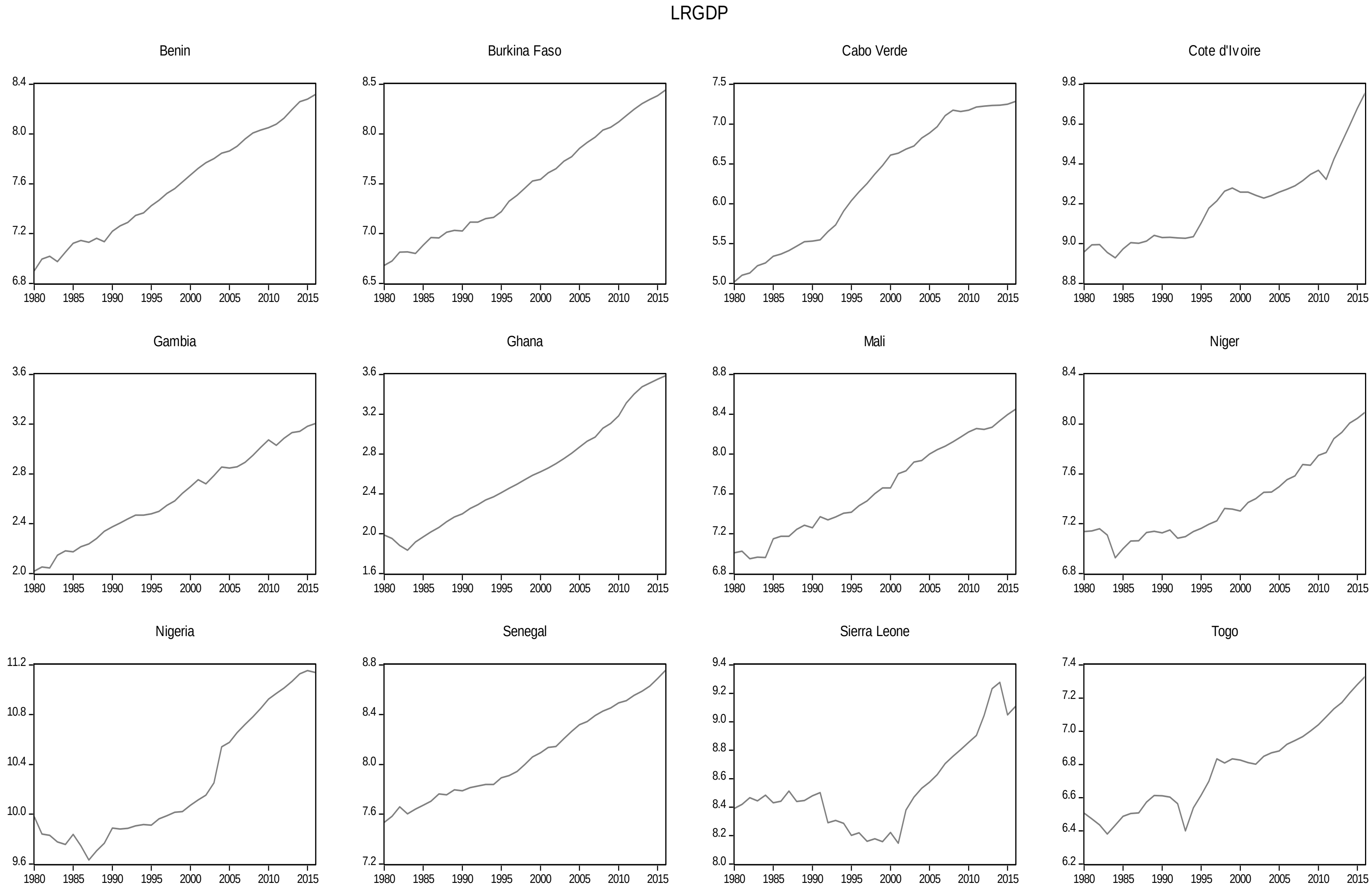
24 Sub-Saharan African countries	Salisu, Ademuyiwa, Fatai (2013) – Extension of Hamori (2008)	Residual-based cointegration (Kao, 1999), Johansen-type panel cointegration test (Maddala and Wu) Panel URTs – LLC, IPS, ADF_Fisher, PP_Fisher	**Variables:** Narrow money, price index, nominal GDP, nominal interest rate, Nominal effective exchange rate **Frequency:** Annual data - 1980 - 2010	Finds the existence of a cointegrating relationship among money demand, income, price level, interest rate, and exchange rate
EMU Founding members (Belgium, Germany, Ireland, Spain, France, Italy, Austria, Portugal, Finland, and Netherlands)	Nautz and Rondorf, (2011)	Pooled mean group estimation (PMGE) – Pesaran, Shin and Smith (1999) Panel URTs – Pesaran (2007)	**Variables:** Real money, Income, Long-run interest rate, Wealth (Equity prices, House prices) **Frequency:** Quarterly – 1999:1 – 2008:2	Evidence obtained in favour of a stable long-run money demand function. Stable cross-country money demand indicates the instability of standard euro area money demand functions could be explained by omitted macro variables
Euro Area	Dreger and Wolters (2010)	Johansen (1995) Cointegration Test	**Variables:** Real money balances, Real income, Nominal return of financial assets, and annualized inflation rate. **Frequency**: Quarterly (Seasonally adjusted) – 1983:1 – 2004:4	Strong evidence in favour of a stable money demand relationship

Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates	Harb (2004)	Modified version of FMOLS (Group-mean estimator) by Pedroni Panel URTs - IPS	**Variables** – Real M1, Real GDP, Real Consumption, Nominal interest rate, Nominal Exchange rate **Frequency:** Annual 1979 - 2000	Significant effect of interest rate on money demand
17 Asian countries	Kumar and Rao (2012)	ECM based Westerlund (2007) cointegration tests; Pedroni-FMOLS; Pedroni-DOLS; Panel URTs - LLC, Breitung, IPS, ADF, PP, Hadri	**Variables:** Real M1, Real GDP, 90 day bill-rate; 5-year bond rate, Exchange rate **Frequency:** Annual – 1970 – 2009	Null of no cointegration rejected at 5%. On stability, the relationships for individual countries show breaks at different dates. Sub-sample estimations by Pedroni FMOLS and DOLS found the ratio of money holding to GDP increased in post-break samples
8 African countries (Angola, Equatorial Guinea, Gambia, Guinea-Bisau, Kenya, Mali, Nigeria and Uganda)	Nyumah (2017)	Pedroni (1999) Panel FMOLS Panel URTs - LLC, Breitung, IPS, ADF, PP, Hadri	**Variables:** Real M1, Real GDP, Interest rate, Inflation rate **Frequency:** Annual 1998 - 2012	Demand for money interest-inelastic in the short run but interest elastic in the long run
6 Asian-Pacific countries (China, Japan, Malaysia, the Philippines, Singapore, and Fiji)	Valadkhani (2008)	Engle-Granger two-step procedure. Dynamic error correction model Panel URTs - IPS	**Variables:** M2, GDP price deflator, real GDP, Deposit interest rate, Lending interest rate, REER. **Frequency:** Annual – 1975 – 2002	Real M2 is a predictable monetary aggregate. The estimated long-run income elasticity for all six countries exceeds unity

15 Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Paraguay, Peru, Uruguay, Venezuela	Carrera (2016)	Pedroni (1999) Group mean panel FMOLS Panel URTs – LLC, IPS, Pedroni (1999) pooled panel root test; Pedroni (2002) group mean unit root test.	**Variables:** M2, GDP price deflator, real GDP, Deposit interest rate, Lending interest rate, REER. **Frequency:** Annual – 1975 – 2002	Relatively sharp and stable estimates of money demand elasticities
19 countries (Austria, Australia, Belgium, Canada, Denmark, France, Finland, Germany Iceland, Ireland, Japan, Norway, New Zealand, Netherlands, Portugal, Spain, Switzerland, UK, and USA)	Mark and Sul (2003)	Panel DOLS; Pedroni (1999) panel-t test (to investigate stationarity of equilibrium errors) Panel URTs – IPS (1997), Maddala and Wu (1999)	**Variables:** M1, Price level, real GDP, and nominal short-term interest rate **Frequency:** Annual – 1957 – 1996	Point estimates of income elasticity of close to one and interest semi-elasticity of -0.02. Estimates stable and reasonably robust
27 developed and developing countries	Garcia-Hiernaux and Cerno (2006)	GMM (Static and Dynamic Fixed Effects models)	**Variables:** Monetary Base, GDP, Consumer Price Index, Exchange rate, Nominal interest rates **Frequency:** Annual – 1988 – 1998	Money demand depends on lags of the interest rate but not income.
11 Asian countries	Rao et al. (2009)	System GMM (Blundell and Bond, 1998)	**Variables:** Real M1, Real Output, Nominal interest rate, Inflation, exchange rate **Frequency:** Annual – 1970 – 2007	Demand for money is stable, and is not affected by structural break due to financial reforms

Appendix A.14: Country-specific graphs of variables used in the estimations

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Cabo Verde
Cote d'Ivoire
Gambia
Ghana
Mali
Niger
Nigeria
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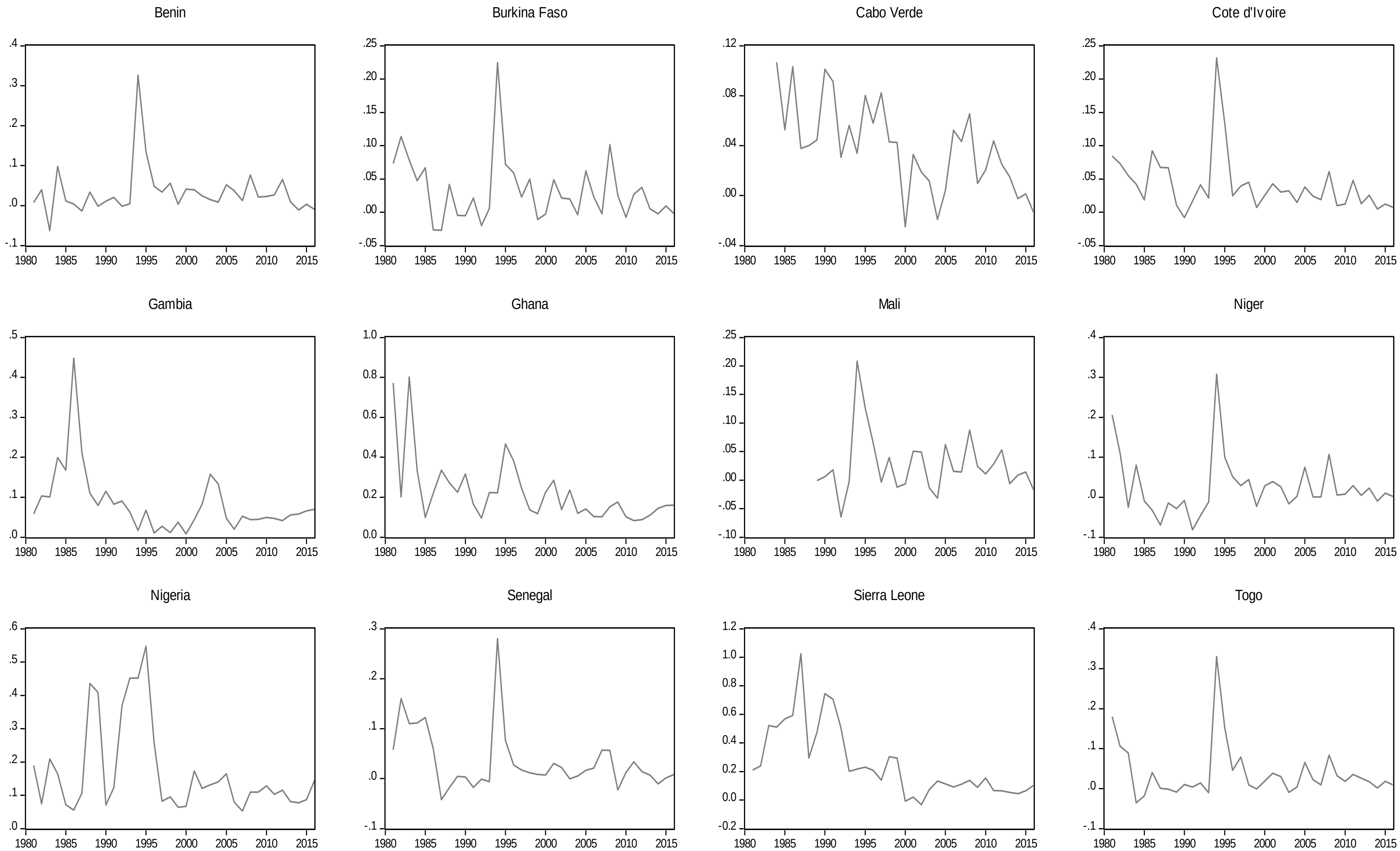
Sierra Leone
Togo

INF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Sierra Leone
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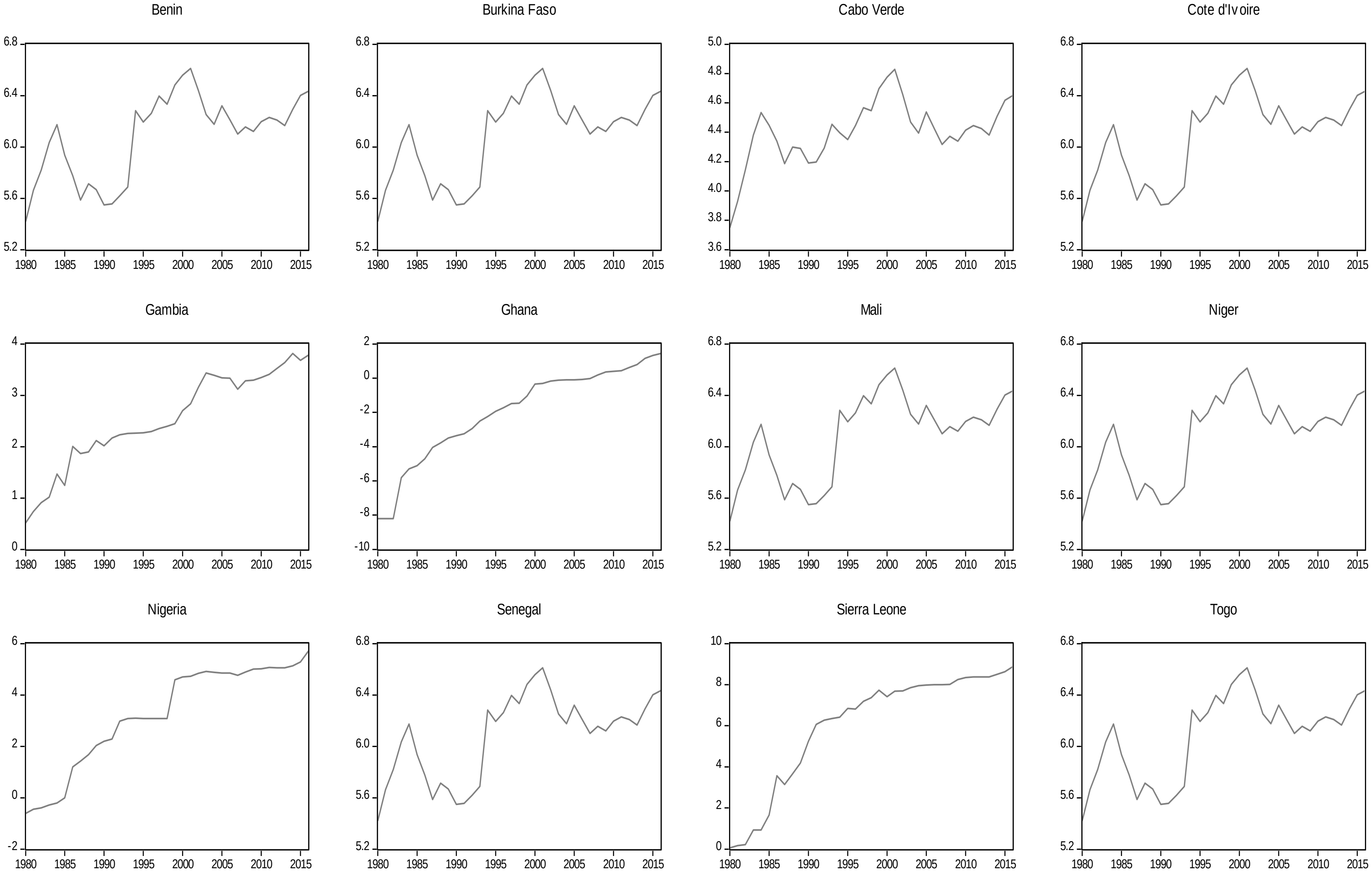
LEXR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Cote d'Ivoire
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Ghana
Mali
Niger
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Senegal
Sierra Leone
Togo
1980
1985
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1995
2000
2005
2010
2015

Appendix A.15: Parameter stability - Estimation results based on selected sub-samples – Annual frequency

	Sub-Sample 1980 - 1994		Sub-Sample 1995 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016		Sub-Sample 1980 - 2000		Sub-Sample 2001 - 2016	
	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	1.372***	1.423***	0.691*	0.610	0.860***	0.988***	0.832*	0.784*	1.013***	0.937***	0.975***	1.116***
	(0.001)	(0.002)	(0.066)	(0.118)	(0.001)	(0.006)	(0.066)	(0.074)	(0.000)	(0.002)	(0.007)	(0.003)
Inf	0.224	0.117	-1.071***	-1.009***	0.162	-0.114	-0.900**	-0.838**	0.058	0.002	-0.542	-0.405
	(0.497)	(0.742)	(0.002)	(0.004)	(0.177)	(0.739)	(0.037)	(0.045)	(0.775)	(0.992)	(0.232)	(0.289)
lexr	-0.001	0.073	0.455***	0.345**	-0.120	0.322	0.442***	0.334**	-0.156	-0.026	0.100	-0.023
	(0.993)	(0.586)	(0.002)	(0.014)	(0.247)	(0.458)	(0.003)	(0.024)	(0.132)	(0.860)	(0.734)	(0.936)
cons	-2.357	-5.24	-0.865	1.916	2.895	0.064	-1.498	0.006	4.89	3.994	-2.559	-1.993
	(0.440)	(0.201)	(0.744)	(0.810)	(0.348)	(0.474)	(0.774)	(0.944)	(0.133)	(0.348)	(0.607)	(0.794)
trend		-0.031		0.023		3.654		0.443		0.002		-0.009
		(0.385)		(0.773)		(0.421)		(0.950)		(0.960)		(0.906)
RMSE	0.0634	0.0491	0.0778	0.0715	0.0669	0.0557	0.0691	0.0608	0.0749	0.0636	0.0552	0.0497
Observations	157	157	264	264	193	193	228	228	229	229	192	192

Source: Author's computation

Note: Figures in parentheses are probability values of the respective coefficients

The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Econometric software employed: Stata 15

Appendix A.16: Parameter stability - Estimation results based on selected sub-samples – Quarterly frequency

	Sub-Sample 1980 - 1994		Sub-Sample 1995 - 2016		Sub-Sample 1980 - 1997		Sub-Sample 1998 - 2016		Sub-Sample 1980 - 2000		Sub-Sample 2001 - 2016	
	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend
lrgdp	0.370	0.112	0.910***	1.058***	0.546	0.102	0.938***	1.063	0.639*	0.709*	0.854***	1.228**
	(0.623)	(0.913)	(0.000)	(0.003)	(0.174)	(0.901)	(0.000)	(0.013)	(0.097)	(0.071)	(0.000)	(0.011)
Inf	0.0002	-0.052	-0.166***	-0.126**	-0.065	-0.062	-0.113*	-0.149**	-0.061	-0.061	-0.019	-0.035
	(0.998)	(0.267)	(0.005)	(0.021)	(0.180)	(0.159)	(0.081)	(0.043)	(0.182)	(0.128)	(0.824)	(0.646)
lexr	-0.346	-0.116*	0.355**	0.131	-0.139*	-0.134*	0.257	0.187	-0.128*	-0.144**	-0.096	-0.118
	(0.250)	(0.085)	(0.046)	(0.466)	(0.076)	(0.076)	(0.154)	(0.272)	(0.067)	(0.043)	(0.700)	(0.640)
cons	4.991	13.479	-2.753	6.338	4.726	9.902	-0.282	5.959	4.178	2.241	2.229	2.683
	(0.388)	(0.364)	(0.467)	(0.496)	(0.418)	(0.290)	(0.944)	(0.549)	(0.535)	0.753)	(0.647)	(0.769)
trend		0.009		0.112		0.004		0.010		-0.004		0.003
		(0.510)		(0.339)		(0.667)		(0.378)		(0.387)		(0.701)
RMSE	0.0079	0.0745	0.0866	0.0791	0.0855	0.0806	0.0815	0.0773	0.0901	0.0858	0.071	0.0678
Observations	597	597	1049	1049	741	741	905	905	885	885	761	761

Source: Author's computation

Note: Figures in parentheses are probability values of the respective coefficients

The asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
Econometric software employed: Stata 15

Appendix A.17: Governance Indicators for ECOWAS member countries (Percentile Rank)

	Voice and Accountability	Political Stability	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
WAEMU						
Benin	58.62	48.10	26.44	33.17	30.29	33.65
Burkina Faso	48.28	16.19	30.77	34.62	38.94	53.37
Côte d'Ivoire	37.93	11.90	21.63	37.98	29.81	36.54
Guinea-Bissau	24.63	25.24	3.37	11.06	6.73	2.88
Mali	38.42	6.19	17.31	30.29	23.08	29.81
Niger	33.99	10.00	24.04	26.92	27.88	28.85
Senegal	39.41	43.33	40.38	49.04	50.48	54.81
Togo	29.56	19.52	12.50	21.63	24.52	25.96
WAMZ						
Ghana	67.49	49.52	49.04	49.52	59.13	49.04
Guinea	25.12	24.76	13.94	17.79	9.13	14.42
Gambia, The	29.06	39.05	25.96	34.13	34.13	27.40
Liberia	46.31	30.48	8.17	15.38	15.87	26.44
Nigeria	34.98	5.24	16.35	16.83	18.75	12.50
Sierra Leone	56.65	46.67	10.58	15.87	22.60	31.25
Cabo Verde	77.34	79.05	59.13	46.15	64.42	80.29

Source: The Worldwide Governance Indicators, 2018 Update www.govindicators.org

Appendix A.18: Matrix of Studies on Monetary Policy Transmission in Monetary Unions

Economic/Monetary Grouping	Publication	Econometric Methodology/ Structural Shock Identification	Model properties (Variables, Data frequency etc.)	Main findings
European Economic and Monetary Union (EMU)	Dornbusch, Favero and Giavazzi (1998) – Germany, France, Italy, Spain, United Kingdom, Sweden	Full Information Maximum Likelihood (FIML)/Decomposition of interest rate changes into expected and unexpected	**Variables:** Output growth, Inflation, short-term interest rates, exchange rate **Frequency:** Monthly 1987:8 – 1996:7	Significant differences in the monetary policy process in the EMU. Cost of disinflation unequal across countries
	Favero, Giavazzi, and Flabbi (1999) – France, Germany, Italy and Spain	OLS with heteroscedastic-consistent standard errors/Episode of synchronized shift in monetary policy (1992 monetary tightening)	**Variables:** Changes in loans, Changes in reserves, Balance sheet strength. **Frequency:** Micro-data on banks 1992 (BankScope)	Significant differences across countries and across banking institutions in their ability to effectively respond to monetary tightening

	Britton and Whitley (1997) – United Kingdom, France, Germany	Small structural model/Holding the short-term interest rate 1%age point higher than a base period and then evolution in line with a common monetary policy rule	**Variables:** Money stock, domestic price level, nominal exchange rate, domestic interest rate, aggregate demand **Frequency:** Annual – 1964 - 1994	No marked differences in the response of output and inflation in each country to a common change in policy interest rates
	Smets (1995) – G7 countries	Large macroeconomic models/Standardized monetary policy tightening	**Variables:** Various sectoral macroeconomic variables **Frequency –** Quarterly – 1994:1 (1993 initial values)	Almost identical responses to the monetary shock were found in all countries, with the exception of the United Kingdom
	Smets and Wouters (2003) - Belgium, France, the Netherlands, Luxembourg, Italy, Spain, Portugal and Greece, Germany, France, Finland, Ireland	DSGE Modelling/Standardized monetary policy tighening	**Variables:** GDP, consumption, investment, prices, real wages, employment, and the nominal interest rate. **Frequency:** 2001Q1-2010Q4	The magnitude and timing of the impacts and the relative contributions of the transmission channels varied across the countries

	Ehrmann (1998) – Thirteen European countries	SVAR/ Cointegration properties for identification restrictions	**Variables:** Short-term interest rate, real Industrial production, inflation, exchange rate, Information variable **Frequency:** Quarterly 1984 - 1997	Weak effect of monetary policy shock. Differences in MTMs. Heterogeneity in the magnitude of responses among countries
	Peersman and Smets (2001) – Synthetic euro area data	SVAR/Cholesky decomposition, Short and long-run restrictions	**Variables:** real GDP, Consumer prices, Broad money supply, domestic nominal short-term interest rate, real effective exchange rate Exogenous variables - World commodity price index, US real GDP, US Short-term nominal interest rate **Frequency:** 1980 - 1998	Contractionary monetary policy leads to real appreciation and drop in output at the euro area level. Large variability in the response of output and prices of individual countries to the euro area policy shock
	Mojon and Peersman (2001) – 10 Euro area countries	SVAR/Cholesky decomposition	**Variables:** Real GDP, Consumer prices, domestic short-term nominal interest rate, and the real effective exchange rate. Foreign variables include World commodity price index, US real GDP, and US short-term nominal interest rate	GDP falls in response to a contractionary monetary policy shock

	Ciccarelli and Rebucci (2002) – Germany, France, Italy, Spain	Time-varying panel VAR/ Recursive Identification	**Variables:** Short-term interest rate, inflation, output, and nominal exchange rate **Frequency**: Monthly – January 1991 – December 1998	Differences in timing of monetary policy effects. Parameters changing over time
	Boivin, Giannoni, and Mojon (2008) – Germany, France, Italy, Spain, The Netherlands, and Belgium	FAVAR/Recursive	**Variables** – 33 economic variables for each country and the euro area **Frequency:** Quarterly series – 1980:1 – 2007:3	Heterogeneity among countries in response to monetary policy shocks prior to euro. Since the euro introduction, greater homogeneity of the transmission mechanisms across countries
	Cecioni and Neri (2010) – Euro area members	Bayesian VAR/ Recursive; Sims and Zha (1999); and Sign restrictions	**Variables:** Industrial production, Harmonized index of consumer prices, overnight interest rate, broad money, commodities prices, nominal effective exchange rate **Frequency:** Monthly – 1994M1 – 2009M9; Quarterly – 1989Q1-2009Q2	VAR analysis indicates the transmission mechanism had not changed significantly. While the DSGE uncovered differences pre- and post-1999
		Estimated DSGE	**Variables:** GDP-deflator based inflation, nominal hourly wage inflation, real	

			consumption, real investment, real GDP, employment, and three-month nominal interest rate **Frequency:** Quarterly1989:1 - 2007:2	
	Geogiadis G (2015) - 14 euro area economies	Global VAR/Sign restrictions	**Variables:** Output, prices, short-term interest rates. Foreign variables – output, prices, interest rates **Frequency:** Quarterly – 1999Q1 – 2009Q4	Asymmetries transmission on account of structural economic differences
	Ciccarelli and Rebucci (2002)	Bayesian VAR(Dynamic heterogenous models)/Recursive	**Variables:** Consumer price index, Industrial production, Nominal exchange rate, Interest rate (Treasury bills) **Frequency:** 1985:01 to 1998:12	Differences in timing of monetary policy effects across European countries. Parameters of the transmission mechanism appear to have changed but degree of heterogeneity has not decreased over time.
Gulf Cooperation Council (GCC)	Espinoza and Prasad (2012)	Panel VAR/Cholesky decomposition	**Variables:** Non-oil real GDP, Government expenditure, CPI Inflation, Broad money. Foreign variables – Federal Funds rate, US GDP, US	Strong impact of US monetary policy on the region. Some degree of asymmetry

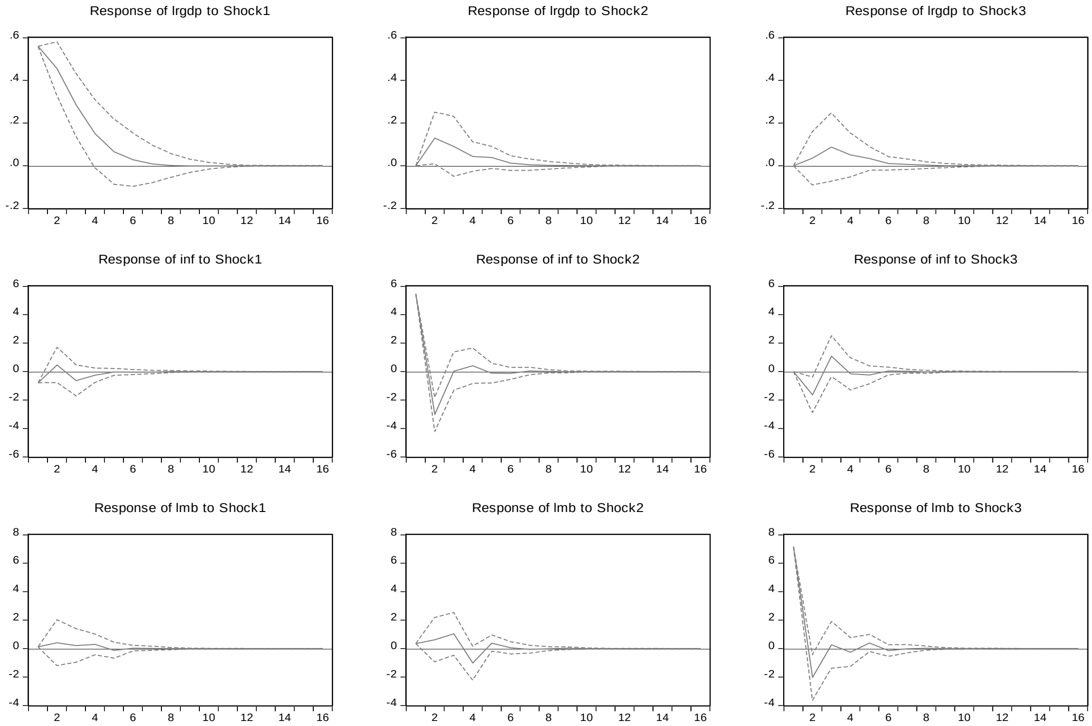
			Personal Consumption Deflator, Agriculture CPI. **Frequency:** Annual and Quarterly – 1980 –2010	
	Cevik and Teksoz (2012)	Structural VAR/Model-based identification strategy	**Variables:** real non-hydrocarbon GDP, consumer prices, domestic credit, domestic nominal short-term interest rate. Exogenous variables: Crude oil price, US Real GDP, US nominal short-term interest rate **Frequency:** Quarterly 1990 – 2010	Relatively strong transmission of monetary policy impulses through the interest rate and bank lending channels. Broadly symmetric responses.
East African Community (EAC)	Davoodi et al (2013) – All EAC countries, except South Sudan	Recursive Structural, Bayesian, and Factor-Augmented VARs/ Choleski Decomposition	**Variables:** real GDP, CPI, reserve money, short-term interest rate, credit to private sector, and the nominal exchange rate. Exogenous variables: global oil price index, a global food price index, US federal funds rate, and U.S. industrial production. **Frequency:** monthly – January 200 to December 2010	Different channels of monetary transmission within the EAC, with exchange rate, credit, and interest rate as the identified channels.

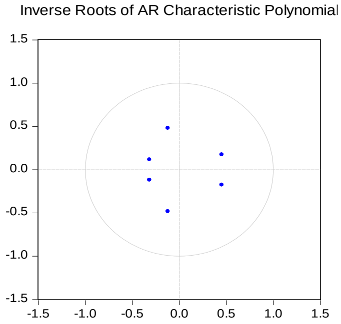
	Buigut (2009) – Uganda, Tanzania, and Kenya	SVAR/ Cholesky Decomposition	Variables: Real GDP, Inflation and Short-term interest rate Frequency: Annual – 1984 - 2006	Similarity in the response of output in all three EAC countries to a monetary contraction. Interest rate channel not important.
Central African Economic and Monetary Union (CAEMU)	Bikai and Kenkouo (2015) – All CAEMU countries	Structural and Panel VARs/	**Variables:** Real GDP, short-term policy rate, Broad money (M2), CPI, Credit to the economy **Frequency:** Quarterly: 1998 – 2013	Weak monetary transmission channels, and asymmetric transmission across countries
	IMF (2015) – All CAEMU countries	Structural VAR/ Cholesky ordering	**Variables:** Policy rate, Credit to the economy, and Inflation (Monetary Base replaces the Policy rate in 2nd Estimation) **Frequency:** Quarterly – 2001Q2-2014Q3	The policy rate, as a monetary instrument, does not affect prices, whereas changes in the monetary base impacts inflation.
West African Economic and Monetary Union (WAEMU)	IMF (2014)/ All WAEMU countries	Distributed lag model & Panel Interaction VAR	**Variables:** Central Bank policy rate, marginal rate of liquidity injection, deposit and lending rates, inflation **Frequency**: Monthly – February 2007-September 2013	Variation across member countries in the size and significance of impacts of policy rates on the interest rates and on inflation.

West African Monetary Zone (WAMZ)	Harvey and Cushing (2015) – The Gambia, Guinea, Ghana, Nigeria, and Sierra Leone	Structural VAR/ Long-run restrictions	**Variables:** Growth in economic activity; nominal exchange rate, and inflation **Frequency:** Monthly – 1987:2 – 2011:4	Asymmetric responses to external shocks, and lack of ex-ante convergence

Appendix A.19: WAMZ - Individual Country Baseline VAR Impulse Responses

The Gambia: Response to Short-run Recursive Innovations ± 2 S.E.





VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 82

Joint test:

Chi-sq	df	Prob.
77.98678	72	0.2943

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 82

Lags	LM-Stat	Prob
1	15.39756	0.0806
2	11.36367	0.2516
3	7.680851	0.5666
4	22.22942	0.0082
5	16.13526	0.0641
6	4.027821	0.9096
7	13.55789	0.1389
8	6.990021	0.6382

Probs from chi-square with 9 df.

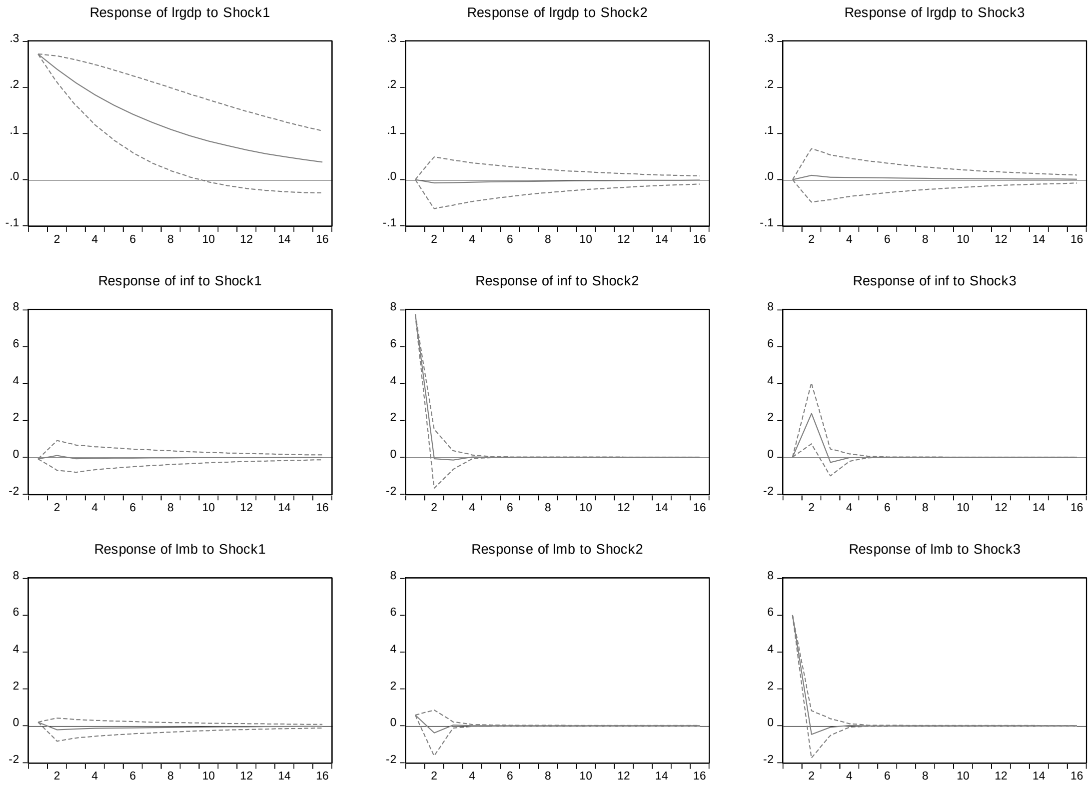
VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal
Sample: 1994Q1 2016Q4 .1
Included observations: 82

Component	Skewness	Chi-sq	df	Prob.
1	-1.193138	15.58965	1	0.0001
2	0.692040	6.484244	1	0.0109
3	0.097249	0.149207	1	0.6993
Joint		22.22311	3	0.0001

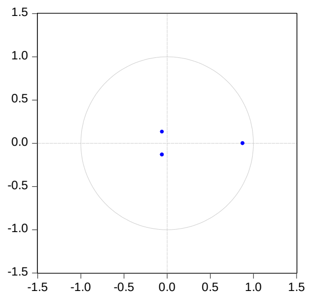
Component	Kurtosis	Chi-sq	df	Prob.
1	9.640683	22.28540	1	0.0000
2	4.847514	3.382870	1	0.0659
3	3.067646	0.482582	1	0.4873
Joint		26.15085	3	0.0000

Component	Jarque-Bera	df	Prob.
1	37.87505	2	0.0000
2	9.867114	2	0.0072
3	0.631789	2	0.7291
Joint	48.37396	6	0.0000

Ghana: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 90

Joint test:

Chi-sq	df	Prob.
27.38045	36	0.8485

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 90

Lags	LM-Stat	Prob
1	11.88552	0.2198
2	8.185585	0.5156
3	8.823780	0.4537
4	11.33867	0.2532
5	7.321066	0.6037
6	2.621474	0.9774
7	5.141163	0.8218
8	9.793188	0.3675

Probs from chi-square with 9 df.

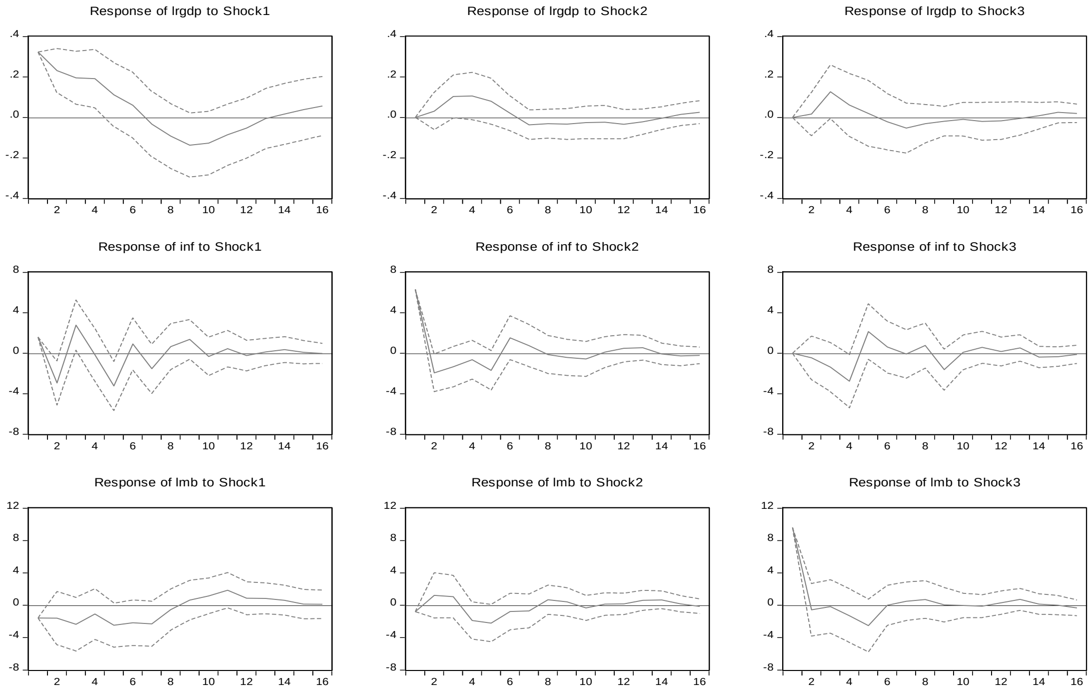
VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal
Sample: 1994Q1 2016Q4
Included observations: 90

Component	Skewness	Chi-sq	df	Prob.
1	2.633033	45.63151	1	0.0000
2	-0.498900	3.912611	1	0.0479
3	-0.280521	1.312554	1	0.2519
Joint		50.85668	3	0.0000

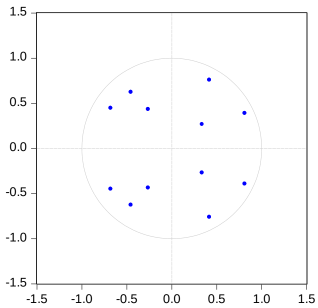
Component	Kurtosis	Chi-sq	df	Prob.
1	20.00903	1.029424	1	0.3103
2	4.340640	3.890943	1	0.0485
3	3.469938	1.346693	1	0.2459
Joint		6.267060	3	0.0993

Component	Jarque-Bera	df	Prob.
1	46.66094	2	0.0000
2	7.803554	2	0.0202
3	2.659248	2	0.2646
Joint	57.12374	6	0.0000

Guinea: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 46

Joint test:

Chi-sq	df	Prob.
131.9719	144	0.7549

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 46

Lags	LM-Stat	Prob
1	18.82858	0.0267
2	11.54538	0.2402
3	12.21503	0.2015
4	14.44400	0.1074
5	8.021196	0.5320
6	4.449932	0.8794
7	10.11508	0.3412
8	12.04505	0.2108

Probs from chi-square with 9 df.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

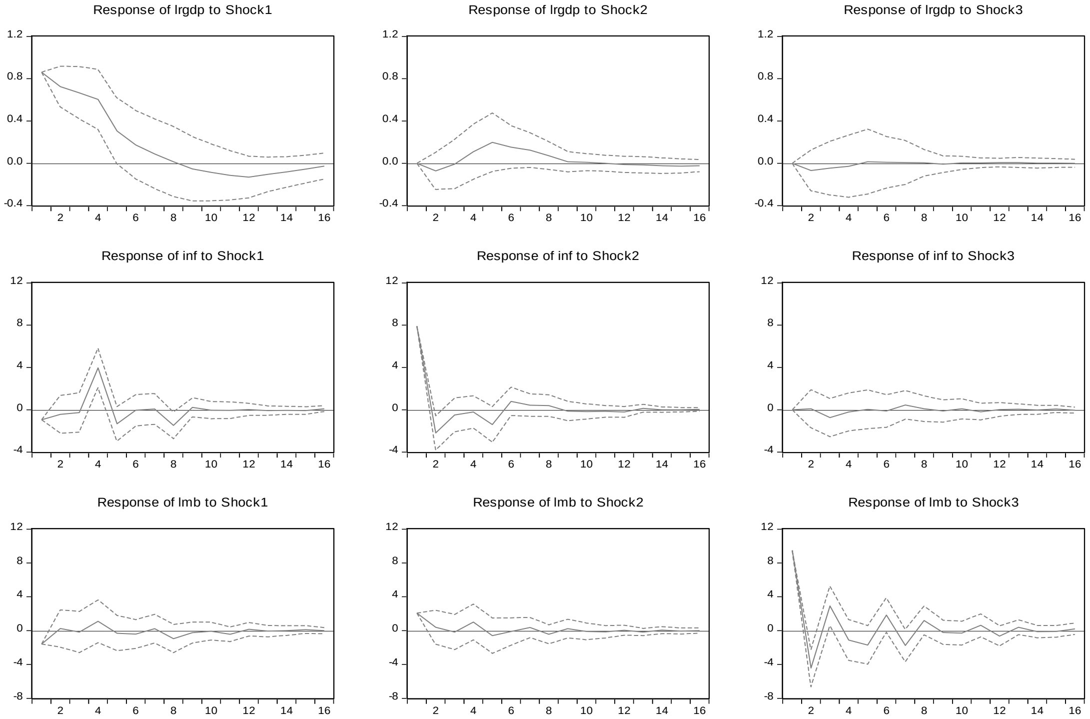
Included observations: 46

Component	Skewness	Chi-sq	df	Prob.
1	-0.029152	0.008213	1	0.9278
2	-0.535065	2.542412	1	0.1108
3	-0.394890	1.436627	1	0.2307
Joint		3.987252	3	0.2628

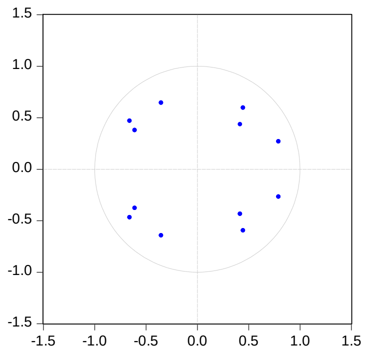
Component	Kurtosis	Chi-sq	df	Prob.
1	5.902215	20.81634	1	0.0000
2	3.539767	0.467122	1	0.4943
3	6.861566	25.89346	1	0.0000
Joint		47.17693	3	0.0000

Component	Jarque-Bera	df	Prob.
1	20.82456	2	0.0000
2	3.009534	2	0.2221
3	27.33009	2	0.0000

Nigeria: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 02/02/20 Time: 22:28

Sample: 1994Q1 2016Q4

Included observations: 87

Joint test:

Chi-sq	df	Prob.
146.2437	144	0.4322

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 87

Lags	LM-Stat	Prob
1	10.95623	0.2787
2	5.176373	0.8187
3	4.926385	0.8407
4	15.63656	0.0749
5	4.836192	0.8483
6	5.107145	0.8249
7	3.908338	0.9173
8	7.835517	0.5508

Probs from chi-square with 9 df

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

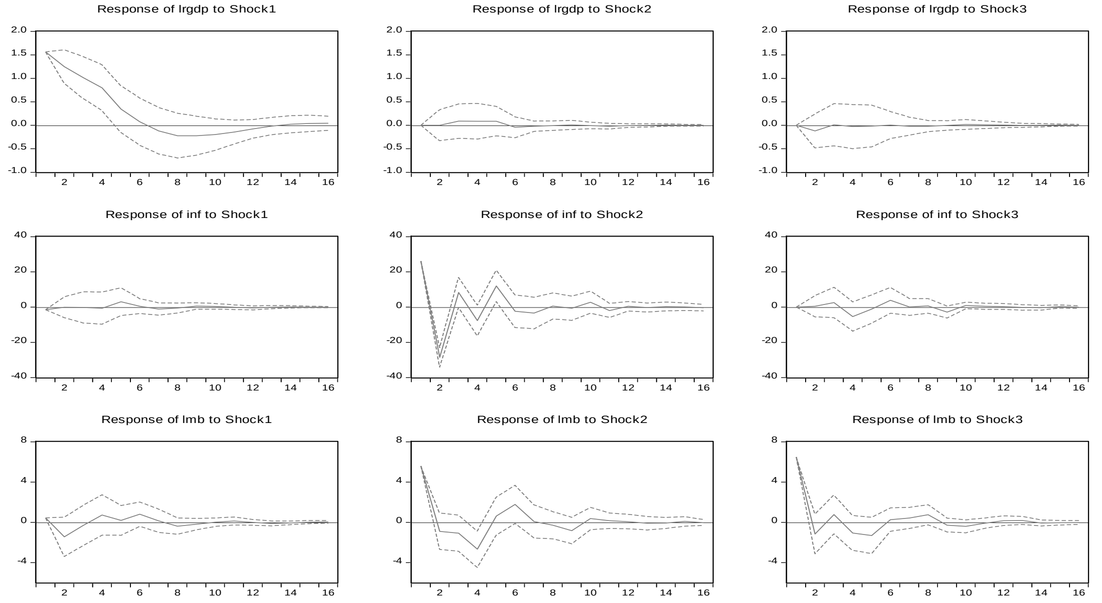
Included observations: 87

Component	Skewness	Chi-sq	df	Prob.
1	1.736146	27.36236	1	0.0000
2	-0.635384	5.874161	1	0.0154
3	0.724279	7.374999	1	0.0066
Joint		40.61152	3	0.0000

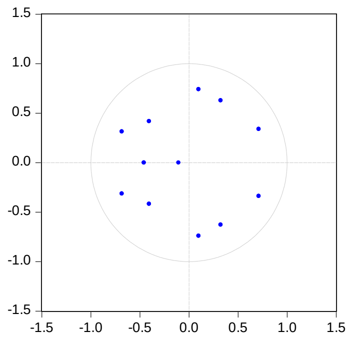
Component	Kurtosis	Chi-sq	df	Prob.
1	22.52421	122.1375	1	0.0000
2	4.443768	2.140554	1	0.1435
3	4.150143	0.136404	1	0.7119
Joint		124.4145	3	0.0000

Component	Jarque-Bera	df	Prob.
1	149.4999	2	0.0000
2	8.014715	2	0.0182
3	7.511403	2	0.0234
Joint	165.0260	6	0.0000

Sierra Leone: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 87

Lags	LM-Stat	Prob
1	15.24188	0.0845
2	9.451120	0.3967
3	13.76312	0.1310
4	15.72545	0.0728
5	13.57271	0.1384
6	14.14339	0.1173
7	7.192296	0.6171
8	13.59106	0.1376

Probs from chi-square with 9 df.

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 87

Joint test:

Chi-sq	df	Prob.
196.6909	144	0.0023

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

Included observations: 87

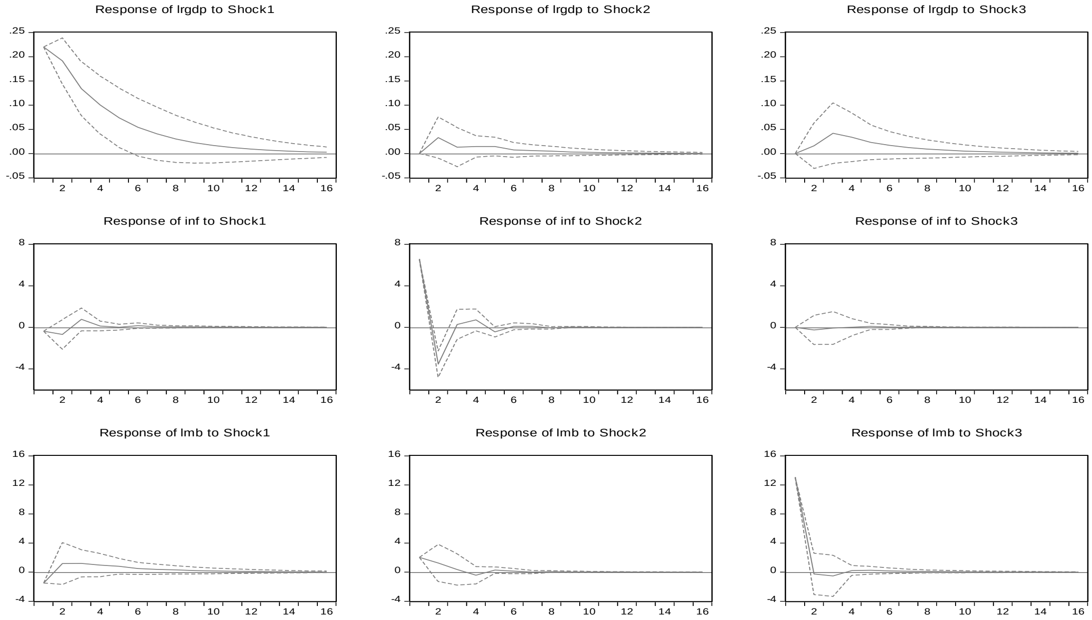
Component	Skewness	Chi-sq	df	Prob.
1	1.182923	16.16004	1	0.0001
2	0.775143	8.275729	1	0.0040
3	0.579717	4.990435	1	0.0255
Joint		29.42620	3	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	12.77250	60.12706	1	0.0000
2	7.386546	23.58598	1	0.0000
3	5.517467	11.78885	1	0.0006
Joint		95.50189	3	0.0000

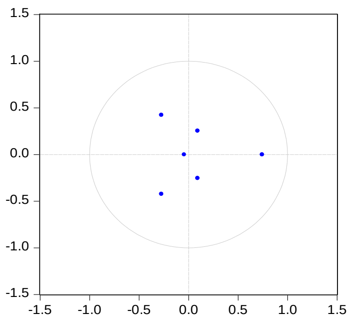
Component	Jarque-Bera	df	Prob.
1	76.28710	2	0.0000
2	31.86171	2	0.0000
3	16.77929	2	0.0002
Joint	124.9281	6	0.0000

Appendix A.20: WAEMU - Individual Country Baseline VAR Impulse Responses

Benin: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 89

Lags	LM-Stat	Prob
1	12.67377	0.1779
2	16.05179	0.0658
3	6.439738	0.6952
4	10.44156	0.3159
5	5.550133	0.7840
6	8.660799	0.4692
7	4.660914	0.8628
8	16.30252	0.0608

Probs from chi-square with 9 df.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

Included observations: 89

Component	Skewness	Chi-sq	df	Prob.
1	-0.585013	5.172737	1	0.0229
2	-0.240637	0.963865	1	0.3262
3	-0.130800	0.289268	1	0.5907
Joint		6.425869	3	0.0926

Component	Kurtosis	Chi-sq	df	Prob.
1	8.513443	48.39065	1	0.0000
2	3.871812	4.114660	1	0.0425
3	4.683434	12.57011	1	0.0004
Joint		65.07542	3	0.0000

Component	Jarque-Bera	df	Prob.
1	53.56338	2	0.0000
2	5.078525	2	0.0789
3	12.85938	2	0.0016
Joint	71.50129	6	0.0000

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

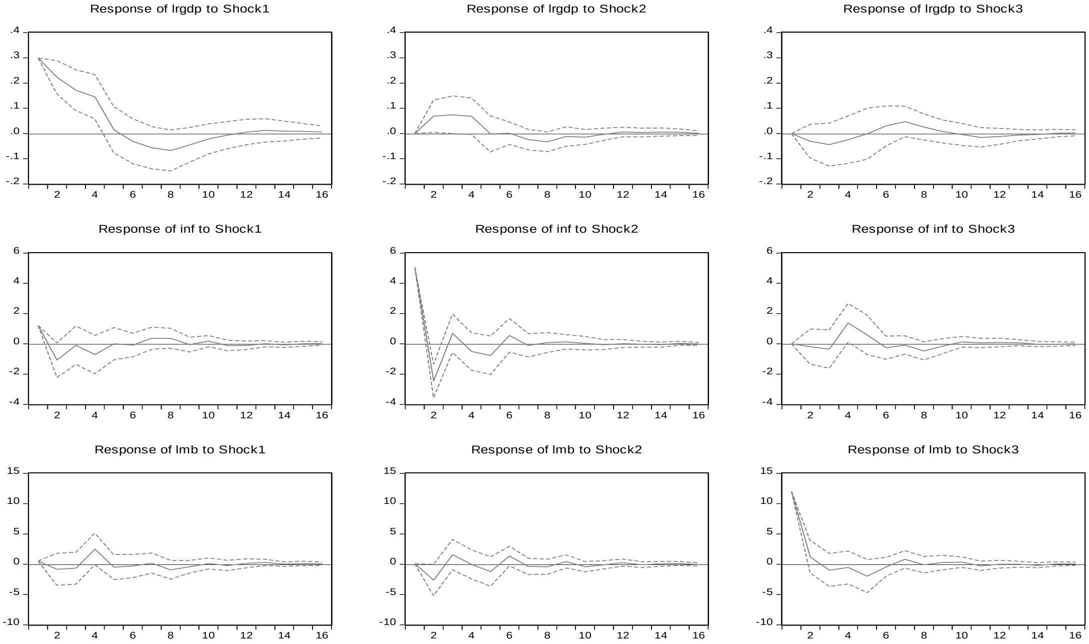
Sample: 1994Q1 2016Q4

Included observations: 89

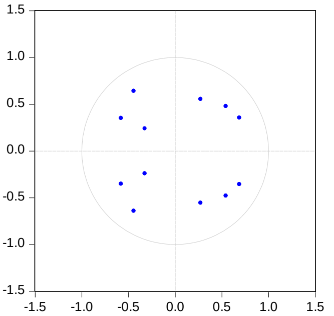
Joint test:

Chi-sq	df	Prob.
116.0721	72	0.0008

Burkina Faso: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 87

Lags	LM-Stat	Prob
1	13.26291	0.1511
2	11.24565	0.2592
3	5.230000	0.8138
4	20.93360	0.0129
5	10.34249	0.3235
6	7.559024	0.5791
7	5.920175	0.7479
8	12.25463	0.1993

Probs from chi-square with 9 df.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

Included observations: 87

Component	Skewness	Chi-sq	df	Prob.
1	-0.215333	0.759826	1	0.3834
2	-0.031724	0.016783	1	0.8969
3	1.702432	26.68680	1	0.0000
Joint		27.46341	3	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	8.389834	59.82788	1	0.0000
2	2.952519	0.219921	1	0.6391
3	9.416535	0.005176	1	0.9426
Joint		60.05298	3	0.0000

Component	Jarque-Bera	df	Prob.
1	60.58771	2	0.0000
2	0.236703	2	0.8884
3	26.69197	2	0.0000
Joint	87.51639	6	0.0000

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

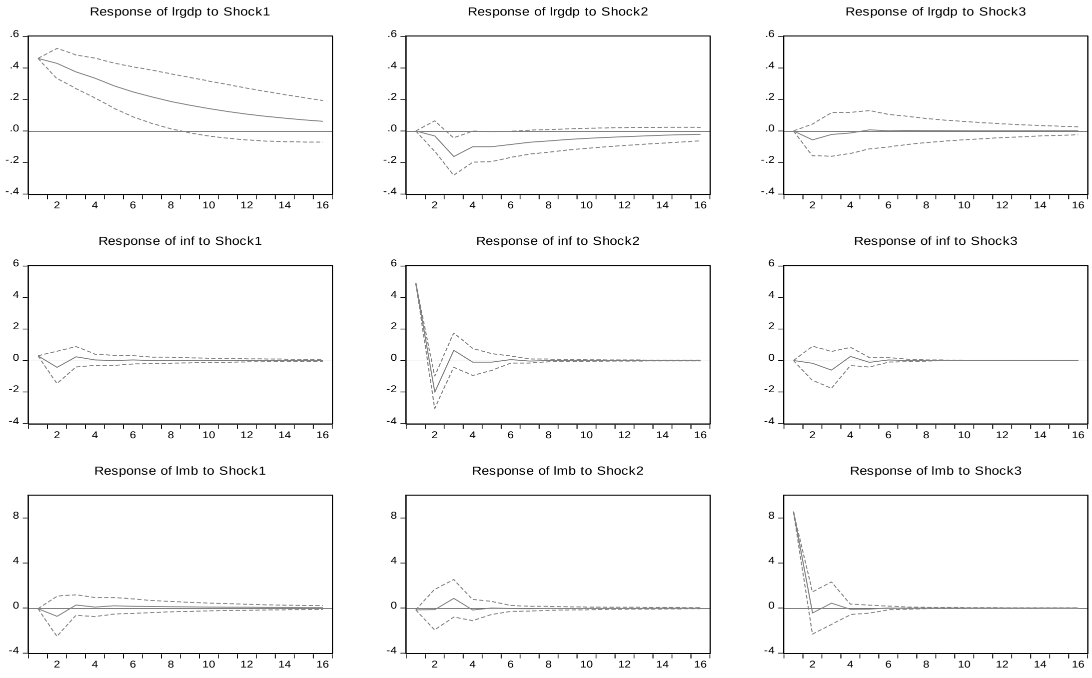
Sample: 1994Q1 2016Q4

Included observations: 87

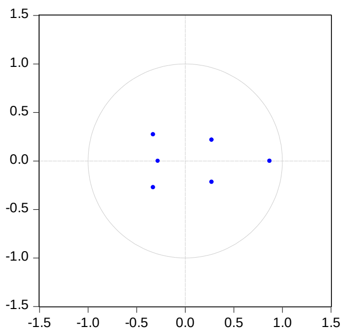
Joint test:

Chi-sq	df	Prob.
123.0109	144	0.8967

Cote d'Ivoire: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 89

Lags	LM-Stat	Prob
1	13.42854	0.1442
2	10.87586	0.2843
3	3.582138	0.9367
4	20.55868	0.0148
5	3.014548	0.9637
6	2.689397	0.9753
7	6.587729	0.6800
8	9.432938	0.3983

Probs from chi-square with 9 df.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

Included observations: 89

Component	Skewness	Chi-sq	df	Prob.
1	2.614613	44.89653	1	0.0000
2	-0.830196	9.459624	1	0.0021
3	-4.082167	69.27015	1	0.0000
Joint		123.6263	3	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	24.63656	25.31924	1	0.0000
2	4.452011	0.032533	1	0.8569
3	32.95236	43.24426	1	0.0000
Joint		68.59603	3	0.0000

Component	Jarque-Bera	df	Prob.
1	70.21577	2	0.0000
2	9.492157	2	0.0087
3	112.5144	2	0.0000
Joint	192.2223	6	0.0000

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

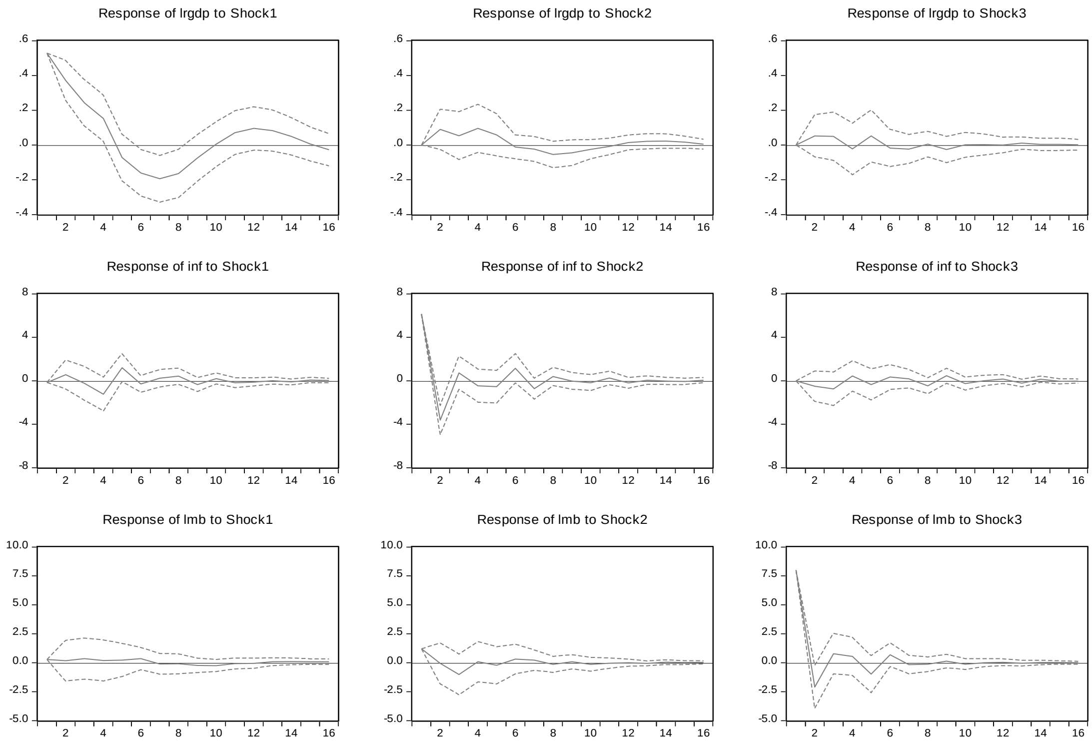
Sample: 1994Q1 2016Q4

Included observations: 89

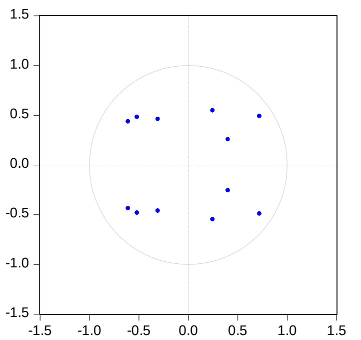
Joint test:

Chi-sq	df	Prob.
89.18162	72	0.0829

Mali: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 87

Joint test:

Chi-sq	df	Prob.
165.2596	144	0.1085

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 87

Lags	LM-Stat	Prob
1	26.66976	0.0016
2	10.31177	0.3258
3	4.498601	0.8756
4	24.73187	0.0033
5	18.46701	0.0301
6	7.659546	0.5688
7	14.81064	0.0963
8	18.32250	0.0316

Probs from chi-square with 9 df.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

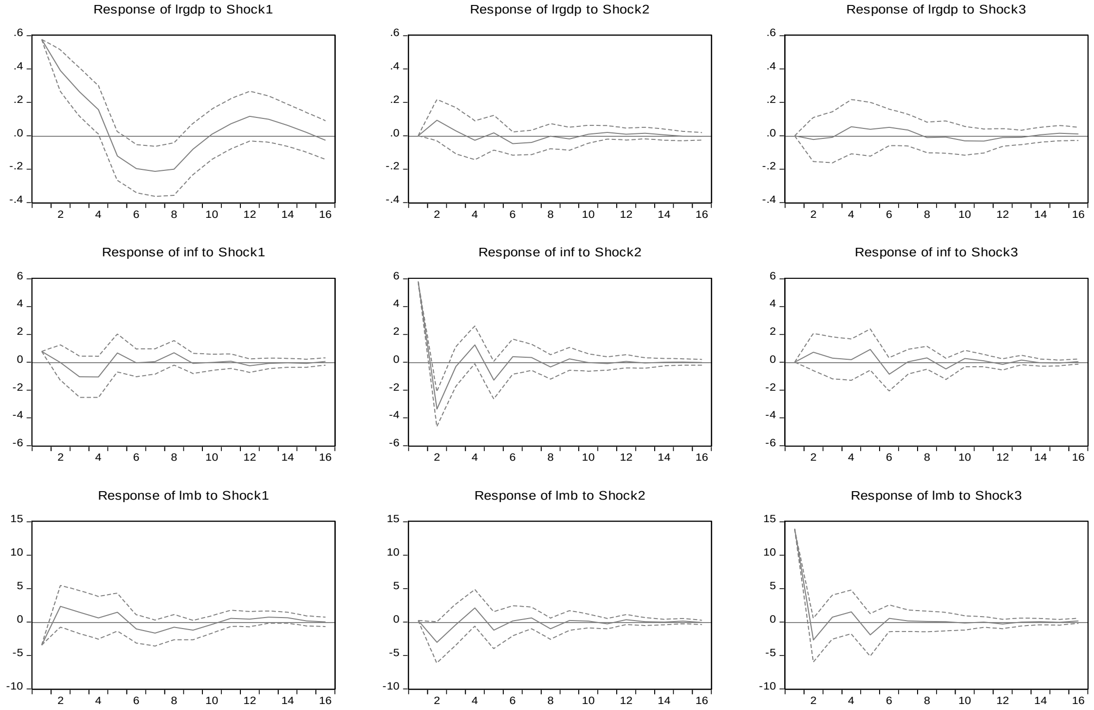
Included observations: 87

Component	Skewness	Chi-sq	df	Prob.
1	1.366786	19.88895	1	0.0000
2	-1.231699	17.14556	1	0.0000
3	0.298886	1.440662	1	0.2300
Joint		38.47516	3	0.0000

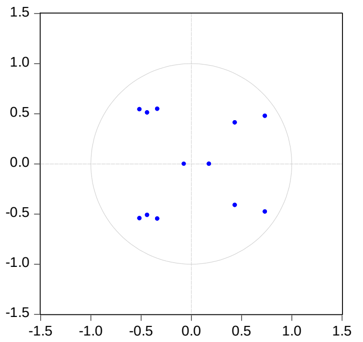
Component	Kurtosis	Chi-sq	df	Prob.
1	11.96929	33.62356	1	0.0000
2	5.205268	3.855533	1	0.0496
3	9.279649	70.75536	1	0.0000
Joint		108.2345	3	0.0000

Component	Jarque-Bera	df	Prob.
1	53.51250	2	0.0000
2	21.00109	2	0.0000
3	72.19603	2	0.0000
Joint	146.7096	6	0.0000

Niger: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 87

Joint test:

Chi-sq	df	Prob.
157.5427	144	0.2080

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 87

Lags	LM-Stat	Prob
1	36.46335	0.0000
2	9.355036	0.4052
3	7.778060	0.5567
4	29.30742	0.0006
5	8.486798	0.4859
6	5.565142	0.7825
7	9.923508	0.3567
8	25.58896	0.0024

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

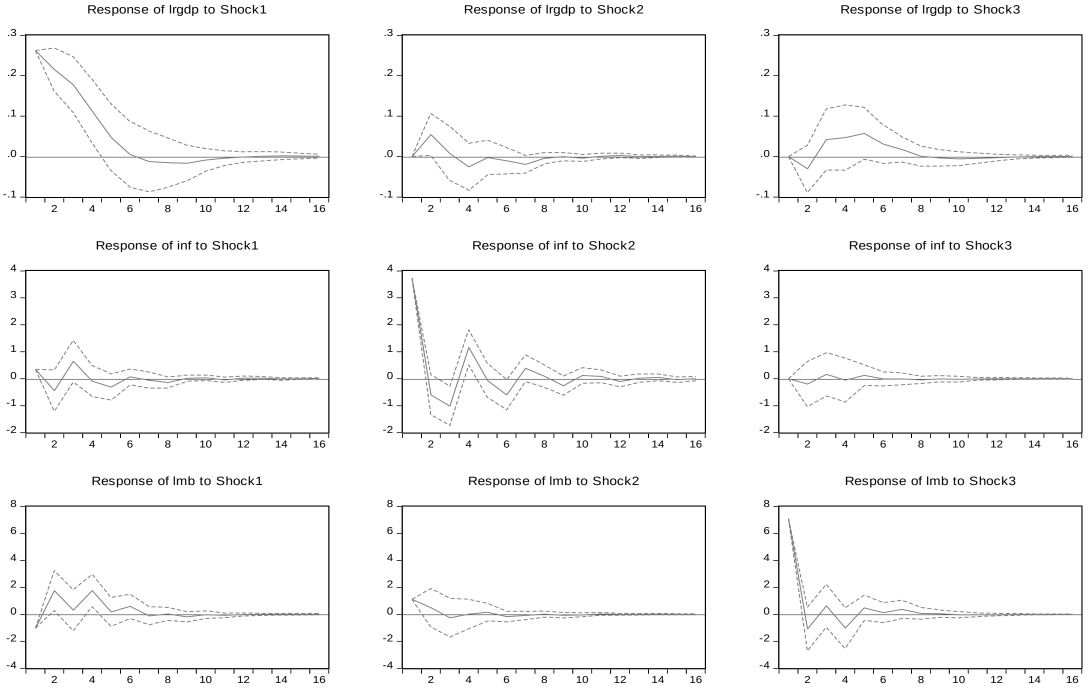
Included observations: 87

Component	Skewness	Chi-sq	df	Prob.
1	0.605806	5.398680	1	0.0202
2	-0.510826	3.967538	1	0.0464
3	1.097990	14.45597	1	0.0001
Joint		23.82219	3	0.0000

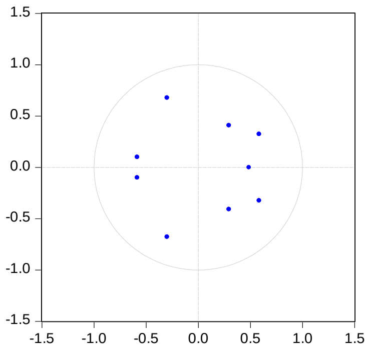
Component	Kurtosis	Chi-sq	df	Prob.
1	5.068585	7.006288	1	0.0081
2	4.759015	6.800329	1	0.0091
3	13.24617	74.64455	1	0.0000
Joint		88.45117	3	0.0000

Component	Jarque-Bera	df	Prob.
1	12.40497	2	0.0020
2	10.76787	2	0.0046
3	89.10052	2	0.0000
Joint	112.2734	6	0.0000

Senegal: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 88

Lags	LM-Stat	Prob
1	19.24099	0.0232
2	29.82211	0.0005
3	31.33994	0.0003
4	25.21509	0.0027
5	8.949666	0.4419
6	4.460776	0.8786
7	8.939986	0.4428
8	10.75654	0.2928

Probs from chi-square with 9 df.

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

Included observations: 88

Component	Skewness	Chi-sq	df	Prob.
1	-0.088152	0.130555	1	0.7179
2	-0.786059	8.555056	1	0.0034
3	0.503753	3.905868	1	0.0481
Joint		12.59148	3	0.0056

Component	Kurtosis	Chi-sq	df	Prob.
1	6.635817	37.07040	1	0.0000
2	4.433781	0.230100	1	0.6314
3	4.586327	5.583819	1	0.0181
Joint		42.88432	3	0.0000

Component	Jarque-Bera	df	Prob.
1	37.20096	2	0.0000
2	8.785156	2	0.0124
3	9.489687	2	0.0087
Joint	55.47580	6	0.0000

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

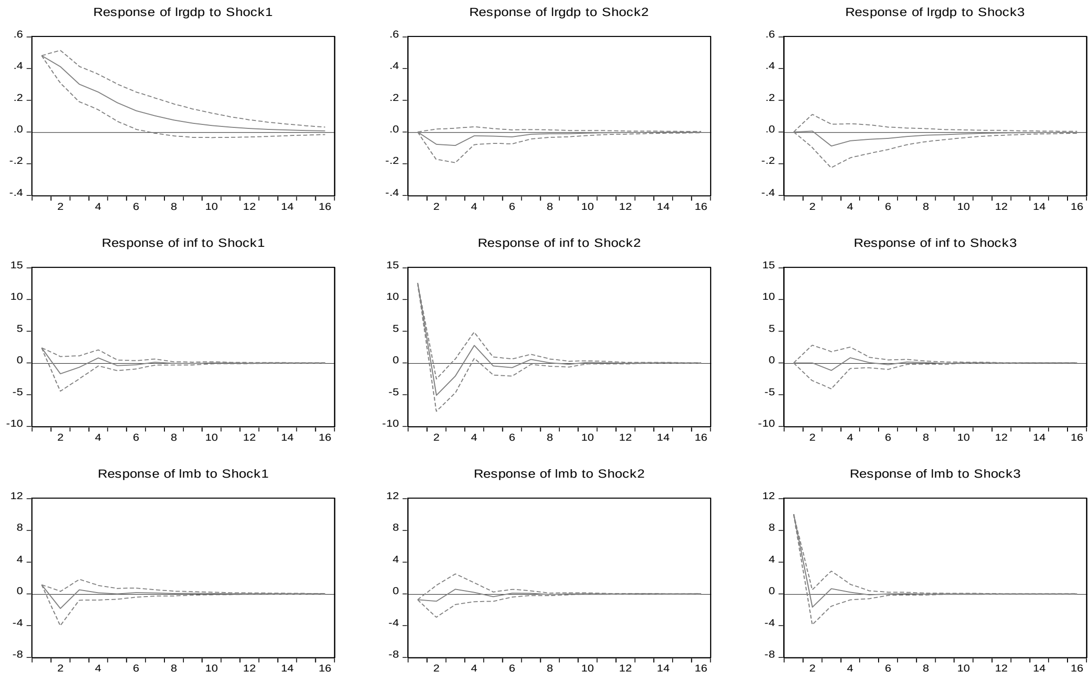
Sample: 1994Q1 2016Q4

Included observations: 88

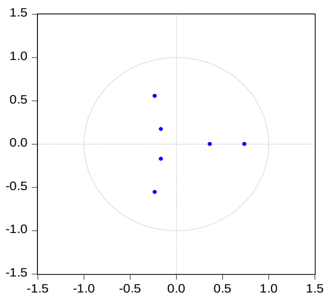
Joint test:

Chi-sq	df	Prob.
131.8183	108	0.0595

Togo: Response to Short-run Recursive Innovations ± 2 S.E.



Inverse Roots of AR Characteristic Polynomial



VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Sample: 1994Q1 2016Q4

Included observations: 89

Lags	LM-Stat	Prob
1	10.64612	0.3007
2	18.41628	0.0306
3	20.01030	0.0178
4	22.39616	0.0077
5	9.216577	0.4175
6	7.296244	0.6063
7	7.060498	0.6308
8	14.70087	0.0995

Probs from chi-square with 9 df.

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Sample: 1994Q1 2016Q4

Included observations: 89

Joint test:

Chi-sq	df	Prob.
100.8127	72	0.0141

VAR Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal

Sample: 1994Q1 2016Q4

Included observations: 89

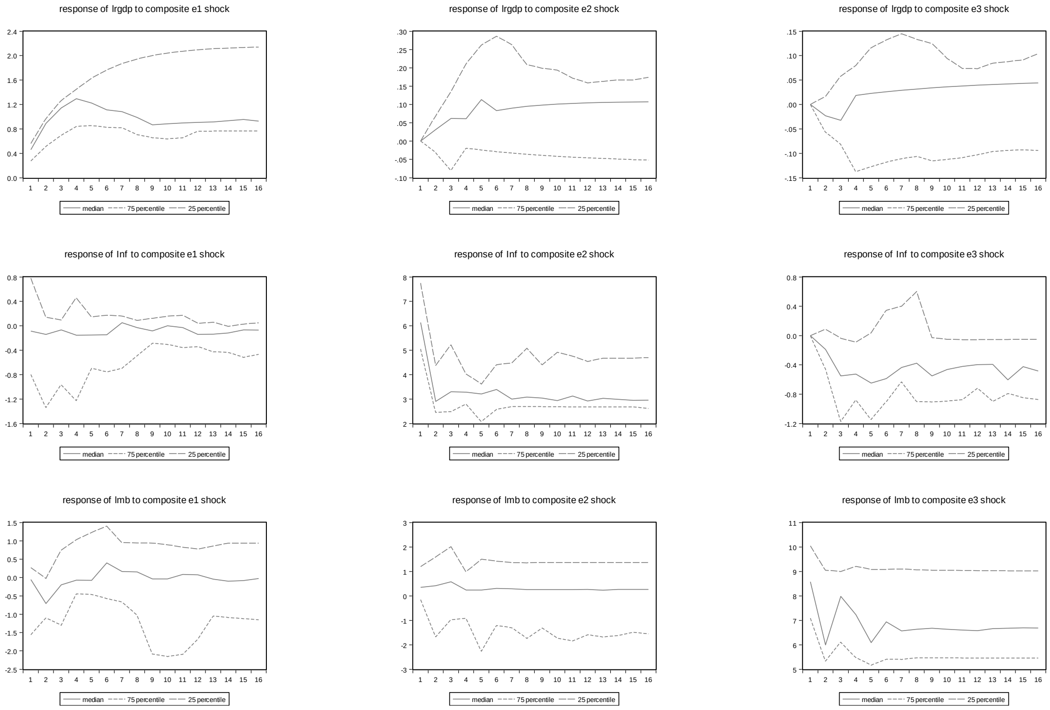
Component	Skewness	Chi-sq	df	Prob.
1	-2.568713	44.05334	1	0.0000
2	-0.415185	2.753349	1	0.0971
3	0.076583	0.099599	1	0.7523
Joint		46.90629	3	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	23.52753	21.82309	1	0.0000
2	3.821295	1.925757	1	0.1652
3	2.792026	0.003266	1	0.9544
Joint		23.75211	3	0.0000

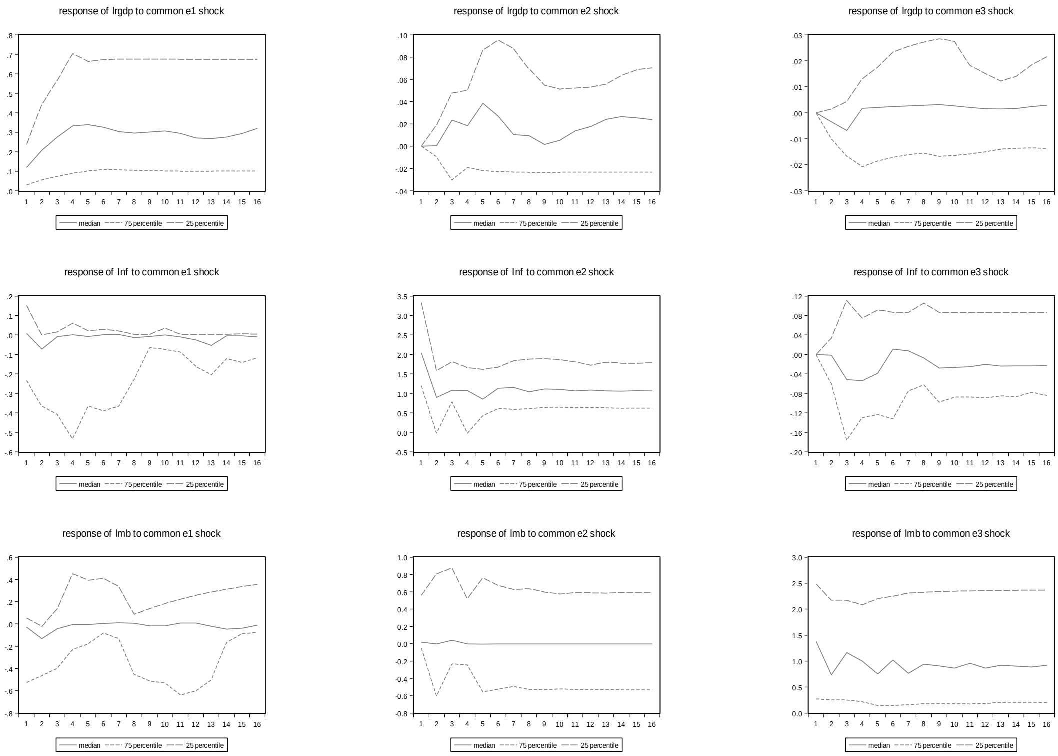
Component	Jarque-Bera	df	Prob.
1	65.87643	2	0.0000
2	4.679107	2	0.0964
3	0.102866	2	0.9499
Joint	70.65840	6	0.0000

Appendix A.21: ECOWAS - Response Estimates to Composite, Common and Idiosyncratic Shock (Baseline VAR - lrgdp inf lmb)

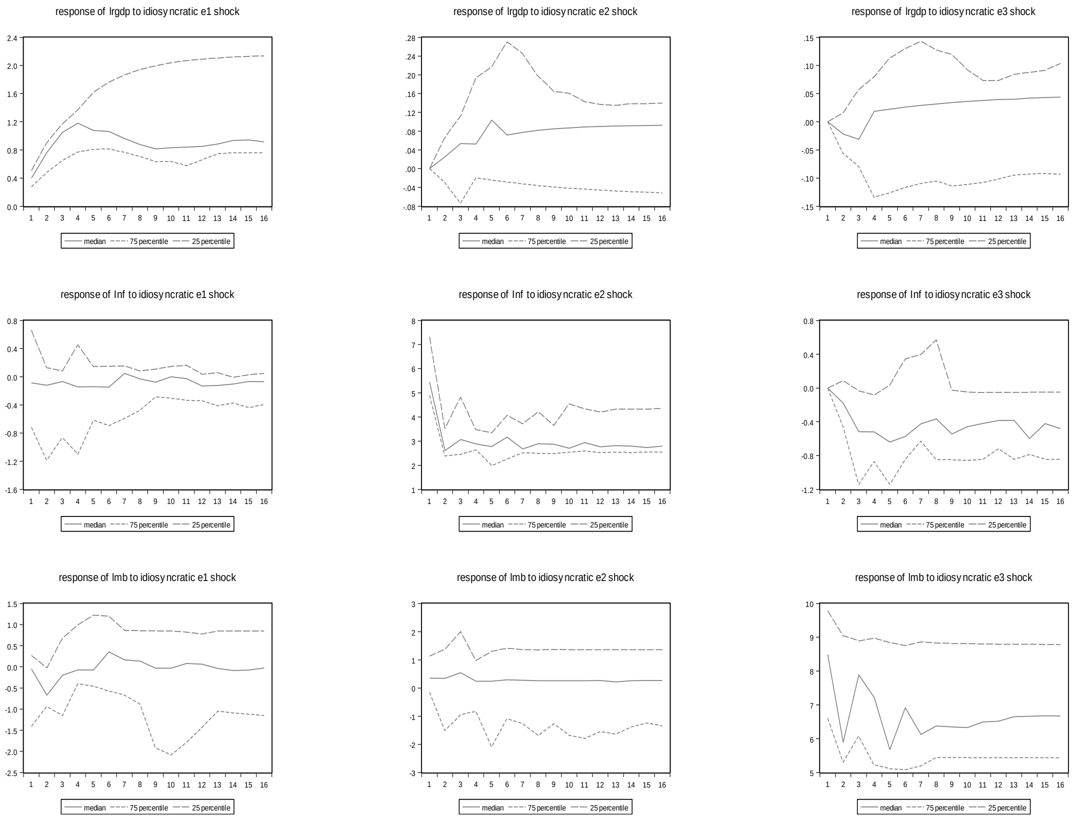
ECOWAS: Response Estimates to Composite Shocks



ECOWAS: Response Estimates to Common Shocks



ECOWAS: Response Estimates to Idiosyncratic Shocks



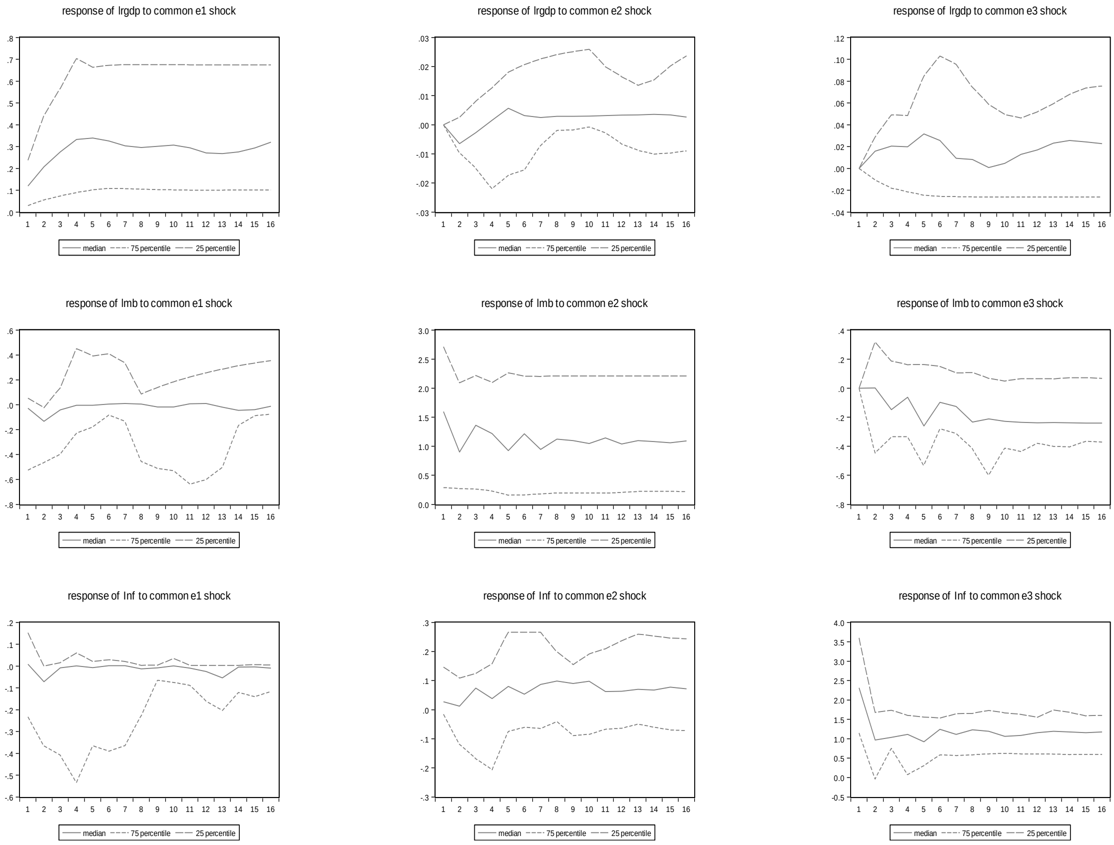
Source: Author's computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5

Appendix A.22: ECOWAS - Response Estimates to Common Shocks (Baseline VAR Model_ Alternate Ordering - lrgdp lmb inf)

ECOWAS: Response Estimates to Common Shocks

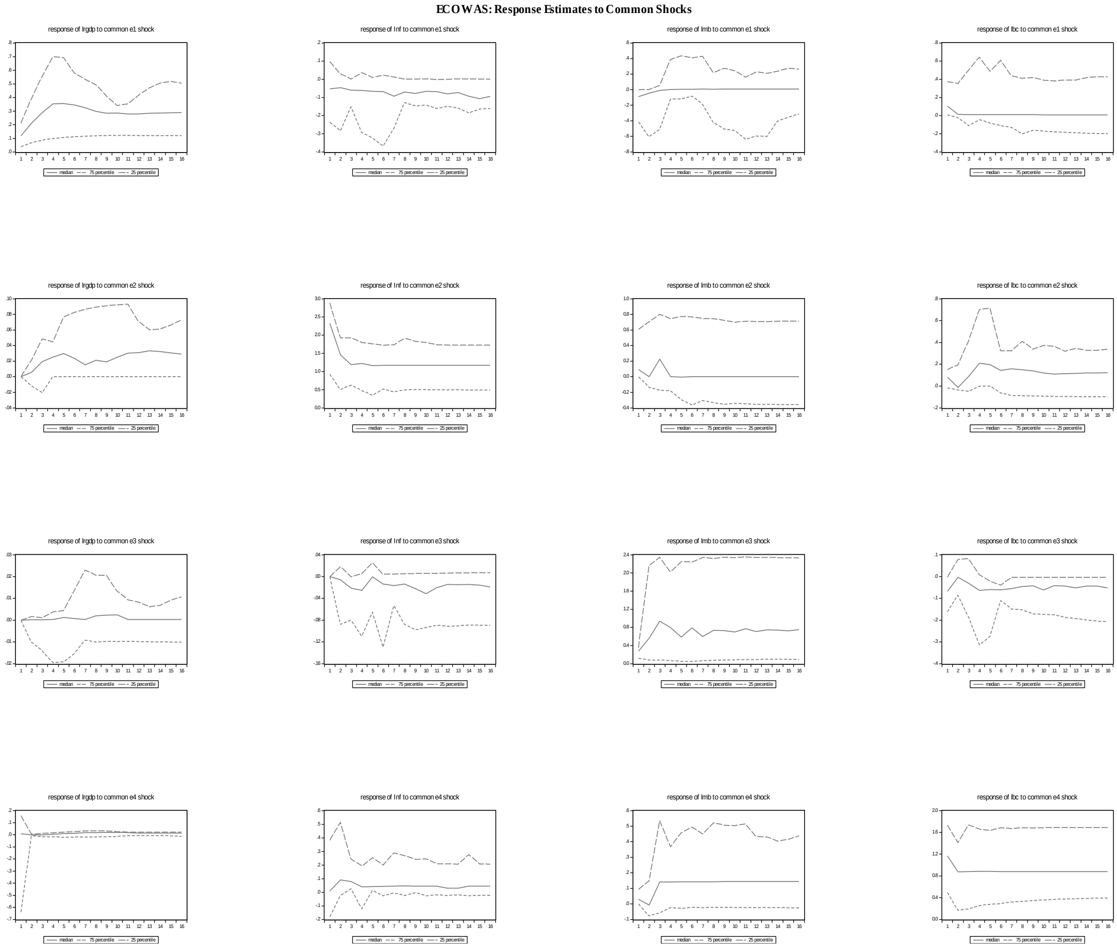


Source: Author’s computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5

Appendix A.23: ECOWAS - Response Estimates to Common Shocks (Extended VAR including Bank Credit)

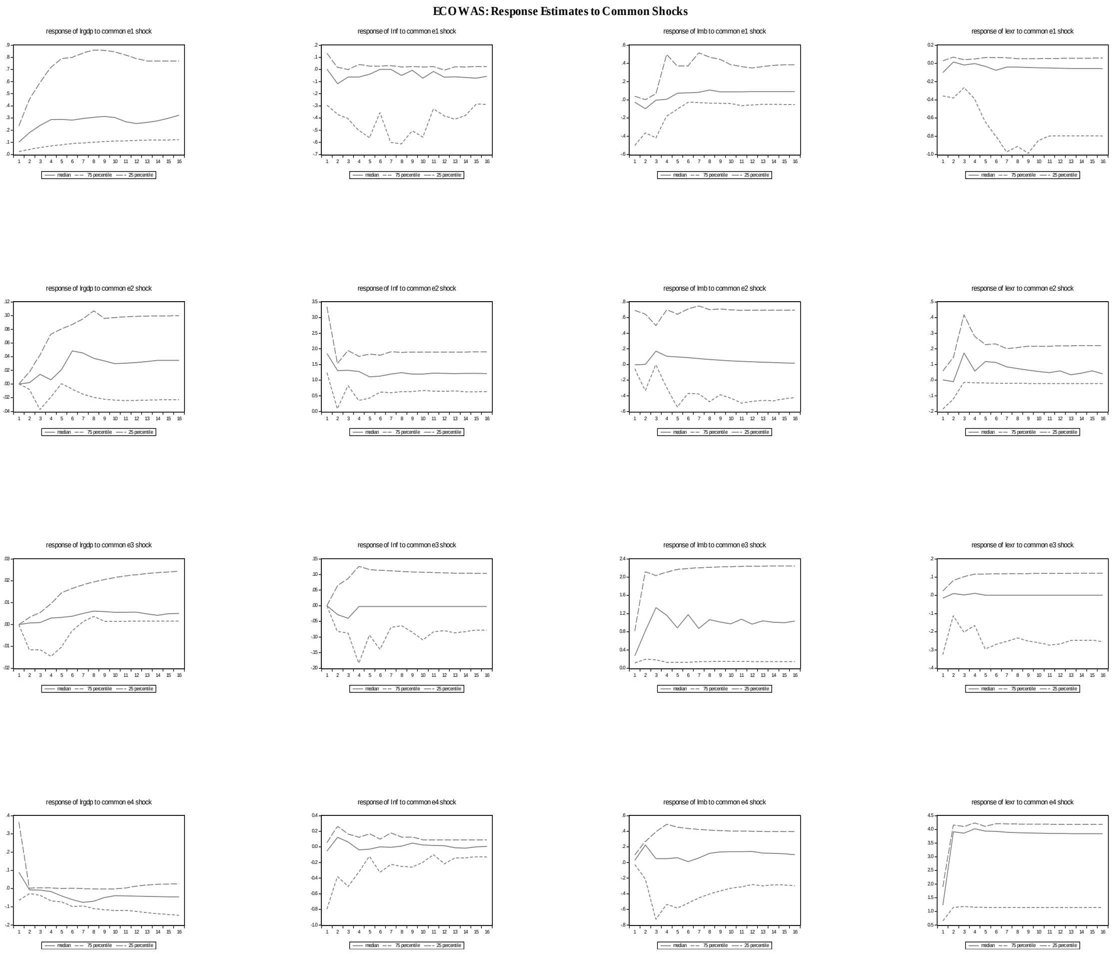


Source: Author’s computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5

Appendix A.24: ECOWAS - Response Estimates to Common Shocks (Extended VAR including Exchange Rate)



Source: Author’s computation

Note: Total number of observations is 1104

Econometric software employed – EViews 9.5