

**ESSAYS ON THE PROPOSED MONETARY INTEGRATION IN THE ECOWAS
REGION**

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ABSTRACT

Monetary integration has been projected to increase trade relations among member countries and plays an important role when it comes to economic growth through the elimination of trade barriers, the promotion of free movement of people and goods and the introduction of common external tariff and integration of payment system and capital markets of member countries. Whiles monetary integration in ECOWAS has been given much interest in extant literature; relevant research gaps remain largely in areas such as the introduction of ex-post monetary integration. In specifics, where the salient OCA criteria is used to examine the economic benefits member countries intend to gain with ex-post introduction of the single currency. The thesis contributes to fill this gap by investigating the ex-post introduction of monetary integration in ECOWAS. Knowledge of this is extremely crucial to policymakers to understand whether monetary integration can thus promote intra-regional trade in the ECOWAS region. This thesis comprises of four self-contained empirical essays. Each essay investigates a relevant lacuna in extant literature by relying on several advanced econometric techniques.

In the first empirical study, we examined the level of integration of exchange rates between the West African Monetary Zone and the West African Economic and Monetary Union countries using wavelet-based methods. Findings suggest low degrees of integration between the two blocs at higher frequencies, but the level of integration gradually becomes stronger as it navigates from the higher frequency (lower scale) to the lower frequency (higher scale). It implies that ex-ante convergence of exchange rates is difficult, however, in the long-time horizon, exchange rates convergence is possible. Evidence from the cross-correlation analysis depicts lead (lag) effects

are time-varying and heterogeneous, showing no country's exchange rates as leader or follower. Different currencies have the potential to lead or lag at varying scales.

In the second empirical essay, we investigated whether the impact of stock market development on growth in the ECOWAS region is dependent on the level of institutional quality such as voice and accountability, political stability, rule of law, control of corruption, government effectiveness, and government regulatory control. Our evidence suggests that, when institutional quality index is used as the mediating variable, we are able to establish that stock market development and economic growth nexus is contingent on institutional quality. Thus, the quality of the development of the stock market is important for economic growth, where better institutional quality is potent in ensuring the effectiveness of stock exchanges in promoting growth. The results also demonstrate that low quality of institutions tends to distort the ability of foreign direct investment (FDI) and domestic credit to the private sector which is used in this study to proxy for financial development to have any positive significant effect on growth. When we disaggregated the institutional quality index into its various dimensions whiles we constructed a stock market development index, our evidence suggests that, stock market development has a positive and significant effect on growth when political stability is above the threshold level. We further realized that, when government effectiveness is the threshold variable, stock market development has a positive and significant relationship with growth below the threshold level whiles higher regulatory control has a negative effect on how stock market development influences growth. This indicates that too much government interference inhibit the development of stock market to have a substantial positive influence on growth. This corroborates the financial repression and financial liberalisation theory by McKinnon and Shaw (1973) which is tested in this study objective. We established that, below the threshold level of

voice and accountability, rule of law, and control of corruption, economic growth is largely insensitive to stock market development. Our main conclusion drawn is that, when there are higher levels of institutional quality, it can promote growth in the ECOWAS region.

In the third empirical essay, we departed from the conventional way of studies on the relationship between labor migration and economic growth by examining the nonlinearities in this relationship by using Shin et al. (2014) methodology. What emerged is that the evidence supports the salutary effect of labor migration on economic growth in the ECOWAS sub-region. The baseline Autoregressive Distributed Lag results show that a 1% increase in labor migration reduces GDP by 0.66% which is statistically significant while the Non-linear Autoregressive Distributed Lag results show that, an increase in labor migration reduces GDP by 0.16% and a decrease in labor migration, increases GDP by 1.36% albeit insignificant in the long run. The essay evidences asymmetry relationship in the labor migration and economic growth nexus in ECOWAS. A key implication that emanates from this essay is that, policy makers in the ECOWAS sub-region should institute pragmatic measures to reap the full benefits of migration.

In the fourth and final essay, the study examined whether there is a homogeneous causal relationship between trade openness and economic growth in the ECOWAS region by employing the Granger causality test by Dumitrescu and Hurlin (2012). As a robustness check, the study used four separate lags to establish this and out of the four lags, three lags show that trade openness homogeneously cause economic growth in the ECOWAS region, however, there is evidence from all the lags that economic growth does not homogeneously cause trade openness. The findings reported no bidirectional causality in each of the variables. We further test the resilience of growth on impulses from trade openness; the evidence suggests the effect of transmission of GDP on its own shocks was permanent. In the long term, it will proceed to have

a positive impact on the economy. Evidence from the Impulse Response Function (IRF) result also discovered permanent policy shock of foreign direct investment (FDI) with a positive influence on GDP in the long-term while the percentage of variance explained by own shock in the short term accounted for 81.16% and continue a downward trend until it ends with an average around 68.42% at the end of the 10th period. The Pooled Mean Group/autoregressive distributed lag results show that trade openness has a positive and significant effect on economic growth with coefficient of 0.834 (0.0470) with P-value reported in parenthesis which indicates that a 1% increase in trade openness would lead to a 0.83% increase in GDP growth. At the policy front, ECOWAS heads of state should provide more effervescent and effective trade policies that are responsive to changing the trading market landscape in the sub-region while engaging economic agents to improve on trade infrastructure development which has evincing health for trade and economic growth.

Keywords: Economic growth; Exchange rates; Convergence; Labor migration; Monetary integration; Stock market development; Trade openness.

JEL Classification: C40, C58, F31, F36, G10, G11, G15.

LIST OF PUBLICATIONS AND OUTPUTS

Parts of this thesis and related works have been submitted for publication or are being prepared for submission in peer reviewed journals. Many of them are currently under review.

I. Empirical research outputs: Chapter Three

1. **Eshun, R.**, & Tweneboah, G. (2024). Exchange rates convergence in ECOWAS: WAMZ and WAEMU analysis on frequency time domains. *Cogent Business & Management*

II. Empirical research outputs: Chapter Four

2. **Eshun, R.**, & Tweneboah, G. (2024). Effects of stock market development on economic growth in ECOWAS: Does institutional quality matter? *Cogent Economics and Finance*

3. **Eshun, R.**, & Tweneboah, G. (2024). Revisiting stock market development and growth analysis in ECOWAS: A disaggregated analysis of institutional quality as mediating variable. *Cogent Social Sciences*

III. Empirical research outputs: Chapter Five

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5. **Eshun, R.**, & Tweneboah, G. (2024). Trade liberalization and economic expansion in ECOWAS: Sensitivity analysis. *The Journal of International Trade & Economic Development*

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7. **Eshun, R.**, & Tweneboah, G. (2024). Has trade liberalization played a helpful, benign, or malign role on economic growth within the ECOWAS trading bloc? *African Development Review*

V. Related published article in peer-reviewed journal

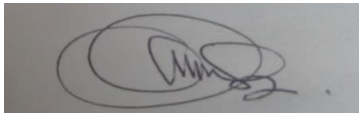
Tweneboah, G., & **Eshun, R.** (2023). Integration of macroeconomic fundamentals in the West African Monetary Zone: A multi scale perspective. *Cogent Social Sciences*, 9:2217000
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VI. Academic Conference

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DECLARATION

I, **Richard Eshun** with student number **2262844**, hereby declare that this research report is my work except as indicated in the references and acknowledgements. It is submitted in fulfilment of the requirements for the award of Doctor of Philosophy degree in the field of Economics and Finance at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



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Signed at: Wits Business School, Johannesburg, South Africa.

On the 14th day of February 2024.

DEDICATION

This work is dedicated to my elder sister Mary Eshun, under whose tutelage I began my primary education up to the university level; to my wife Mrs Joana Boakye, who has been outstandingly supportive throughout this epic academic journey, and my beloved children, **Michelle Eshun**, **Richard Eshun Junior** and **Vanessa Eshun**.

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TABLE OF ACRONYMS AND ABBREVIATIONS

ABBREVIATIONS	MEANING
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criteria
ARDL	Autoregressive Distributed Lag
AU	African Union
CC	Control of Corruption
COMESA	Common Market for East and Southern Africa
CMWT	Continuous Morlet Wavelet Transform
DCC	Dynamic Conditional Correlation
DH	Dumistriscu and Hurlin
DS	Domestic Savings
DWT	Discrete Wavelet Transform
EAC	East African Community
ECOWAS	Economic Community of West African States
ECCAS	Economic Community of Central African States
EMU	European Monetary Union
FDI	Foreign Direct Investment
FPE	Final Prediction Error
GDP	Gross Domestic Product
GE	Government Effectiveness
GMM	Generalized Methods of Moments
HC	Household Consumption
HCD	Human Capital Development
HENC	Heterogeneous Non-Causality
IFS	International Financial Statistics
IPS	Im-Peasran-Shin

IQ	Institutional Quality
IMF	International Monetary Fund
INF	Inflation
INV	Investment
LLC	Levin-Lin-Chu
LMR	Labor Migration
MC	Market Capitalization
MODWT	Maximal Overlap Discrete Wavelet Transform
NARDL	Non-Linear Autogressive Distributed Lag
NEPAD	New Partnership for Africa's Development
OCA	Optimum Currency Area
OCA/R	Optimum Currency Area/Region
OLS	Ordinary Least Square
PP	Philips Perron
PPP	Purchasing Power Parity
PMG	Pooled Mean Group
PMG/ARDL	Pooled Mean Group/Autoregressive Distributed Lag
PSTRM	Panel Smooth Transition Regression
PS	Political Stability
REC	Regional Economic Communities
REM	Remittance
RC	Regulatory Control
RL	Rule of Law
SADC	Southern African Development Community
SIC	Schwartz Information Criteria
STVL	Stock Traded Value
STO	Stock Turnover Ratio
SVAR	Structural Vector Autoregression

UEM	Unemployment
UEMOA	Union Économique Et Monétaire Ouest-Africaine
USD	United States Dollar
UMA	Arab Maghred Union
VA	Voice and Accountability
VAR	Vector Autoregression
VECM	Vector Error Correction Model
WAMZ	West African Monetary Zone
WAEMU	West African Economic and Monetary Union
WDI	World Development Indicators
WMC	Wavelet Multiple Correlation
WMCC	Wavelet Multiple Cross Correlation

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The concept of monetary integration has been defined by Mason and Pattillo (2005) as a currency union agreement among members of a particular region or jurisdiction that share a common currency as well as a single and foreign exchange policy. According to Masson and Pattillo (2005), this union represents a single currency or a number of currencies that are entirely convertible at an irrevocably fixed exchange rate. It entails monetary policy which should be implemented by single central bank or a system of central banks that have the sole authority over external exchange rate policy to cover participating countries within the region.

The idea of adopting one currency for the entire African continent has been one of the objectives of the African Union (AU). According to Masson and Pattillo (2004), there are two main reasons that can explain the enthusiasm for an Africa-wide monetary union: the successful inauguration of the Euro and the need to overcome perceived economic and political weaknesses in the region. The AU strategy for establishing a Monetary Union in Africa is dependent upon the formation of Monetary Unions in the regional economic communities (REC). There are many RECs that exist on the African continent, for instance the East African Community (EAC). However five of these RECs are regarded as the main building blocks for the successful implementation of the single currency for the entire African continent. They include the Common Market for East and Southern Africa (COMESA), the Economic Community of Central African States (ECCAS), the Southern African Development Community (SADC), the Arab Maghreb Union (UMA) and the

Economic Community of West African States (ECOWAS). These RECs are at varying stages of implementing the Abuja Treaty and monetary cooperation programmes.

Some of the incontrovertible objectives of monetary integration among scholars which has been documented in extant literature are that, monetary integration eliminates trade barriers, it promotes free movement of people and goods, it also helps participating countries to introduce common external tariff and integrate the payment system and capital markets of member states (Mason & Patillo, 2004; Alagidede, Tweneboah & Adams, 2008; Owusu junior. 2017). In the nutshell, the ultimate objective of monetary integration is to promote intra-regional trade among member countries.

This thesis concentrates on the Economic Community of West African States (ECOWAS), since there are existing contradicting perceptions among scholars and policy makers on the issue of ECOWAS countries preparedness for a common currency. This wavering attitude is due to the failure of member countries to achieve the conditions set for the convergence of their economies. The inability of members to attain the convergence has invigorated and lengthened the discourse on the prospects of ECOWAS as an optimal currency area. In spite of that, an important problem which engenders the debate is the limited empirical advances that clearly explore the feasibility of such a union ex-post.

The formation of a currency union in any region has its cost which is prospective members must relinquish its monetary policy independence to a supranational central bank. This raises an important question which is, is it worthwhile to join a currency union compared to the cost of relinquishing monetary policy instruments? The determination of this critical issue is enshrined in the theory of Optimum Currency Area (OCA) which was propounded by Mundell (1961) and others.

The Optimum Currency Area (OCA) theory is the workhorse of monetary integration. Any discussion of monetary integration revolves around the OCA. It has become useful in any discussion on regional integration. The successful implementation of any monetary integration is dependent on whether the region can attain the conditions stipulated by the OCA criteria. In his seminal article in 1961, Mundel describes a region to be an optimum currency area if there is full mobility when it comes to factors of production internally while those factors of production are immobile internationally. This according to Mundel will enable the facilitation of the intraregional redistribution of resources especially when responding to shifts in demand. The OCA has a number of characteristics and among the most relevant ones are that, one, there should be price and wage flexibility. The second is that there should be financial market integration, in other words, for a currency area to succeed in monetary integration, there should be sufficient financial integration. The third characteristic of the OCA is that there should be factor market integration which includes internal factor mobility. This internal factor mobility should include inter-regional and inter-industry mobility. The fourth characteristic of the OCA is that there should be integration of the goods market, in other words, for a currency area to be successful, there should be high degree of trade openness among member countries. This intensity of trade openness could be measured by the marginal propensity to import, or the ratio of tradable to non-tradable goods in production or consumption.

To achieve these conditions, ECOWAS heads of states set up several macroeconomic convergence criteria which was to be attained by all countries in the proposed monetary zone. However extant literature has documented that, the macroeconomic convergence criteria would be difficult for member countries to achieved (see: Alagidede, Tweneboah & Adam, 2008; Adam et al., 2010; Cham, 2009; Debrun et al, 2002; Harvey & Cushing, 2015; and among others).

Some of the findings from these studies report of vulnerabilities of member countries to external shocks, differences in economic structures and among others.

Due to these concerns and other related issues, the assessment of ECOWAS countries on the macroeconomic convergence criteria has been extensively studied in both policy and academic environments. However, few studies have assessed the feasibility of the benefits that would be derived by respective individual members of ECOWAS on the formation of monetary union particularly in line with the criteria stated in the OCA theory.

The purpose of this thesis is to use some of the important conditions enumerated by the classical contributors to assess whether ECOWAS stands to benefit ex post in terms of economic growth. First, the thesis seeks to establish the extent of interdependence of exchange rate in the ECOWAS sub region with emphasis placed on their co-movement and possible contagion effects which have implication for the success of monetary integration. Second, the study assesses the extent of financial market integration. With this criterion, the thesis concentrates on stock market development and economic growth in ECOWAS. Third, the thesis assesses the extent of labor mobility and economic growth in ECOWAS. For this study, labor mobility and labor migration are used interchangeably. Finally, trade openness, which captures the goods market and economic growth, is assessed among member countries.

On the various OCA conditions within the ECOWAS region, first, effective exchange rates seem not to be stable. The fluctuations of the exchange rates can lead to increase costs, it can also lead to destabilization of markets and misallocation of capital (Rose, 2000). The stabilization of currencies is a key ingredient for the introduction of a single currency. This is because in a situation where there are rigidities in wages and prices, one of the most effective economic policy instrument to manage macroeconomic consequences of international competitiveness

problems is the exchange rates. Second, the stock market is an integral part of the financial sector and as such the integration of the whole financial sectors depends largely on the integration of the stock market within a region (Mundel, 1961). However, it remains a daunting task to conclude that African stock markets are integrated and therefore enjoying the associated benefits of integration or still segmented (see: Alagidede, 2017; Boako & Alagidede, 2017). Third, on labor migration, ECOWAS citizens are legally allowed to enter each country and stay visa-free for up to 90 days. The reality, however, is that apart from the visa-free entry of people, the rights to establishment and residency is far from being implemented. Even with visa-free entry, an identity document is needed to cross the borders, which is an obstacle for the many ECOWAS citizens (Olusegun, 2015). Fourth, on trade, though the ambition of ECOWAS is to achieve a common market in the sub region, intra-regional trade in the West African region remains very low. The level of intra-regional trade in the region recorded 4.1% in 1975 and in 2005, trade among member states stood at around 11% of their total production and the volume of intra-regional trade in the informal sector was estimated to be around 15 per cent of total trade (New Partnership for Africa's Development, 2011).

It is against these backdrops that this thesis concentrates on these four main conditions and subjects it to empirical inspection to assess how member countries stands to gain economically in their quest for the attainment of the OCA conditions. While the extant literature may be replete with evidence pointing to non-convergence of ECOWAS member countries, most of them take a direct approach by analyzing the convergence alone without much emphasis on measuring its corresponding economic growth for the respective member countries (see: Alagidede, Tweneboah & Adam, 2008; Adam et al., 2010).

It is, therefore, important that fresh evidence from new research that examines the quest for the attainment of the OCA criteria and the potential benefits member states seeks to gain in terms of growth of their economies. To this end, various stakeholders could benefit from a deeper understanding of ECOWAS monetary integration, and at the same time moderate the expectations of the benefits of such integration.

Again, this study observed from extant literature that, assessing the feasibility/desirability of potential monetary union in ECOWAS, a number of issues with its establishments are identified. Among them are the variations in choice of variables, the empirical strategies used, sampled countries, and considered periodicities. This thesis addresses most of these shortfalls by using current data which includes all member countries of the region.

The uniqueness of this thesis is that, since ex ante conditions is difficult to be achieved by ECOWAS member countries, it is assessing the benefits from ex post perspectives something which is scarcely researched in empirical literature. Mundell (1961) and others stated that, a currency area is adjudged optimum if the benefits member countries can reap is greater than the costs.

From the foregoing, it can be inferred that, the success of monetary union hinges on the fulfilment of a number of conditions necessary for policy coordination known as Optimum Currency Area/ Region (OCA/R) propounded mainly by Mundel (1961). It requires existence of intra-regional trade amongst prospective members, high degree of labor mobility within the union, wage and price flexibility coupled with fiscal transfers to mitigate the impact of asymmetric shocks on members' diverse economies (Jayaraman, Ward & Xu, 2007). Thus, failure to empirically quantify the relative benefits of monetary integration for respective member countries may have dire implications.

1.2 Statement of the problem

The problem statement presented here is carved around four thematic areas from the classical contributors (Mundel, 1961; Mckinnon, 1963 and Kenen, 1969) of the Optimal Currency Area (OCA) criteria in accordance with identified gaps in the literature. These are price and wage flexibility; financial market integration; factor mobility, particularly, capital and labor; market integration, specifically the goods market. In accordance with these four main conditions proposed by the classical contributors, this thesis concentrates on exchange rates comovement, stock market development and economic growth, labor mobility and economic growth, and trade openness and economic growth in the ECOWAS region. These problems are individually discussed below.

a. Interdependence of Exchange rates

Understanding the behavior and volatility transmission of exchange rates and any comovement is very significant to international portfolio investors in the region. This is because, when there is volatility in the exchange rates, it increases the cost of doing business and thus also leads to output lost which sometimes result in enhancing uncertainty and poverty (Joyce & Nabar, 2009). After reviews, this study identifies the following gaps in literature. First, the study of exchange rates behavior (co-movement) in the ECOWAS region has mostly been on the countries that belong to the West African Monetary Zone (WAMZ). Examples of studies on exchange rates behavior in the WAMZ are Seraphin (2019), Owusu junior, Adam and Tweneboah (2017), Owusu junior, Tweneboah and Adam (2019), Adams et al (2010), Agyapong and Adam (2012), Alagidede, Tweneboah and Adam (2008) and among others.

The studies in exchange rates co-movement in the ECOWAS region are skewed towards the WAMZ countries. This may be due to the difference between the fixed exchange rate regime of

the WAEMU countries on the one hand and the flexible regimes of the WAMZ countries on the other hand. This has left a gap in the extant literature on how WAMZ and WAEMU exchange rates relate to each other. To the best of my knowledge, studies are few when it comes to the interdependence of exchange rates between the West African Monetary Zone countries (WAMZ) and the West African Economic and Monetary Union (WAEMU) countries. This study contributes to existing literature by trying to ascertain if the difference between the fixed exchange rate regime of the WAEMU countries on the one hand and the flexible regimes of the WAMZ countries on the other hand, can be one of the factors of non-convergence of business cycles in the region by looking at their co-movement.

Second, most studies that are conducted on the WAMZ normally use some of the countries but not all countries that belong to the zone (see: Coleman, 2011; Ngouana, 2012; Abayomi & Olaronke, 2015; Tweneboah, Agyapong & Frimpong, 2016; and among others). This has not presented a clear picture of the behavior of exchange rates even for the WAMZ countries. This has left a gap in extant literature on the comprehensive analysis of exchange rates behavior in relation to co-movement in the WAMZ. This study contributes to existing literature by studying the behavior of exchange rates by using all the six countries that belong to the WAMZ and exchange rates of the WAEMU countries.

Third, most studies that examined how exchange rate behave in the West African region were conducted before the COVID-19 pandemic. The study assesses the interdependence of exchange rates between the WAMZ and WAEMU post COVID-19 thereby contributing to existing literature since there are few studies on exchange rates co-movement after the COVID-19 pandemic in the sub-region. Fourth, on methodology, most studies that used the wavelets give much consideration to stock returns (see: Boako & Alagidede, 2017; Brooks & Del Negro,

2004). When it comes to macroeconomic variables, the study of their relationship around interdependence is not replete in extant literature when the study area is the ECOWAS region. This study will augment to the sparse studies in extant literature on the usefulness of wavelet methodology in understanding the relationship of exchange rates in the sub-region.

b. Stock market development and economic growth

Regulatory mechanisms are sets of rules that can serve as important determinants of economic growth (see Challe et al., 2019). For example, it has been shown that better institutional quality increases the likelihood of repaying debts (Chen & Chen, 2018). Economies that have good institutions can attract capital inflows to enhance productive sectors of the economy and bring stable long-run growth. For example, well-established institutional structures that influence the easiness of doing business have been found to result in the spillover of knowledge, technology, and innovation which in the end impact productivity, and growth (Bournakis et al., 2018; Gillanders & Whelan, 2014). Williamson (2019) asserted that growth is affected by institutional quality; therefore stock markets that are not operated under a higher institutional framework will not have greater impact on growth of economies. Williamson (2019) further postulated that countries with average or low institutional quality, which is likely in groups of emerging economies such as ECOWAS, could have distinct levels of development due to the fluctuations in the level of institutional quality of such countries.

Regarding the effect of stock markets on economic growth, Demirguc-Kunt and Levine (1996) raised doubts about the contribution of stock market liquidity to long-term economic growth in Africa in general and ECOWAS in particular. The reality today is that most of the exchanges in ECOWAS leave a significant gap in the debate on the effect of stock market development on economic growth. In most stock exchanges in ECOWAS, for instance in Ghana, Nigeria, and

Cote d’voire, which has the most effective stock exchanges in the sub-region, the market indicators have declined sharply as a result of the global pandemic (COVID 19). Investors engaging in capital flight and profit-taking on the stock market could have adverse effects on the economy over time. This can be attributed to the weak institutional structures in the sub-region.

In this study, we realized that studies in ECOWAS on this relationship have not considered the mediating role of institutional quality on the stock market development and economic growth nexus (see: Asamoah, 2018; Ofori-Abebrese, Kamasa & Pickson, 2016; Owusu, 2016; Owusu & Odhiambo, 2014). However, studies such as Effiong (2015) and Omoteso and Ishola Mobolaji (2014) in other jurisdictions have considered institutional quality as control variables when dealing with the finance-growth nexus. The studies employed the GMM method and fixed and random effects method respectively and realized that institutional quality, when coupled with stock market development can promote economic growth. The study seeks to contribute to the extant literature in the context of ECOWAS in two ways. First, we try to establish whether the effect of stock market development on economic growth is conditioned on the institutional quality and its dimensions. The motivation to apply the disaggregated institutional quality variables as well is to enable us to identify which dimensions ECOWAS can leverage on better to achieve long term growth. Study by Öhler and Nunnenkamp (2014) find that countries with stronger political stability and higher government effectiveness are likely to receive a higher share of World Bank funds. Again, Tang and Tang (2018) also revealed in their study that countries that have high political stability and a stable democracy experience higher levels of innovation in the area of technology and institutional structures. While the literature is unambiguously clear on the important role of institutional quality in the overall nation’s development, the role of institutional quality and its various constituents have been given less

attention in the context of ECOWAS in determining how stock market development influences economic growth. Second we assess whether beyond a certain threshold of institutional quality and its dimensions, stock market development can spur growth. According to Chinn and Ito (2006), in countries where the legal system is not clear regarding the definition of property rights or the enforcement of contracts is not adhered to, the incentives for lending can be restricted. This is because lenders and creditors are afraid of losing funds. Hence, the effects of institutional quality in closing the gap in the finance-growth nexus cannot be underestimated.

c. Labor mobility and economic growth

The empirical studies on the relationship between labor mobility and economic growth in ECOWAS countries have produced mixed results. Some studies have revealed that labor mobility enhances economic growth (see for instance, Akinyede & Williams, 2018; Adarkwa, 2015; Nyeadi & Atiga, 2014; Nyeadi, Yidana & Imoro, 2014; and among others). Some studies also find no evidence that labor mobility enhances economic growth (see for instance, Adams, 2010 and Ustarz & Issahaku, 2017).

The limitations of these studies above are that, first; most of these studies are done on country specific studies which fail to give a clear picture in the context of ECOWAS. Again, studies that are conducted in the ECOWAS region have mostly concentrated on the relationship between labor migration and economic growth for the origin/sending countries without considering the impact of labor migration on the destination/receiving countries. This study therefore fills that gap by undertaking an empirical investigation on the relationship that exist between labor mobility and economic growth for the destination country thereby making a modest contribution to extant literature.

Another limitation of these studies is that, on the periodicities of the sampled span, most studies have not captured the year 2021 in order to account for how the global COVID-19 pandemic has affected labor mobility and growth of economies in the West African region. This study therefore uses data that span from the period 2000 to 2021 thereby giving a fresh perspective on the issue.

In addition to the limitations discussed above, studies on labor mobility and economic growth in ECOWAS region have investigated the relationship as linear one (see for instance, Nyeadi, Yidana & Imoro, 2014; Nyeadi & Atiga, 2014; Adarkwa, 2015, and among others). A ground laying input of this objective to existing literature for studies in ECOWAS is the application of Shin et al. (2014) advanced Non-linear Autoregressive Distributed Lag (NARDL) cointegration approach to examine the relationship that exist between labor mobility and economic growth in the West African region. The NARDL is able to mutually estimate the short and long run non-linear asymmetries. The NARDL capability to simultaneously estimate both the short and long run non-linearities makes it possible to deal with the issue of inconspicuous cointegration as first suggested implicitly by Granger and Yoon (2002). So far, to the best of my knowledge, there are no studies in ECOWAS that have used the Non-linear Autoregressive Distributed Lag (NARDL) cointegration approach by Shin et al. (2014) to study the relationship that exist between labor mobility/migration and economic growth.

d. Trade openness and economic growth

One of the aims of the establishment of ECOWAS was to promote trade among member countries. ECOWAS has rectified several treaties to promote trade among member countries. Among some of the treaties are ECOWAS Trade Liberalization Scheme, ECOWAS Common Trade Policy, Harmonized Customs Documentation and Automated Clearance Procedures,

ECOWAS Common External Tariff and among others. Since most member states are primary exporters, the sub-region trades more with the developed economies than with member states. For instance, Nigeria's major trading partners are China, and India; Niger, Sierra Leone, and the Gambia trading partners are mostly the EU, while Burkina Faso mostly trade with Europe, among others (see Bloomberg Trade Flows, 2019 for details). This has resulted in low level of trading among ECOWAS member states. Though the region has recorded low levels of trade integration among member states; the impact of regional trade on economic growth in the sub-region has received little attention from scholars and policy makers. We identified a number of gaps after reviewing the extant literature in the context of ECOWAS. First, where research is conducted in the region, most studies are silent on the level of resilience for growth or recovery of shocks from trade openness in the ECOWAS region nor draw out the similarities as well as differences among the West African countries (see for instance Iyoha & Okim, 2017; Osabuohien, 2007; Yelwa & Diyoke, 2013; Kwame, 2013; Keho, 2017; Ijirshar, 2019 and among others). Second, human capital development (gross secondary school enrollment) which is a key ingredient when it comes to the adoption of technology (Romer, 1986; Mankiw, Romer & Weil, 1992; Yanikkaya, 2003) has been omitted from most studies in ECOWAS. The endogenous growth model, by Mankiw, Romer and Weil (1992) stated education to be important for technology to be absorbed from abroad. Therefore, the omission of this pertinent variable has resulted in questioning the validity of previous studies whether the results are a true reflection of studies conducted in the ECOWAS region. Third, most of the studies carried out (see: Asiedu, 2013; Zakari, 2013; Keho, 2017; Moyo, 2018; Egbulonu & Ezeocha, 2018; and among others) have been country-specific which is limited to individual West African countries. The decision to assess the resilience of growth from trade openness shocks, and to determine the efficacy of

human capital development in this relationship, and examining the causal relationship in a panel of the fifteen countries is the motivation for this study.

1.3 Research objectives

The principal objective of this thesis is to undertake an empirical examination on whether ECOWAS stands to benefit from the introduction of ex post monetary integration in terms of economic growth by employing the main conditions proposed by the classical contributors (Mundel, 1961; Mckinnon, 1963 and Kenen, 1969) of the OCA. This will unravel the misperceptions of whether a single currency introduction ex-post is favorable for the ECOWAS region. The OCA criterion is chosen since it has extensively been used in empirical literature. It is what the European Monetary Union used for the formation of the Euro and since then most regional blocs have adopted the OCA conditions in forming currency union. This study follows the empirics in using it to assess ECOWAS quest for monetary integration. Explicitly, the following seeks to achieve the study objectives:

1. To analyze the interdependence of exchange rates among ECOWAS countries. This objective seeks to explore the first characteristic that is enshrined in the OCA which is price and wage flexibility. The study examines systematically the co-movement of exchange rates among ECOWAS member countries by using a multivariate wavelet technique developed by Fernandez Macho (2012).
2. To evaluate the extent of stock market development and economic growth among ECOWAS countries. This objective explores the second characteristic of the OCA which is the integration of the financial market. Extant literature documents that Africa stock markets are not integrated (see: Alagidede, 2008; Tweneboah, Owusu Junior & Oseifuah, 2019; Boako & Alagidede, 2017). Hence, this study looks at stock market development

instead of its integration as a proxy for financial market integration. The study employs the Hansen (1996, 2000) threshold regression to achieve this objective.

3. To assess the extent of labor migration and economic growth among ECOWAS countries. This objective explores the third characteristic of the OCA which is the integration of the factor market. This comprises internal factor mobility which is categorized as inter-regional and inter-industry mobility. Since labor migration affects economic growth through its different components, this research objective disaggregates labor migration into receiving and sending country's component in examining the extent it impact on economic growth in the ECOWAS region. This study employs the NARDL approach by Shin et al. (2014) to achieve this objective.
4. To examine the causal relationship between trade openness and economic growth among ECOWAS countries. The fourth characteristic of an OCA is the integration of the goods market; this suggests that internal trade openness is an ingredient for a successful currency union. To achieve this study objective, PMG/ARDL approach to cointegration by Pesaran et al (1999), and Dumitrescu and Hurlin (2012) non granger causality test are used as estimation techniques to achieve the stated objective.

1.4 Research questions

The above discussion inherently yields the following research questions:

1. What is the level of interdependence of exchange rate among ECOWAS countries?
2. What is the extent of stock market development and economic growth among ECOWAS countries?
3. What is the extent of labor migration and economic growth among ECOWAS countries?

4. What is the causal relationship between trade openness and economic growth among ECOWAS countries?

1.5 Significance and contribution to knowledge

ECOWAS monetary integration has seen several postponements. This is as a result of members' inability to achieve the convergence criteria. Ex-post introduction of a single currency for the ECOWAS region has not received much attention in extant literature. A study by Frankel and Rose (1998) on the endogeneity of the OCA brings hope that monetary integration can be achieved ex-post once members trade among themselves. Further studies could still be undertaken to make significant and justifiable contributions to the limited literature on ex-post introduction of a single currency.

The first contribution of this study addresses the dearth in the knowledge on the level of integration between West African Monetary Zone (WAMZ) and the West African Economic Monetary Union (WAEMU) exchange rates across time. The study of exchange rate is necessary when it comes to the introduction of a single currency. Mundel (1961) argues that a fixed exchange rate regime is appropriate for countries that seek to form a currency union. Thus an analysis of the integration between the WAMZ and WAEMU exchange rates is expected to advance our understanding of this relationship since most studies on exchange rates in the ECOWAS region focus on the WAMZ countries. This study provides insight to exchange rates co-movement between the Anglophone and the Francophone countries thereby testing the contagion theory.

The second contribution is made in examining how threshold on institutional quality impact the development of the stock market and the growth of economies in the ECOWAS region. Most

studies that have examined the relationship between stock market development and economic growth in ECOWAS sub-region have not considered institutional quality in their study. This study therefore considers the threshold level of institutional quality in this relationship thereby making a modest contribution to extant literature on this relationship in the ECOWAS region. This is expected to advance our knowledge on how institutional quality affects the development of the stock market and economic growth in the ECOWAS region thereby testing the McKinnon and Shaw (1973) Financial Liberalization Theory and the Financial Repression Theory.

The third contribution of this study is how labor mobility impact economic growth for the destination or receiving countries. Studies in ECOWAS on how labor mobility impact economic growth is centered on the effect on the sending country and this is measured through remittance. However, the impact that labor mobility has on economic growth for the receiving countries is still sparse with no studies on the effect on the receiving countries in the ECOWAS region.

Another basic input of this objective to extant literature is the application of Shin et al. (2014) advanced Non-linear Autoregressive Distributed Lag (NARDL) cointegration approach to examine the relationship between labor mobility and economic growth in ECOWAS because studies in ECOWAS have always investigated this relationship as a linear one. This study makes a modest contribution to literature in the context of the West African region by studying this relationship in a nonlinear framework. This study provides insight to the labor mobility and economic growth thereby testing the Solow (1956) growth theory.

The fourth contribution of this study is how human capital development plays a role in the trade openness and economic growth nexus in ECOWAS. Most studies in ECOWAS exclude human capital development as one of their regressors in their estimation analysis (see for instance, Owusu & Odhiambo, 2014; Owusu, 2016; Enisan & Olufisayo, 2009; Adefeso et al., 2013;

Okonkwo et al., 2014; Gries et al., 2009; and among others). However, the endogenous growth theory highlights knowledge, skills and innovations as the main drivers of economic growth. Its exclusion in most studies in ECOWAS makes the results ambiguous. This brings into question the validity and reliability of such related studies in the sub-region.

Again, the level of resilience from economic growth to shocks or impulses from trade openness in the ECOWAS region is not studied enough. This study makes a modest contribution to extant literature on trade openness and economic growth in ECOWAS by assessing how impulse to GDP per capita reverberate through the system when there is an innovation from trade openness. This will provide insight to policy makers on how the economy response to impulses from trade openness. This provides insight into the relationship between trade openness and economic growth in the West African region thereby testing the endogenous growth theory.

Whether trade openness simultaneously and homogeneously induces economic growth for all the fifteen countries in the ECOWAS region has not been studied enough. We make a modest contribution by filling this lacuna in the context of ECOWAS.

In addition to the contribution to the body of knowledge on monetary integration in the ECOWAS region, the novelty of this study is propagated through using some of the OCA conditions to assess the feasibility of a currency introduction ex-post. This study will provide policy decisions to the various stakeholders.

Furthermore, this study has prospects of provoking renewed interest in the monetary integration research in ECOWAS in areas that may have been unexplored. This thesis also makes a modest theoretical contribution by testing the OCA criteria ex-post.

1.6 Structure of the thesis

The thesis consists of seven standalone chapters woven into one. We utilized data from 2000-2020 to examine the feasibility of ex-post monetary integration in the ECOWAS region. Our choice of study period is based on the fact that, the WAMZ was formed in the year 2000, and the last date for the implementation of the “*ECO*” was the year 2020. This date was postponed due to non-convergence of macroeconomic variables. We therefore use the year 2000 to 2020 to assess if monetary integration is feasible ex-post. The rest of the thesis is organized as follows:

Chapter two reviews an extensive theoretical literature on OCA and economic growth. The OCA theory is widely regarded as the workhorse of monetary integration. The chapter again reviewed the economic growth theory by Solow (1956). These two theories underpinned this thesis.

Chapter three examined the co-movement of exchange rates between the WAMZ and the CFA Franc used by the WAEMU countries. The limitation of current literature was the elimination of the CFA Franc when it comes to co-movement of exchange rates in the West African sub-region. Extant literature is replete with co-movement of WAMZ exchange rates. Employing the multivariate wavelet methodology by Fernandez-Macho (2012), we determined the levels of interdependence between the English speaking countries exchange rates and the French speaking countries exchange rates.

In chapter four, we assessed the level of institutional quality threshold beyond which stock market development can spur economic growth in the ECOWAS sub-region. We present new evidence by introducing a previously missing link in the stock market development and economic growth nexus in ECOWAS since previous studies have not considered the role of

institutional quality in this relationship. We employed the Hansen (1996, 2000) threshold regression model. This method is unique since it is based on asymptotic distribution theory.

In chapter five, we extended the labor migration and economic growth debate by arguing that there exist possible thresholds in the relationship between labor migration/mobility and economic growth. Employing NARDL by Shin et al. (2014) we tested for any threshold effect of remittance, and labor migration on economic growth since these two variables are used to represent the origin/sending countries and the destination/receiving countries respectively.

In chapter six, we sought to achieve three empirical exercises in one objective; first, we examined the effect of trade openness on economic growth in the ECOWAS region. We established this relationship by using PMG/ARDL and second, we used the Dumitrescu and Hurlin (2012) Granger causality test to assess whether there is homogeneous causality between trade openness and economic growth in the region, and third we used the Impulse Response Function (IRF) and the Forecast Error Variance Decomposition to assess the extent to which growth response to shocks from trade openness.

Chapter seven summed up the entire study with recommendations for policy implementation and further studies.

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CHAPTER TWO

THEORETICAL REVIEW ON THE OPTIMAL CURRENCY AREA

2.1 Introduction

This chapter gives a detailed review of theoretical literature on OCA, which has been argued in extant literature as the main theory of monetary integration.

2.2 Theoretical Review

The theoretical review presented here is carved around the Optimal Currency Area (OCA). The discussion in the theoretical framework of monetary integration is important in the empirical work of the proceeding chapters.

2.2.1 The Optimal Currency Area (OCA)

One of the theoretical literatures underpinning this thesis is the Optimum Currency Area Theory. This theory seems to be the main analytical framework that is used to evaluate the intended benefits that will be accrued to members in a currency union and the costs that is accompanied by the formation of a monetary union. The optimal currency area theory was developed and matured in three highly influential papers of Mundell (1961), McKinnon (1963) and Kenen (1969). They asserted that when labor mobility is high among countries and there is high degree of trade openness which is coupled with substantial product diversification, sufficient flexible price and wage as well as effective monetary policy, similar inflation rates, and the desire by the member countries to relinquish their currencies stands in a better position to reap the benefits of currency union. Optimal currency area theory has become the standard tool to assess the preparedness of countries nurturing the formation of a currency union (Mundell, 1961; and

others). This review categorizes the contributions of these individual authors who are regarded as the classical contributors of the OCA theory.

2.2.1.1 Mundell (1961)

Mundell (1961) is the first contributor of the traditional view which is known in extant literature as the classical contributions of the OCA. Mundell (1961) defines an OCA as a geographic region where there is internal mobility of factors of production but immobile internationally. This according to Mundel will enable the facilitation of intraregional redistribution of resources especially when responding to shifts in demand. To elaborate on Mundel (1961) position, he used two countries to explain this point, countries A and B, initially are at full employment and balance of payments (BOP) equilibrium. Assuming there is a shift in demand of products which is in favor of region B and if wages are not flexible, inflation will rise in region B while region A experience unemployment. When the two countries have an exchange rate regime that is fixed, then devaluation of currency can be used as an adjustment mechanism to bring back the economies to equilibrium. However, in a monetary integration, devaluation is not an option for member countries in the union.

When an asymmetric demand shock occurs among two countries in a region that has formed monetary union, in order to bring these two countries to equilibrium, Mundel analyzed two processes that can be applied. The first mechanism is that wages have to be flexible to enable workers who are unemployed in B to offer their labor services at lower wages, while excess demand for labor in A will result in wage increases. The second mechanism is that there should be labor mobility which will enable unemployed workers in B to easily relocate to region A which has excess demand for labor. If both wages and labor are not flexible and mobile respectively, then the incidence of asymmetric shocks can be used to judge optimality (Mundell,

1961). According to Mundell (1961) free labor mobility can be used to nullify shocks that are asymmetric especially when factor markets are liberalized in the area.

2.2.1.2 McKinnon (1963)

McKinnon (1963) extended the OCA theory by introducing some conditions under which countries nurturing the formation of an OCA can benefit. Among them is the degree to which an economy is opened. McKinnon (1963) argued that the degree of openness in terms of the relationship between tradable and non-tradable is essential when it comes to the formation of an OCA. That is there should be trade integration for economies that seek to form a currency union. If the extent of openness of an economy is high, movements in prices of tradable in the international markets is likely to be transmitted to the domestic economy. Again, the effects of devaluation will be more swiftly transmitted to the price of tradable. This will minimize the intended effects thereby bringing the cost of living to manageable standards. This in effect implies that, the nominal exchange rate would be less useful as an adjustment instrument for small open economies (Horváth & Kuâerová, 2005). McKinnon (1963) asserts that an OCA should have a common currency and within which macroeconomic policy decisions on monetary and fiscal decisions as well as exchange rate flexibility can be applied to solve problems that are related to price stability, employment, and international payment which are conflicting.

Three conclusions can be drawn from McKinnon (1963) conceptualization of OCA theory. The first conclusion is that, relatively open economies can fix their exchange rates, and secondly economies that are open tend to trade more with each other and would find it useful to establish a monetary union in such an area. Third, small or large geographic size might be relatively open or closed so that the size of the area could determine the exchange rate regime to be adopted by countries.

2.2.1.3 Kenen (1969)

Kenen (1969) is the third contributor to the traditional OCA theory who builds on the arguments put forward by the earlier contributors, that is, Mundell (1961), and McKinnon (1963). Kenen emphasizes on the effects of shocks to a particular sector or industry. Kenen (1969) put more emphasis on fiscal integration when determining the efficient criteria for the formation of an OCA. According to him, fiscal integration can increase the ability of smoothing shocks that are asymmetric by instituting fiscal transfers from a region with whose unemployment situation is low to one where unemployment is high. Kenen (1969) supports views expressed by Mundel on labor mobility as a way of an adjustment mechanism when there is an asymmetric shock of demand especially when such countries have similar structures of production. His position extends the argument by Mundell that countries that are predisposed to symmetric shocks should have a fixed exchange rate. His view is that in terms of trade among countries, shocks that are sector specific are likely to affect them in different ways. Kenen (1969) introduced another dimension by emphasizing on product diversification as an important criterion for an OCA. According to Kenen (1969), countries that have their economies more diversified stands in a better position to form a currency union than less diversified ones. He argues that it is unusual for an economy that is well diversified to experience changes in demand for its exports. He posits that the significance of shocks that are asymmetric would be of less importance in a diversified economy than it is in a less diversified one.

In summary, the criteria for the determination of the eligibility of countries that wish to form a monetary union from these three classical authors is that, there should be a high degree of labor mobility, there should be flexibility in terms of wages and prices (Mundell, 1961); there should be high degree of trade integration and openness of economies (McKinnon, 1963) and the

economic structures of member countries should be similar, and lastly there should be a high degree of fiscal integration and diversification of products among member countries (Kenen, 1969).

2.2.1.4 The new OCA theory

Several opinions on the OCA theory have emerged after the classical contributions from Mundell (1961), McKinnon (1963), and Kenen (1969). According to Mongelli (2002), during the 1970s there was a drive towards a flexible exchange rate monetary system, and flexibility of the exchange rate system was related to the works of Ishiyama (1975), Tower and Willet (1976), Tavlas (1993), and Frankel and Rose (1998). The proponents of the new OCA put more emphasis on the merits and demerits of monetary integration in comparison with other exchange rate arrangements by making the European Union economic integration the reference point, while making nominal convergence of macroeconomic variables determinants of an OCA.

Tavlas (1993) called the new OCA the cost-benefits analysis approach, and according to the new OCA approach to monetary integration, countries nurturing the formation of a currency union should attain certain criteria. These criteria states the following conditions prospective member countries should achieve to enable them qualify as an OCA region. First, there should be similarities in the respective countries inflation rates and there should also be financial integration among member countries as well as variability in real exchange rate. Second, there should be willingness on the part of respective government as well as the presence of a political will to sacrifice on the OCA endogeneity. Van de Coevering (2003), Dellas and Tavlas (2009) assert that the reawakened of academic interest in the OCA theory is as a result of the Maastricht convergence criteria and experience of the EMU and its developments. The theoretical

framework of the new OCA theory is hybrid and pairs off contradicting approaches (Priewe, 2007). The views on the new OCA theory properties are discussed next.

According to Vaubel (1976), he proposed that real exchange rate should be the main criterion when determining countries that should form a currency union. His argument is that if the exchange rate between two countries is stable, then it is proof that in the past shocks to exchange rate was few and requires no adjustment as a measure. He anticipates that this trend of fewer shocks to the exchange rate will continue to hold even in the future. Ingram (1973) saw the determinant for countries that wish to enter into a currency union in a different dimension. He views the degree of financial integration to be the major criterion for the determination of currency area optimality. He asserts that when there is high level of financial integration among countries wishing to form a currency union, it will bring capital movements across member states even when there are small changes in interest rate. Mongelli (2002) supports the assertion made by Ingram (1973), by saying that when there is financial integration among countries, external financing of imbalance would be eased thereby promoting efficient allocation of resources when long-term interest rates are reduced. The need for exchange rate adjustment will be reduced when financial markets are integrated. Financial integration among participating countries will help domestic economy to be cushioned against short-term disturbances through inflow of capital.

Fleming (1971) argues that a monetary union can only be formed by countries whose inflation rates exhibit similar patterns. Laabas and Limam (2002) posit that, when there is similarity in the inflation rates, it also indicates that there is similarity in their economic policies and structures. According to Fleming (1971), terms of trade between countries will continue to be stable once there is a low and similar rate of inflation over time. The result of this will in turn

promote current account and trade balance which may reduce the need for adjustment of nominal exchange rate. However, it is not always the case that differences in inflation rates are problematic.

Feldstein (2008) considers willingness on the part of prospective member states to sacrifice as an important determinant of the formation of a monetary union. Feldstein (2008) is of the view that the willingness on the part of member countries to accept policy measures taken by common monetary authority, and which may not necessarily be of specific interest to them is an important feature in a monetary union. This willingness of countries and public support for common policy which might not be of specific interest of a particular country but for the common good of all partners is a critical element that will determine success and survival in the long-run.

Frankel and Rose (1998) advanced the concept of endogeneity of OCA and they argue that, there is endogeneity between trade integration and correlations of business cycles. They assert that closer trade links among countries has a higher propensity to synchronize their business cycles. Mongelli (2002) postulates that, the intuition of endogeneity hypothesis is that trade costs are reduced, when there is monetary integration beyond what less exchange rate volatility can achieved. Thus, if countries seeking to form a monetary union do not satisfy the OCA criteria ex ante they meet it ex post. Economies can become OCA after adopting a single currency because a common currency will generate forces that will make the countries become an OCA (Janicki, Warin & Wunnava, 2005).

According to Mintz (1970), the presence of political will to integrate by prospective member countries is an important requirement for the formation of a monetary union. The logic is that in as much as monetary integration is an economic process, the success or otherwise of a single currency adoption is largely dependent upon political will of government. Jurek (2004) advanced

that creating a monetary union is rather a political process and economic considerations. He however conceded that measuring of political will is difficult, and Mongelli (2008) states that the presence of political will enables compliance to joint commitments to be possible which invariably fosters cooperation in economic policies of various aspects.

2.2.1.5 Weaknesses of the OCA theory

The OCA theory is not devoid of weaknesses. According to Broz (2005), the OCA theory is not standard and as a result of that, it has several limitations. He advanced his argument that, the OCA main limitation is that it does not give an index or algorithm that can unambiguously indicate as to whether a given country can or cannot join a monetary union. Again, the OCA theory fails to consider respective countries wishing to form monetary union economic development levels, since each country development may be at different stages prior to the formation of a currency union (Dellas & Tavlas, 2009). Let's assume two countries that are at different stages of economic development, that is A and B. Country A is a mature economy with a high income per capita and country B with a relatively low per capita income, the supranational central bank is expected to maintain price stability by adopting a common monetary policy that should produce optimal results for all member countries' economies. Assume an event occurs which makes country B, which is the relatively poor country loses competitiveness, for it to regain competitiveness it has to undergo a prolonged period of deflation. This is because devaluation is not a policy option for the supranational central bank since it has to adopt a monetary policy that is optimal to all country and not to respond to specific country disturbances. The OCA theory is not able to capture political integration due to difficulties of measuring political will. According to Krugman (2012), in spite of weaknesses identified with the application of the OCA, it is the only available framework that is use for analyzing

appropriateness of countries desiring to create a monetary union, and Krugman (2012) advanced his argument that, indeed, it is the only one that has been used to analyze the Euro zone crisis.

Robson (1987) observes that most of the OCA criteria are problematic to measure since it does not have a unifying framework and one can end up creating different boards for a monetary union by referring to different OCA criteria. According to Tavlas (1994), this clearly shows the inconclusiveness of the theory. Van de Coevering (2003) makes a similar observation and asserts that challenges are related to methodology and data which makes it difficult to create a criterion that can be easy to interpret especially for variables such as mobility of labor, and flexibility of wages and prices.

Tavlas (1994) associates OCA theory main problem to be inconsistency. He furthers his argument that small open economies can establish a currency union by resorting to trade openness criterion, since small open economies are more likely to have economic structures that are less diversified. This implies that these small open economies stand in a better position to have their own independent exchange rates considering the fact that, they have low levels of diversification in production. Kenen and Meade (2008) identify some shortcoming of the Mundell (1961) model which primarily emanates from its restrictive assumptions. First, his theory deals with a two-country world and could therefore not ascertain how those countries' involvement with the rest of the world affects the costs of forming a monetary union.

According to Jurek (2004), political integration is one of most important OCA criteria per the new OCA theory, however, since measuring political will is somehow impossible, it is usually not considered when undertaking OCA analysis. Lastly, in the mid-1970s up to mid-1980s, OCA theory as a subject suffered academic limbo (Tavlas, 1993). This is because intellectuals and policy makers that resorted to OCA to assess the feasibility of regional blocs' integration were

not able to get clear answers on whether European countries should go ahead and form a monetary union, and which countries were eligible to join. Emerson, Gros and Italianer (1992) make a similar observation and realized that there was not ready-to-use theory to evaluate the pros and cons of a monetary union. Dellas and Tavlas (2009) advanced that the initial OCA theory could not have anticipated the importance of the service sector, which is more diversified, diffused, and fragmented. The OCA theory is not able to predict the significant role that institutions play in obstructing flexibility and mobility in the product and labor markets. According to Dellas and Tavlas (2009), collapse of the early OCA theory conceptual framework leading to erosion of its foundation is the most crucial weakness.

2.2.1.6 Cost and Benefit analysis of OCA

This section discusses some of the cost and benefits of the creation of monetary integration for member countries. First, a discussion of the potential benefits for member countries in an OCA region are discussed below

2.2.1.6.1 Benefits

One of the benefits for the formation of a monetary integration by applying the OCA criteria is that, monetary integration reduces transaction costs and the uncertainty around exchange rate. According to Mundell (1961) when it comes to currencies performing the functions of medium of exchange and unit of account, the use of single currency is very effective than a situation where there are several currencies. To give credence to Mundel position, Mongelli (2008) asserts that, under flexible exchange rate regime, currency conversion is increased when there are many currencies, thus he argues for single currency. Again, in a floating exchange rate regime, the introduction of a common currency helps to remove risk associated with exchange rates. In a

similar argument, Horvath (2003) and Marco (2014) argued strongly that a single currency promotes growth. They argued that fluctuations in exchange rate have a negative effect on economic conditions. In another development, Volz (2010) believed that a common currency increases foreign direct investments and also the removal of tariffs in international trade promotes intra-regional trade. Kenen and Meade (2010) and Volz (2010) believed the introduction of a single currency can bring efficiency gain. They assert that this will make investors have confidence when investing in productive activities since exchange rate volatility is removed. When this happens, fundamentally, it will enable the private sector to grow.

2.2.1.6.2 Costs

According to Mongelli (2002), when there is monetary unification, member countries monetary independence is lost to a supranational central bank. This he argues is the main cost of currency union by member countries, and he argues further to say that, it often put pressure on national fiscal policy. Frankel (2013) observed that another problem of monetary integration is that member countries are unable to devalue their currencies in order for them to gain competitive advantage. This he argued strongly that, it is a clear difficulty since it is structurally built into currency union formation. Furthermore, when there is monetary integration, member countries tend to lose revenue that could have been generated from seigniorage (Emerson 1992; i Marco 2014). In conclusion, the traditional OCA theory pioneered by Mundell (1961), McKinnon (1963), and Kenen (1969) failed to account for the implication that may arise as a result of monetary union when it comes to fiscal policy since monetary integration affects the interactions among the national governments with potential consequences for the monetary, and fiscal policy mix, and also the macroeconomic outcomes, the recent developments in the Eurozone debt crisis have provided a practical example of this type of cost in a monetary union.

2.2.2 Economic Growth Theory

The neoclassical growth theories have dominated economic growth studies. The mobilization of domestic and international savings has become one of the important conduits when it comes to the generation of adequate investment to quicken growth of economies. In economics, the process by which sufficient investment both local and foreign leads to an appreciable growth is mostly understood well by applying the Harrod-Domar growth model (Todaro & Smith, 2009).

2.2.2.1 Solow's Economic Growth Theory

The Harrod-Domar growth model has been reviewed and expanded by Robert Solow in 1956 in his treatise titled the contribution to economic growth theories when he added another variable which is labor as well as the introduction of a third explanatory variable, technology, when it comes to the growth equation model. Solow assumes that, there should be an uninterrupted production function that connects the end product, that is output to capital and labor which is the input.

In Harrod-Domar model, there is an assumption of a fixed-coefficient and constant-return to scale, however, unlike the new neoclassical growth model by Solow, it separately shows that, there is diminishing return to both labor and capital while there is a joint constant returns to both factors.

In Solow growth model, technological progress is the residual factor that explains growth in the long term, and its level is presumed to be exogenously determined. Solow's economic growth theory is described as a multi-dimensional in terms of factor productivity that assumes that output, which is the rate of production denoted by $y(t)$, is a single commodity and this output according to Solow is referred as the real income. The output produced at any given time is in

two parts, one portion is consumed while the other portion is put into savings and investment. The saving portion of the output is constant, and the rate of savings is denoted by $sY(t)$. $K(t)$ represents the stock of capital generated by the country which is an accumulation of the composite commodity. The degree of increase in terms of capital stock which is represented by dK/dt or K is the net investment, the basic identity at every period of time is written:

$$K = sY \quad (1)$$

Two factors of production, that is, capital and labor help in the production of the output. The degree or level of input is $L(t)$. Technology is represented by the production function

$$Y = f(K, L) \quad (2)$$

The output is described as the net output when provision of depreciation of capital is computed. The natural assumption of the Solow growth model is that, there should be a constant return to scale while the production function assumes homogeneity to demonstrate constant returns to scale. This leads to the assumption that, a critical factor of production which is land should always be available. According to Solow, if land case is not removed in the model, it would result in a decrease returns to scale both for capital and labor. When this happens, it would make the model look similar to the Ricardian model (Solow, 1956).

The Solow growth model excludes certain economic variables such as the fluctuations in employment, institutional structures, and the role of the government, and also it fails to account for the increasing rate of globalization, and geographical locations. The exclusion of these vital economic variables however has made it much easier to understand what roles labor, capital as well as knowledge play when it comes to the study of economic growth.

Predictions of the Solow's model: the following assumptions can be adduced if the Solow model is assumed to be accurate, and that economic growth emanates from the accumulation of capital.

(i) When countries begin to experience capital accumulation, it is expected that, their economies should grow, however, once the accumulation of capital continues, there should be a gradual decline in terms of growth, for instance, in the case of Japan, the country experienced growth during the 1950s as well as the 1960s than what is been experienced in this 21st century.

(ii) If Solow's theory holds, there would be convergence of output per capita as well as the living standards of some countries. When countries like Singapore, Thailand, Taiwan, Malaysia, and Hong Kong begin to experience capital accumulation, per the Solow's growth theory, these countries living standards is expected to close the gap with the countries that have attained a higher development.

Undoubtedly, some countries have practically experienced what is Solow's model albeit some problems as well:

- (i) In the 19th century, the US experienced a lower growth rate on per capita basis than what they experienced during the 20th century.
- (ii) In the Soviet Union, when President Stalin was at the realms of affairs, the country experienced a considerable high percentage of national income which was more than what the US achieved. Since, there was a higher savings rate which began with a lower level of capital; going by the Solow growth theory, it should have increase sharply, however, it did not.

- (iii) With the exception of Taiwan, Hong Kong, Korea, and Singapore, some less developed countries are generally still far behind the developed countries in terms of development. Ironically, in many situations, the difference in terms of development keeps widening.

When there is an upward increase in the output per capita, several reasons may be accounted for this, one, it can be as a result of an increase in multi-factor productivity, and second it can be as a result of an increase in capital per worker. If these assumptions hold, then the Solow model should not be rendered wrong or invalid. The neoclassical theory posits that, when there is liberalization of the market, it attracts domestic and foreign investment thereby increasing the accumulation of capital.

According to Todaro and Smith (2009), the neoclassical growth theory outlines three critical factors that can bring economic growth. First, there should be an increase in the quantity of labor and its quality. This can be achieved through increasing the rate of population growth and the quality of knowledge acquisition through education. The second factor is that, there should be an increase in capital through investment and savings, and thirdly there should be technological improvement.

Countries that have no trade liberalization tend to grow more slowly especially when it has a low savings rates in the short run. Due to that, such countries convergence on per capita income levels are low. On the other hand, countries with an open economies experience convergence of income at the highest level since capital flows from the most developed countries to the less developed countries.

2.2.3 Theoretical Linkage

Economic literature is replete with different kinds of explanations when it comes to the relationship between economic variables such as capital mobility, labor mobility, trade liberalization, and economic growth. It is, however, not seemingly or apparently valid to rely on only one of the theories as the best to explain both capital mobility and economic growth, labor mobility and economic growth or trade openness and economic growth in developing countries. Factor productivity is the main determinant of economic growth theories. Economic growth theorists such as the Solow's growth theory assumes that open economies, especially countries that have trade liberalization, and foreign investment drive policies can achieve growth in output since capital flows from the developed countries to the less developed countries. The Solow growth model is to simplify the role of labor, capital, and knowledge in the study of growth of economies. The Solow's growth model is the main economic growth theory that underpins this thesis.

2.2.4 Conclusion

In this section, we conducted a comprehensive review on the optimal currency area (OCA) criteria and Solow's economic growth theory and identified some gaps on these theories.

First, price and wage flexibility which is one of the criteria of OCA has been proven in the literature that prices and wages are not flexible but adjust slowly. We used the Dornbusch's sticky price model to clarify this situation. Dornbusch (1976) assumes that prices of goods are sticky in the short run and that PPP holds only in the long run but does not hold in the short run because goods prices adjust slowly relatively to asset prices. Second, inter-regional and inter-industry mobility of labor which is another criterion of the OCA has also been found to be too restrictive. In reality, external migration exists because globalisation has taught us factors will

move to where rewards are high, while the Solow growth theory is silent on the skills, knowledge, and abilities of labor as the real factors that promote economic growth (Lucas, 1998). We therefore acknowledge these as limitations of the theories underpinning this study and recommend future studies on modification of these criteria.

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CHAPTER THREE

INTERDEPENDENCE OF EXCHANGE RATES AMONG ECOWAS COUNTRIES

3.1 Introduction

The exchange rate can be defined as the price of a country's currency, which is expressed in terms of other currencies. It helps determine the relative prices of local and foreign goods, as well as the strength of external sector participation in the international market (Adeniran, 2014). According to Jhingan (2009), an exchange rate is the rate at which a country's currency is exchanged for different currencies used by another country. He posited that this is the price of one currency in terms of another currency. Exchange rate convergence is among one of the criteria stipulated in the optimum currency area (OCA) conditions for successful introduction of a single currency among regional blocs (Mundell, 1961).

The Economic Community of West African States (ECOWAS), which was created on May 28, 1975, with the signing of the Treaty of Lagos by the Heads of States of West African countries in Lagos (Nigeria), nurtured the idea of introducing a single currency to facilitate trade among member countries. One of the aims of this objective is to achieve "collective self-reliance" for member states by creating a single large trading bloc through an economic and trading union. The organization comprises two regional blocs: that is, the West African Monetary Zone (WAMZ) and the West African Economic and Monetary Union (WAEMU). The WAMZ consists of a group of six West African nations within the ECOWAS formed in 2000. Countries that constitute the WAMZ are Ghana, Gambia, Nigeria, Liberia, Guinea, and Sierra Leone. The group plans to introduce a common currency by 2027, called the Eco. The WAMZ is largely dominated by Nigeria, which reflects its status as Africa's largest oil producer and the most

populous nation in the sub-region. All members of this group are English-speaking countries except Guinea, which is a Francophone. The WAEMU, also known as the UEMOA in France, comprises eight West African states. The WAEMU was formed to promote economic integration among member countries. They have adopted the CFA Franc as a common currency among the WAEMU region. The introduction of single currency adoption by the WAEMU has led to several economic achievements in the region. Primarily, these are the successful implementation of macro economic convergence criteria and an effective surveillance mechanism. The WAEMU has also introduced common external tariffs and customs unions among members, and amalgamated regulations on indirect taxation. The successful implementation of these policies informed the heads of states of ECOWAS to introduce a second monetary zone, which will eventually be merged with the CFA Franc used by the WAEMU to create a single currency for the entire region (WAMI, 2019).

Because of this development, the West African Monetary Agency (WAMA) was created by ECOWAS in 1996 after it was metamorphosed from the West African Clearing House (WACH). Its main responsibilities were to monitor, coordinate, and implement the ECOWAS Monetary Cooperation Programme (EMCP), which will pave the way for the smooth introduction of the ECOWAS single currency. The major features that were enshrined in the EMCP were for members to manage and pool all their reserves, as well as a common monetary policy and common convertible currency, and an agreement on the convertibility guarantee, among others. From this perspective, the heads of states of the ECOWAS introduced first-order and second-order convergence criteria. The first-order criteria, whose achievements are critical for the creation of a single currency, stipulated among others that members should maintain a single digit inflation rate, budget deficit should be lower than 4%, external reserves should be greater

than three months of imports, and central bank financing of government budget deficit should be lower than 10% of the previous year's tax revenue. With reference to second-order criteria, members focus on monetary and exchange rate policy management; that is, members should have a positive interest rate and stable nominal exchange rate, and on the structure of public accounts, members should have no domestic arrears, and members should have tax revenue that is greater than 20% of GDP, members' salary mass should be lower than 35% of tax revenue, and public investment should be greater than 20% of domestic receipts (Issiaka & Blaise, 2013).

Members of the region need to achieve the first-order and second-order criteria stated above for the region to satisfy as an optimum currency area (OCA), which will enable the region to have homogeneous economic structures. This will pave the way for the successful introduction of common currency. Mundell (1961) and others have stated that, among others, an OCA should satisfy some of these conditions: there should be a mechanism for fiscal transfer among member countries, there should be a high degree of labor mobility within the region, trading activities among member countries should be high, and members should have harmonized business cycles.

The launch date of the ECO has seen several postponements because of the members' inability to achieve convergence criteria. Because of these concerns and other related issues, the assessment of ECOWAS countries on macroeconomic convergence criteria has been extensively studied in both policy and academic environments (see: Alagidede, Tweneboah & Adam, 2008; Adam et al., 2010; Debrun et al, 2002; Owusu-junior et al. 2017, 2019 and among others). Despite considerable attempts to study the convergence of macroeconomic variables in the region, the evidence is far from being conclusive. However; the study of exchange rate convergence in the ECOWAS region is not replete in the extant literature, while the few studies in the region are skewed towards the WAMZ. This study contributes to the existing literature by

trying to ascertain whether the difference between the fixed exchange rate regime of the WAEMU countries on the one hand and the flexible regimes of the WAMZ countries on the other hand can be one of the factors of non-convergence of business cycles in the region by looking at their co-movement.

The main objective of this chapter is to contribute to the empirical literature on the comovement of exchange rates between the WAMZ and WAEMU countries by employing the wavelet technique for the estimation. The wavelet technique can clearly assess the time-frequency domain dynamics, lead/lag switches, and overall correlation within a multivariate framework. The Vector Error Correction Model (VECM) is widely used to examine the interdependence or integration of macroeconomic variables. The wavelets technique has recently been used by academics because of its superiority over the VECM. The inherent disadvantage of the VECM is the inability to accommodate frequency and time-scale domain of time series (Tweneboah & Eshun, 2023). We also contribute to the literature on currency unions between the WAMZ and the WAEMU by assessing the preparedness or the extent of exchange rate convergence, which is one of the requirements to be fulfilled to enable the successful introduction of the *eco* by the new date in 2027 after several postponements.

The most important thing worthy of attention is that, such interdependence or comovement has the potential to affect imports competitiveness. It also has the potential to increase exposure of risk to traders and investors. It would be interesting to verify whether co-movement in the foreign exchange market behaves differently in the ECOWAS sub-region in this era of globalization and financial market integration after the COVID-19 pandemic. When asset markets are very integrated, returns will be lower and volatility tends to be higher. When this happens, correlation between asset markets tends to be higher (Coudert et al., 2011; Sanjay &

Wasim, 2015). The necessity of currency co-movement is essential for understanding different insights on risks as well as its management.

The remainder of the chapter is organized as follows. Section 3.2 covers the status of the convergence criteria with a focus on the WAMZ because the WAEMU is already in a currency union. Section 3.3 details the theoretical framework of comovement/contagion and the empirical literature. Section 3.4 specifies the wavelet estimation technique and data used for the study. Section 5 details the findings and analysis of the comovement of exchange rates between the WAMZ and the WAEMU, and the concluding section presents the conclusions of the study and provides recommendations for policy directions.

3.2. STATUS OF THE WAMZ CONVERGENCE PROGRAMME AS AT DECEMBER 2018

3.2.1 The WAMZ Convergence Programme

It is clear from the extant literature that the WAMZ monetary union witnessed several postponements since its initial commencement date of January 2003. Although Member States made frantic efforts to comply with the targets needed for the introduction of the single currency, the launch date was rescheduled to July 1, 2005, because members were not able to meet the structural and macroeconomic convergence criteria. When the introduction date was rescheduled to a later date, member countries made significant strides to attain set benchmarks by improving their macroeconomic performance. The region witnessed an improvement in growth, a moderate inflation rate, and an improvement on their foreign reserves. Nevertheless, despite the considerable gains achieved by member countries in the WAMZ, the level of convergence of macroeconomic structures was not adequate for creating a single currency in the WAMZ. Since

then, the launch date has been witnessing several postponements. An evaluation of some of the scope of the program is as follows:

3.2.1.1 Programme Area I: Macroeconomic Convergence

In the macroeconomic convergence criteria, all member countries failed to meet the primary convergence criteria. Ghana was able to achieve two criteria: central bank financing of government deficit and gross external reserves and failed to achieve fiscal deficit and inflation criteria. Nigeria, the most populous nation among the WAMZ, met the three criteria. The country was able to achieve central bank financing of government deficit, gross external reserves, and fiscal deficit but failed on the inflation criterion. The Gambia was able to achieve three, that is, central bank financing of government deficit, inflation, and gross external reserves, but had a slippage on the fiscal deficit criterion. Guinea met three criteria. The country was able to achieve inflation, fiscal deficit, and central bank financing of the government deficit, and missed out on gross external reserves. Liberia achieved two criteria: gross external reserves and fiscal deficit, while it missed two, central bank financing of government deficit and inflation. Sierra Leone missed out on inflation and fiscal deficit, but was able to achieve gross external reserves and central bank financing of government deficits (WAMI, 2018).

3.2.1.2 Programme Area II: Monetary Policy Framework for West African Central bank (WACB)

The WACB should determine a monetary policy framework for the WAMZ region. This framework includes tools, instruments, and processes for an anticipated single central bank. The region will need a monetary policy framework that is suitable for all members, that is, whether the ultimate goal will be to undertake monetary targeting, embark on inflation targeting, or any

other framework that is appropriate for the smooth functioning of a currency union. Policy direction on the exchange rate would also have to be determined by the WACB, that is, whether to adopt a flexible or fixed exchange rate regime (WAMI, 2018).

3.2.1.3 Programme Area III: Trade Integration

Each Member State of ECOWAS has committed to ensuring free trade in the sub-region by signing the Protocol on the ECOWAS Trade Liberalization Scheme (ETLS). Its implementation at this stage can be described as relatively satisfactory, albeit with a few administrative challenges. The ECOWAS has gone ahead to adopt the Common External Tariff (CET), which seeks to create a customs union among member states. WAMZ members are seeking implementation with the exception of Sierra Leone, due to the technical challenges it has confronted. The right of members to freely move across borders for leisure, jobs, and residence has been implemented and observed across the zone (WAMI, 2018).

3.2.1.4 Programme Area IV: Financial Integration

The WAMZ is at different stages when it comes to the liberalization of their capital account. Currently, The Gambia has fully liberalized its capital account, while its members have not fully removed restrictions on capital flows. Quoting and trading using currencies of the WAMZ by Deposit Money Banks (DMB) remain few in operation. The reason for this low participation in the programme is the lack of proper procedures for clearing and settling the accumulation of long positions (WAMI, 2018).

3.2.1.5 Programme Area V: Sensitization

Public awareness regarding the establishment of a single currency has remained very low. This is because of successive witnesses of postponement. At present, the level of sensitization is too

low to energize interest, garner public appreciation, and even measure their level of acceptance of the proposed monetary union (WAMI, 2018).

3.2.1.6 Programme Area VI: Preparations toward introducing the eco

For a single currency to become a reality in the WAMZ region member countries should have the objective of transitioning their individual currencies to the eco-currency; Member States are expected to implement a number of measures before the introduction of the single currency. Member states should instruct their individual National Central Banks (NCBs) to prepare a policy framework that seeks to establish dual pricing in national and eco-currencies (WAMI, 2018). In the nutshell, this indicates that achieving convergence before the introduction of the eco-currency is a challenging task, and this calls for debate whether ECOWAS monetary integration is best introduced ex ante or ex post.

3.3 Theoretical literature

Comovement of macroeconomic variables can be defined as when the variables move together or when the variables are highly correlated such that a shock in one can easily be transmitted to the other in a short span of time. Excessive comovement is what is known in extant literature as contagion (Tweneboah, 2019). The theories of contagion/comovement are categorized into two, that is fundamental based theories and belief based theories. Shocks that transcend from one economy to the other are the principal ingredients of the fundamental based theories. Real shocks that lead to spillover to other economies are as a result of the dynamic nature of the trading patterns among countries, for instance, when there is an increment in crude oil prices. Real shocks may also come from liquidity such as a change in monetary policy, which when happens

reduces world liquidity. We also have macroeconomic shocks like recession, which reduces import demand and invariably world aggregate demand.

3.3.1 Global Shock

There are several types of fundamental causes of contagion/comovement. Global shock which is a shock that arises when there are economic shifts in the developed countries in terms of relative changes in prices in exchange rates, interest rates and other macroeconomic variables is one of the types of fundamental causes of contagion/comovement. When there is a shock in interest rates, exchange rates, commodity markets and the others, it leads to increase in comovement of assets prices and foreign direct investments. When there is financial crisis, it leads to reversal in capital account. When this happens, it can result in economic recession (Calvo & Mendoza, 2000). On a different perspective on the capital account reversal, it can result in equilibrium situations for economies especially for those economies experiencing imperfect credit market when it happens (Mendoza, 2001). The findings of Mendoza also revealed that economic recession can reduce domestic demand and output of countries as well as exports whereas an outflow of capital from a country forces that country to increase its exports. A typical example of this type of shock happened in the 1980s in Latin America which resulted in several crises and primarily among them was the debt crisis. This resulted in a sharp upward adjustment of global interest rates in 1994 in Latin America when the Federal Reserve Bank increased the US interest rates during the early 1980s. This shock played a major role in the Mexican crises during the period's 1994 to 1995. There are other ways that transmits shocks, that is in a situation where countries trading patterns are connected to each other as well as their financial markets.

3.3.2 Trade Linkages

Trade linkage is another cause of contagion/comovement and the channels through which this linkage occurs is through direct trade and competitive devaluation. This means that, when there is a negative sudden interruption in one country, the affected country demands for imports is reduced. In such a situation, it affects the total demand of each of her trading partners. Loss of competitiveness is one of the causes of trade linkages. This happens in a situation when the currency of trading partners substantially depreciates among the major currencies. The findings from Glick and Rose (1999) documents that comovement in currencies during periods of crisis are explained by trade linkages especially when countries have controlled for other macroeconomic factors. During financial crises, trade plays a critical role and this has made economist pay attention to trade and financial crises for two main reasons. First, economists argued that the imbalance in trade is assumed to be among the reasons that lead to financial crisis. They posit that when there is deficit in current account which is as a result of trade leads to reduction in foreign reserves. Second, economists argued that when countries trade together and there is financial crisis in one country, the financial crisis can have a spillover effect to the other countries. The dynamism in macroeconomic variables in relation to growth, financial contagion and globalization can be explained by the statistical properties of world trade networks (Reyes, 2007, 2010). Giving empirical evidence to Reyes assertion, Eichengreen and Rose (1999) used a simple probit model and employed data that span from the period 1959 to 1993 to determine whether financial crises in a specific country can have a spillover effect to other trading partners. The study finds trade to be statistically significant and that the possibility of financial crises happening in a country is high if the country has bilateral trade association with other countries that are in crisis.

3.3.3 Financial Linkages

Financial linkage is another cause of contagion/comovement. There are many ways by which financial linkages lead to contagion/comovement. Among some of the ways by which economies that are connected financially can lead to comovement/contagion are common creditor, lenders that are interconnected, portfolio rebalancing and interactions which occurs under market based financial systems. A study by Kaminsky and Reinhart (2000) on common creditor observed that, common creditors are likely to withdraw their lending funds from other economies when shocks occur since it may weakened their capital position especially when such countries have bilateral trades. The shock may start with a foreign bank and then a spillover effect to other economies through decreased in lending. According to Kaminsky and Reinhart (1998), portfolio rebalancing may cause financial market contagion.

3.3.4 Belief Based Theories

The belief based theory is another theory of contagion/comovement. The belief based theories of comovement/contagion are certain beliefs factors from individual investors and policy makers. Among some of these beliefs are explained by herding, self-fulfillment as well as wake-up-call channels. For instance according to Diamond and Dybvig (1983), the self-fulfillment way of contagion follows liquidity and bank runs models. Economic agents' expectations are formed in accordance with the behavior of other agents; this then makes it optimal for other individual to also perform same (Diamond & Dybvig, 1993). In this study, strong WMC and WMCC at higher frequencies can be designated as "contagion" whereas those at the lower frequencies are termed as "interdependence" (see: Gallegati, 2012; Saiti et al., 2016; Vincent & Bertrand, 2005).

3.4 Empirical literature

There are plethora empirical evidences when it comes to studies on exchange rate co-movement albeit conflicting and mixed results. Majority of the empirical studies on exchange rates comovement have been carried out among trading partners' however when it comes to comovement of exchange rates in the regional monetary unions or common currency area, studies are sparse.

Tweneboah and Eshun (2023) examined the interdependence of macroeconomic variables in the West African Monetary zone (WAMZ). The variables used for the study were interest rates, inflation rates, and exchange rates, employed data that spanning the period 2000-2018 and used the wavelet methods by Fernando-Macho (2012). The findings reveal that the nature of interdependence among exchange, inflation, and interest rates varies across countries. The study documents that the overall correlations of the three macroeconomic variables are weak in the short, medium, and long terms. The findings reveal evidence of weaker integration at all frequencies for exchange rates, inflation rates, and interest rates. This study reports that Ghana has the maximum wavelet multiple correlations at these times. The overall correlations of macroeconomic variables show inconsistencies. This may be accounted for by varying factors that often influence market linkages over time. The study advised heads of state of the ECOWAS to consider ex-post monetary integration because it was clear from empirical evidence that the ex-ante conditionality for the introduction of a single currency in West African Monetary Zone will be difficult to achieve.

Adefemi (2023) used the Markov switching model to assess the feasibility of a currency union in the WAMZ. The findings indicate that prior to the formation of the WAMZ; there were significant divergences in real exchange rates among the member countries. However, a modest

but noticeable convergence was observed among four countries (Nigeria, Sierra Leone, Gambia, and Liberia) following the establishment of the zone. The study concludes that while the WAMZ is making progress toward establishing a currency union, it is crucial for the monetary authorities of member countries, particularly Ghana, and Liberia, to collaborate and synchronize their policy efforts. Additionally, policymakers need to implement measures to strengthen harmonious trade interactions to facilitate the successful realization of the currency union.

Ndiaye (2021) analyzed the exchange rate and inflation rate convergence within the Economic Community of West African States (ECOWAS). The objective was to determine whether the difference in exchange rate regimes, with the West Africa Economic and Monetary Union (WAEMU) countries adopting a fixed exchange rate and the West African Monetary Zone (WAMZ) countries employing flexible regimes, contributes to the non-convergence of exchange rates, and inflation rates. The study utilized Granger causality tests to examine the relationship between exchange rates, and inflation rates and employed an inflation differential model to identify the factors influencing the convergence or non-convergence of inflation rates. The study period covered 1990-2020. The findings revealed that the WAMZ countries, due to their flexible exchange rate regimes, experience exchange rate pass-through, unlike their WAEMU counterparts.

Agba and Madueme (2021) examined the synchronization of business cycles within the West African Monetary Zone (WAMZ) and the West African Economic and Monetary Union (WAEMU). They utilized macroeconomic data from 1980 to 2019 and applied the Hodrick-Prescott filters to detrend the data. The study employed the Pearson correlation on the computed z-scores to assess the level of business cycle synchronization, symmetry in macroeconomic policies, and symmetry in trade flows. The findings indicated that business cycle synchronization

was increasing, with the WAEMU region exhibiting higher levels of synchronization compared to the WAMZ region. Among the WAMZ region, significant synchronization was observed in pairs such as Ghana-Guinea, Ghana-Nigeria, Guinea-Gambia, and Guinea-Nigeria. Additionally, the study revealed asymmetric trade patterns between Cote d'Ivoire and other WAEMU countries, as well as between Nigeria and other WAMZ countries. Based on the results, the study recommended that highly symmetric pairs of countries within the WAMZ, including Nigeria, Ghana, Gambia, and Guinea, should form the second West African Monetary Union by 2021, providing an opportunity for others to join and eventually merge.

Adu et al. (2019) investigated the responses of real effective exchange rates to shocks in the West African monetary zone. The study utilized annual data from 1980 to 2015 and focused on a country-by-country VECM. By applying long-run restrictions in a structural VAR model, the study identified oil price shocks, supply shocks, and demand shocks. The results showed significant variations in the response of REER to these shocks among the economies studied. Additionally, the study found differences in the short and long-run contribution of these shocks to REER movements across the economies. These findings indicate structural differences and asymmetric shocks among the WAMZ countries, suggesting that the establishment of a monetary union would be costly due to inadequate adjustment mechanisms.

Owusu Junior, Tweneboah, and Adam (2019) examined exchange rate interdependence in the sub-region using only Ghana currency against the major trading currencies of the US dollar, the euro, the pound, and the yen. The study period was May 1999 to February 2018. The results reveal that the dynamics of currencies are time varying and heterogeneous. This study employed a three-dimensional continuous Morlet wavelet transform for the analysis.

Seraphin (2019) studied the asynchronous or synchronous nature of movements in exchange rates of some currencies in the West African region. The study employed the dynamic conditional correlation model and used daily exchange rates of three countries, which are Ghana, Ivory Coast, and Nigeria. The observation period was from May 30, 2010, to December 30, 2016. The DCC model allows the transmission of volatility during the study period to be verified. The findings reveal a transmission of volatility between the three indices (countries). The results again argue in favor of monetary integration.

A similar study by Owusu junior et al. (2017) investigated the comovement of real exchange rates in the West African Monetary Zone. The study used the wavelet methodology using the continuous Morlet wavelet transform to trace the significant frequency–time domain lead-lag relationship for the West African Monetary Zone. This study used monthly data and employed four member countries of the WAMZ. The results revealed the changing dynamics of the relationship between real exchange rates at different periods. None of the countries came out conveniently leading for both the real and absolute returns of the exchange rates. The findings of their study corroborate other studies that have documented the non-convergence of exchange rates in the West African region; the changing dynamics of exchange rates at different periodicities is at variance with how exchange rates should behave in a currency region, which posed as an impediment for the successful introduction of ECOWAS single currency.

Tweneboah et al. (2016) studied economic integration and exchange rate dynamics in the ECOWAS region using countries that belong to the West African Monetary Zone to assess the validity of long-run purchasing power parity. The data span from 1960 to 2014, and the study allowed for unknown endogenous structural breaks in the data. The findings indicate the empirical reality of the cointegration between nominal exchange rates and prices in all countries.

The results support that PPP holds and can serve as a benchmark for exchange rate modelling in the sub-region.

In a related study, Adam and Ofori (2017) investigated the validity of the International Fisher Effect in ECOWAS using Anglophone countries. The study used the conventional Engle-Granger and Fractional cointegration tests to assess nominal exchange differentials and exchange rate changes of all the countries within the WAMZ, except Liberia, due to a lack of data. The study observed a cointegrating relationship for some of the countries paired, indicating evidence of common stochastic drift in nominal exchange differentials and exchange rate change.

Agyapong and Adam (2012) examined the behavior of exchange rates in ECOWAS region using countries that belong to the WAMZ. Fractional integration was used to assess the dynamics of the relationships between macroeconomic variables. The study revealed that Guinea and Sierra Leone experienced infinite and long-lived persistence, whereas Ghana, Gambia, Nigeria, and Liberia also experienced non-mean reverting, had infinite variance, and were non-stationary. In a related study, Alagidede et al. (2008) used DF-GLS and Augmented Dickey Fuller test to study the nominal exchange rate and price convergence in the West African Monetary Zone. Their findings report that real exchange rates in Nigeria, Sierra-Leone, Gambia, and Ghana follow a random walk. The study also reports that in the long run, nominal exchange rates and nominal prices adjust to different speeds to achieve purchasing power parity, with the former adjusting faster than the latter. In addition, the study argued that the successful implementation of a second monetary zone in the West African region depends on macroeconomic policies that are well-coordinated, as well as exchange rates that are stable to annihilate extreme arbitrage profits that may arise.

In another study, Adam, Agyapong and Gyamfi (2012) examined the issues of macroeconomic convergence in the West African Monetary Zone which comprises the Anglophone countries. The study concentrated on exchange rates and inflation rates convergence in the zone. The findings of the study revealed non convergence of inflation rates in the WAMZ; however when it comes to the exchange rates in the region, the findings of the study finds little support for exchange rate convergence. The study used the Structural Vector Autoregressive model to examine the behavior of these macroeconomic variables. Akin to the aforementioned study, Taylor (2013) examined the willingness of the five Anglophones countries and Guinea to form the proposed West African Monetary Zone by studying the co-movement of macroeconomic variables which has exchange rates included in the data for the study. The study used correlation matrix and a gravity equation to assess the extent of monetary union which was based on the theoretical foundation of optimum currency region. The results shows that overtime, currency introduction in the region can become a reality with ex ante policy integration by first starting with the most similar countries.

Abayomi and Olaronke (2015) examined the behavior of exchange rate volatility for six countries in ECOWAS region. The study used countries that belong to the West African Monetary Zone (WAMZ) and the study period was from 1960 through up to 2011. The study selected a sub-sample period which covered the period from the beginning of 2000 and ends at 2011 to assess whether the central bank intervention leads to a decrease in the volatility of the local currencies per US\$. The results revealed that the most erratic currency in the zone is the Ghanaian cedi. The authors also found that, there is no leverage for the Nigerian naira whiles leverage exists for the Gambian Dalasi; however, the results were inconclusive for other countries. The effect of the central bank's intervention on exchange rate fluctuations is also

inconclusive for Ghana, Guinea and Liberia. Nevertheless, the effect of central bank interventions on exchange rates decreases the level of volatility persistence in the Gambia and Nigeria, while it increases the level of volatility persistence in Sierra Leone during the period under review.

Ngouana (2012) studied exchange rate phenomenon in Africa, but concentrated on the West African Economic and Monetary Union (WAEMU), that is the Francophone countries. The results revealed nominal effective exchange rate of the union to be very volatile under the hard peg to the Euro as it would have been under a hypothetical basket peg over the past decade.

Coleman (2011) contributed to the discussion on the long-term sustainability of the embryonic second monetary union in ECOWAS, the West African Monetary Zone (WAMZ). He analyzed the level of convergence of macroeconomic variables which included exchange rates for five candidate countries over the past thirty years. His results indicated a lack of a consistent pattern of synchronization for the WAMZ countries.

On the connection between exchange rates and wage and price flexibility in a currency union, Galí and Monacelli (2016) analyze the gains from an increased in wage flexibility by adopting a small open economy model with staggered price and wage setting. The findings reveal that using labor cost reductions as a means to stimulate employment is negligible in a currency union, and that an increase in wage flexibility sometimes lead to reduction of welfare in a currency union or with an exchange rate-focused monetary policy. Galí and Monacelli (2016) findings bring into question the common view that wage flexibility is desirable in a currency union.

This study differs from the existing research in the following ways. First, most studies on co-movement/behaviour of exchange rates in the ECOWAS region concentrates on countries that

belong to the West African Monetary Zone (WAMZ) (see: Tweneboah, Agyapong & Frimpong, 2016; Owusu Junior, Adam & Twenenboah, 2017 and 2019; Agyapong & Adam, 2012; and among others). The present study contributes to the existing literature by extending the countries to include countries that belong to the West African Economic and Monetary Union (WAEMU). Thus, this study makes a modest contribution to the examination of exchange rate correlations in the ECOWAS region. The necessity of currency co-movement in ECOWAS is essential for understanding different insights on risks, as well as its management for the successful implementation of a single currency. Second, unilaterally considering exchange rates alone makes this study unique, since most studies usually look at stock market and exchange rate co-movement (see: Boako & Alagidede, 2017a; Boako & Alagidede, 2016a; and among others). Most studies that use wavelet methods concentrate on stock returns (e.g., Boako & Alagidede, 2017). The current study attempts to add to the limited volume of literature on the usefulness of the wavelet methodology in understanding the dynamic relationship of exchange rates in the sub-region. Fourth, the study contributes to the existing literature by assessing monetary integration in the ECOWAS region after the COVID 19 pandemic.

In summary, this study contributes to the limited literature on exchange rates behavior in the ECOWAS region by examining the level of integration using the co-movement of currencies in the region. This study adopts the multiscale analysis approach proposed by Fern´andez-Macho (2012), the wavelet method. The methods permit bivariate and multivariate correlations and cross-correlations of exchange rate markets at different time scales, which is more indicative of financial market behavior.

3.5 Empirical Methodology

3.5.1 Multivariate Wavelet Technique

According to Fern´andez-Macho (2012), Gençay et al. (2001), and Percival and Walden (2000), wavelet multiple correlation and wavelet multiple cross-correlation start with the Maximal Overlap Discrete Wavelet Transform (MODWT). In this study, we present a synopsis of the maximal overlap discrete wavelet transform (MODWT) after which wavelet multiple correlation and wavelet multiple cross correlation techniques are specified.

3.5.1.1 Maximal Overlap Discrete Wavelet Transform (MODWT)

The maximal overlap discrete wavelet transform simultaneously localizes variations in signal in time and frequency and can be used to decompose the return series of macroeconomic variables, such as exchange rates data at different timescales (Percival & Walden, 2000). As noted by Ramsey (2002), a function of time $f(t)$ can be represented with a scaling function which is known as father wavelet (ϕ), and another wavelet function known as mother wavelet (ψ). The father wavelets integrate into one and it is used to represent very long scale smooth components of the signal, while the mother wavelets which integrate to zero is used to describe deviations that occur in the smooth components. Scaling (smooth) coefficients are generated by father wavelets, whereas mother wavelets give rise to differencing (detail) coefficients.

We define father wavelet as:

$$\phi_{j,k} = -2^{-j/2} \phi\left(\frac{t-2^jk}{2^j}\right) \text{ with } \int \phi(t) dt = 1 \quad (3.1)$$

And mother wavelet as:

$$\psi_{j,k} = -2^{-j/2} \psi\left(\frac{t-2^jk}{2^j}\right) \text{ with } \int \psi(t) dt = 0 \quad (3.2)$$

The smooth coefficients generated by father wavelet are defined as:

$$s_{j,k} = \int f(t) \phi_{j,k} \quad (3.3)$$

And detail coefficients generated by mother wavelet as:

$$d_{j,k} = \int f(t) \varphi_{j,k} \text{ with } j = 1 \dots j \quad (3.4)$$

The maximal scale of the former is 2^j , while the detailed are computed from the mother wavelets at all scales from 1 to J . The function $f(\cdot)$ from the coefficient above is defined as:

$$f(t) = \sum_k s_{j,k} \phi_{j,k}(t) + \sum_k d_{j,k} \varphi_{j,k}(t) + \dots + \sum_k d_{j,k} \varphi_{j,k}(t) + \dots + \sum_k d_{1,k} \varphi_{1,k}(t) \quad (3.5)$$

This is simplified to

$$f(t) = S_J + D_J + D_{J-1} + \dots + D_J + \dots + D_1 \quad (3.6)$$

With orthogonal components defined as:

$$S_j = \sum_k s_{j,k} \phi_{j,k}(t) \quad (3.7)$$

$$D_j = \sum_k d_{j,k} \varphi_{j,k}(t), j=1, \& \dots J \quad (3.8)$$

The resulting multi horizon (multiresolution) breakdown of $f(t)$ is $\{S_J, D_{J-1}, \dots, D_1\}$. D_j calculates the j th level wavelet detail related to changes in the series at scale λ_j, \dots . S_j denotes cumulative sum of alterations at each level, and as j increases, S_j becomes increasingly smoother (Gençay et al., 2002). The study employed MODWT to estimate the scaling and wavelet coefficients because the MODWT produces a better resolution because it does not down sample data when generating the coefficients, making it easy to compare decomposed and original series (Gençay et al., 2002; Percival & Mofjeld, 1997; Percival, 1995). The MODWT does not restrict the sample size to an integer multiple of 2^J unlike the Discrete Wavelet Transform, and can be applied to a time series of any length (Percival & Walden, 2000).

This study applies a Daubechies Least Asymmetric (LA) filter of length eight (LA8) to decompose the series due to its smooth correlation coefficients compared to HAAR wavelet filters, which have been widely applied in prior studies (Gençay et al., 2002). Cornish et al. (2006) documented that the coefficients provided by LA (8) filter exhibit better uncorrelatedness across scales than the HAAR filter. In the study, the series are decomposed into wavelet coefficients D_1 to D_4 . The detail coefficient D_j provides the resolution of data at scale 2^j to 2^{j+1} . The oscillations of periods of 0–1, 1–2, 2–4, and 4–8 wavelet scales represent days J_1, J_2, J_3 , and J_4 respectively. The wavelet smooth S_4 represents the long-term movements.

3.5.1.2 Wavelet Multiple Correlation and Wavelet Multiple Cross-Correlation

The wavelet multiple correlations and wavelet multiple cross-correlation according to Fernandez-Macho (2012) allows for multiple correlations and multiple cross-correlations in a set involving multiple variables of varying time scales. According to Fernandez-Macho (2012), this helps in protection against type 1 error, which leads to the avoidance of spurious correlation.

The wavelet multiple correlation and wavelet multiple cross correlation start with the Maximal Overlap Discrete Wavelet Transform (MODWT) which is defined as follows:

Let $X_t = x_{1t}, x_{2t}, \dots, x_{nt}$ be a multivariate random process and $W_{jt} = w_{1jt}, w_{2jt}, \dots, w_{njt}$ represent their corresponding scale λ_j coefficients of the wavelet, which is derived by employing the MODWT. The wavelet multiple correlations (WMC) $\varphi_X(\lambda_j)$ can be defined as a single set of multiscale correlations from equation (1) subsequently.

$$\varphi_X(\lambda_j) = \sqrt{1 - \frac{1}{\max \text{diag} P_{j-1}}} \quad (3.9)$$

For each λ_j the square roots of the coefficients of determination of the regression are formed by the linear combination of $w_{ijt}, i = 1, 2, \dots, n$ variables for which such coefficient of determination is maximum. From extant literature, it is known that for regression of a regressand z_t on a set of predictors $z_t \{z_k, k \neq i\}$, a coefficient of determination can be derived as $R_i^2 = 1 - \frac{1}{\rho^{ii}}$, i^{th} diagonal element of the opposite of the complete correlation matrix P . Where P_j is the $(n \times n)$ correlation matrix of $W_{jt} = w_{1jt}, w_{2jt}, \dots, w_{njt}$ and $\text{maxdiag}(\cdot)$ elects the maximum element in the diagonal argument.

The coefficient of determination in a regression theory is the squared correlation between the observed Z_t and fitted \hat{z}_i values. Thus, the wavelet multiple correlations can also be expressed as equation (2), where w_{ij} is selected to maximize $\phi X(\lambda_j)$ and \hat{w}_{ijt} are the fitted values in the regression of w_{ij} on the rest of the wavelet coefficients at scale λ_j ;

$$\psi X(\lambda_j) = \frac{\text{Corr}(w_{ijt}, \hat{w}_{ijt}) \text{Cov}(w_{ijt}, \hat{w}_{ijt})}{\sqrt{\text{Var}(w_{ijt}) \text{Var}(\hat{w}_{ijt})}} \tag{3.10}$$

Following Gençay et al. (2001), the corresponding wavelet covariances and variances can be estimated as;

$$\text{Var}(\tilde{w}_{ijt}) = \bar{\delta}_j^2 = \frac{1}{T} \sum_{t=j-1}^{T-1} \tilde{w}_{ijt}^2 \tag{3.11}$$

$$\text{Var}(\tilde{w}_{ijt}) = \bar{\vartheta}_j^2 = \frac{1}{T} \sum_{t=j-1}^{T-1} \tilde{w}_{ijt}^2 \tag{3.12}$$

$$\text{Cov}(\tilde{w}_{ijt}, \tilde{w}_{ijt}) = \bar{\gamma}_j = \frac{1}{T} \sum_{t=Lj-1}^{T-1} \tilde{w}_{ijt}^2 \tilde{w}_{ijt} \tag{3.13}$$

where \tilde{w}_{ij} is such that the regression of the same on the set of regressors $\{ \tilde{w}_{ij}, k \neq i \}$ maximizes the coefficient of determination, \tilde{w}_{ij} denotes corresponding fitted values, and $L_j - (2^j = 1)(L - 1)$ is the number of wavelet coefficients, which is affected by the boundary conditions that are connected with a wavelet filter of length L and scale λ_j whereas $\tilde{T} = T = L_j + 1$ is the number of wavelet coefficients which is not affected by the boundary conditions.

The wavelet multiple cross-correlations is computed by allowing a lag τ between observed and fitted values of the variables at each scale and can be estimated as;

$$\psi X(\lambda_j) = \text{Corr}(w_{ijt}, \hat{w}_{ijt+\tau}) = \frac{\text{Cov}(w_{ijt}, \hat{w}_{ijt+\tau})}{\sqrt{\text{Var}(w_{ijt})\text{Var}(\hat{w}_{ijt+\tau})}} \quad (3.14)$$

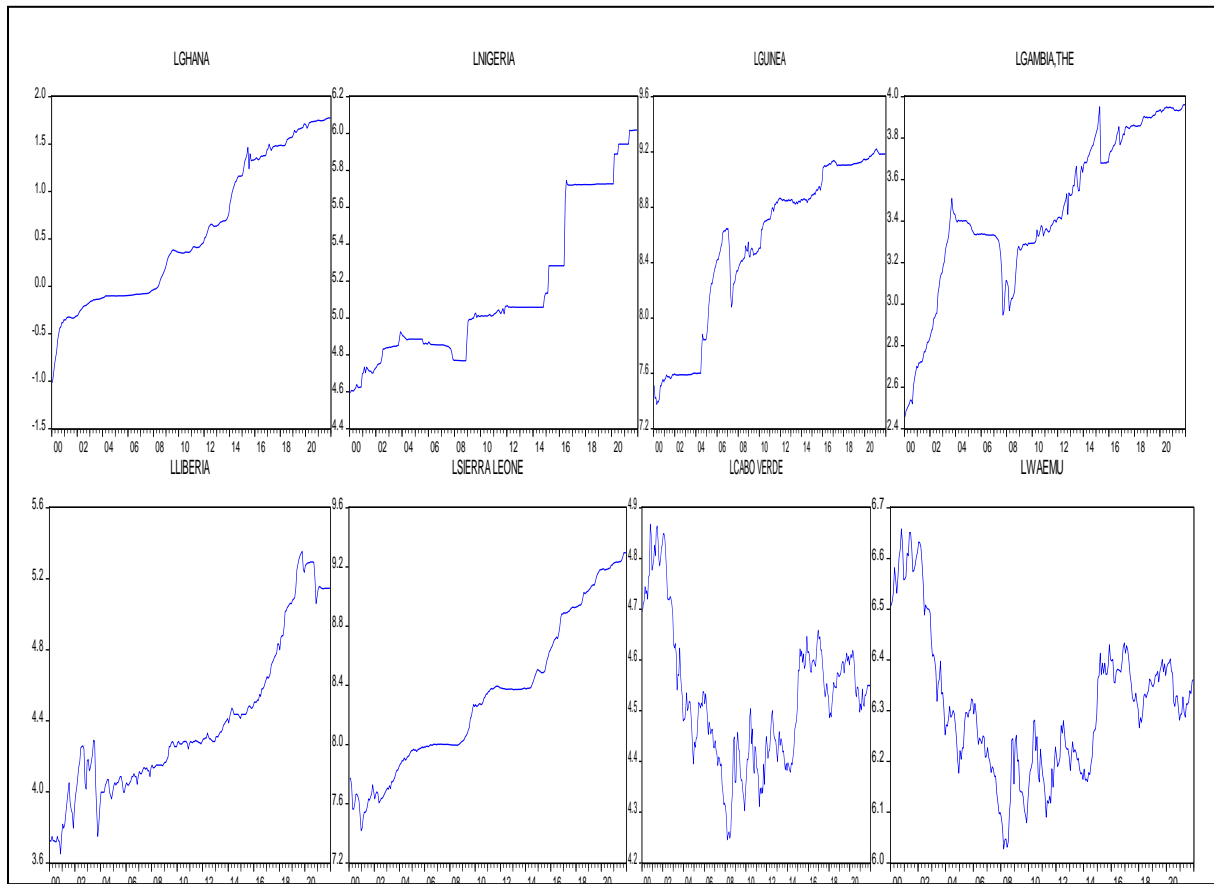
The confidence interval is constructed on the assumption that $X_1 \dots X_T$ is the realization of X in the estimation of wavelet multiple correlation and cross-correlation and hence for (λ_j) in (1) then $\tilde{z}_j \sim \text{FN}(z, (T/2^j - 3)^{-3})$ where $Z_j = \arctan h(\varphi X(\lambda_j))$, $\tilde{Z}_j = \arctan h(\tilde{\varphi} X(\lambda_j))$, and FN symbolize the folded normal distribution. Therefore, an approximate $(1-\alpha)$ CI for the true value of WMC is given by $CI_{(1-\alpha)}(\varphi X(\lambda_j)) = \tanh \left| \tilde{Z}_j - \frac{C_2}{\sqrt{T/2^j - 3}} ; \tilde{Z}_j + \frac{C_1}{\sqrt{T/2^j - 3}} \right|$ where the FN critical values C_1, C_2 are such that $\Phi(C_1) + (C_1 - 2_{z^0}) = 1 - \alpha/2$ and $\Phi(C_2) + \Phi(C_1 - 2_{z^0}) = 2 - \alpha/2$ with $\Phi(\cdot)$ as the standard Gaussian probability distribution function and $\tanh(Z^0) = \varphi_X^0(\lambda)$ as the value of some wavelet multiple correlation as set under certain null hypothesis of no correlation. For a comprehensive reading on DWT, CMWT, MODWT, WMC, and WMCC, (see Fern'andez-Macho, 2012; Carmona et al., 1998; In & Kim, 2013; Tiwari et al., 2013; Nason, 2010).

3.5.2 Data, samples, and preliminary analysis

To investigate the level of interdependence of exchange rates among ECOWAS countries, we employed each member's domestic currency against the US dollar. Individual currencies are expressed in common currency (USD). This was done to ease the comparison and remove the exchange rate noise. According to Pukthuanthong and Roll (2009), using the US dollar as the reference currency has been justified in international financial market research. We follow the work of Carsemer (2016) by selecting the nominal exchange rates in local currency per unit of US dollar due to data availability and to avoid in most general case restrictions imposed for proportionality and symmetry. This allows us to use one currency to represent the WAEMU countries. Our data consisted of countries that belong to the WAMZ and countries that belong to the WAEMU. The Anglophone countries are Ghana, Nigeria, Gambia, Liberia, Sierra Leone, and one French-speaking country, which is Guinea. The countries that constitute the Francophone are Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. These countries have a fixed exchange rate that is pegged to the euro, while Anglophone countries have a flexible exchange rate regime. We employed monthly data from 2000 to 2021. Monthly data was utilized due to the availability of consistent data for these countries. Data were obtained from the International Financial Statistics (IFS) of the International Monetary Fund (IMF). We tested for stationarity in the variables to determine the order of integration although the wavelet methodology is robust for nonstationary variables. The exchange rate data were transformed into monthly log-returns ($r_t = \ln P_t - \ln P_{t-1}$) from January 1, 2000 to December 31, 2021.

3.5.2.1 Graphical representation

A graphical representation of the log of exchange rates (monthly) in their level forms is shown in figure 1 which portrays non-normality by visual inspection. Formal tests of normality are provided in Table 1 to provide further clarity to visual inspections at their level forms.



Figures 3.1: Graphical representation of levels variables

3.5.2.2 Stationarity test of the series

We employed the augmented Dickey Fuller (ADF) test of Dickey and Fuller (1981) to ascertain the order of integration of the variables under study. The ADF test assumes that the variables are non-stationary (or have a unit root).

Table 2 shows that all variables are non-stationary at the 5% significance level in their level form. Thus, all variables are integrated in order one (i.e. I(1)). The variables became stationary after first differencing, which allowed further analysis.

Table 3.1: Augmented-Dickey Fuller (ADF) stationarity test

COUNTRIES	LEVELS			1 ST DIFFERENCE		
	CONSTANT	CONSTANT & TREND	NONE	CONSTANT	CONSTANT & TREND	NONE
GHANA	-0.475 (0.8925)	-2.284 (0.4406)	1.255 (0.9469)	-6.387 (0.0000)**	-6.332 (0.0000)**	-5.689 (0.0000)**
NIGERIA	0.362 (0.9810)	-1.422 (0.8525)	2.568 (0.9977)	-11.230 (0.0000)**	-11.2764 (0.0000)**	-13.264 (0.0000)**
GUINEA	-1.725 (0.4172)	-1.947 (0.6264)	2.126 (0.9922)	-11.243 (0.0000)**	-11.3042 (0.0000)**	-10.932 (0.0000)**
GAMBIA	-2.309 (0.1697)	-2.673 (0.2485)	2.094 (0.9916)	-14.363 (0.0000)**	-14.442 (0.0000)**	-14.045 (0.0000)**
LIBERIA	-0.609 (0.8648)	-2.201 (0.4865)	1.521 (0.9685)	-3.444 (0.0104)**	-3.447 (0.0475)**	-3.044 (0.0024)**
SIERRA LEONE	-0.144 (0.9419)	-1.993 (0.6019)	2.877 (0.9991)	-3.881 (0.0025)**	-3.831 (0.0165)**	-2.301 (0.0209)**
CAPE VERDE	-1.847 (0.3569)	-1.712 (0.7431)	-0.387 (0.5437)	-15.245 (0.0000)**	-15.256 (0.0000)**	-15.267 (0.0000)**
WAEMU	-1.924 (0.3209)	-1.743 (0.7292)	-0.364 (0.5525)	-15.948 (0.0000)**	-15.980 (0.0000)**	-15.972 (0.0000)**

Note: ** denotes 5% significance level, P-Values reported in parenthesis

3.5.2.3 Descriptive/summary statistics

Table 3.2 presents the descriptive statistics of exchange rates across the ECOWAS countries. The exchange rate series generally shows excess kurtosis and skewness, which corroborates the Jarque-Bera test, confirming that the variables under study are not stationary at levels. Guinea

recorded the highest mean of 5866.63, compared to the least of 2.369 for Ghana, albeit positive means across the board. Similarly, Guinea and Ghana shared the highest and lowest unconditional volatility of 2748.6 and 1.766, respectively, which were measured by the standard deviation. Guinea is the country that recorded the highest standard deviation; this implies that it is the most volatile market in the sub-region while Ghana recorded the lowest standard deviation, which also implies it was the least volatile market. All series have positive skewness, with the exception of Guinea, which is negatively skewed. Liberia witnessed the most severe right skewness of 1.38 which is followed by Nigeria (1.15), Sierra Leone (0.95), WAEMU (0.89), Cape Verde (0.86), Ghana (0.75), Gambia (0.10), and Guinea (-0.13). Likewise, in general, all the series are leptokurtic, with Liberia recording the highest (3.7), while Guinea recorded the lowest (1.6), which suggests heavy tails and high peaks indicating asymmetry and non-normality. For investors, a large kurtosis is usually associated with a high level of risk because it indicates high probability of extremely large and extremely small returns. However, a small kurtosis signals a moderate level of risk because the probabilities of extreme returns are relatively low. In general, the exchange rate series is characterized by a heavy-tailed distribution. These features of the exchange rate series in the ECOWAS region justify the use of wavelet techniques to model returns and examine their level of integration over time. Furthermore, the pictorial representation of the exchange rate series in figure 1 exhibits fat tails, volatility clustering, and asymmetry, suggesting nonlinearity.

Table 3.2: Summary statistics of exchange rates in the ECOWAS region

STATISTIC	GHANA	NIGERIA	GUINEA	GAMBIA	LIBERIA	SIERRA LEONE	CABO VERDE	WAEMU
Mean	2.3693	189.1363	5866.628	33.6199	88.5214	4734.50	93.0790	554.3411
Median	1.4743	151.8	6094.23	30.0248	72.5	4229.78	91.3093	542.4495
maximum	5.9009	411.25	10103.98	52.61	211.496	10887.6	130	779.324
Minimum	0.3626	98.9	1596	11.6788	38.5	1666.66	69.806	414.8476
Std.Dev.	1.7664	88.8238	2748.579	11.6005	44.2562	2571.55	13.1567	80.23454
Skewness	0.7514	1.1527	-0.1345	0.1005	1.38567	0.95438	0.8651	0.898824
Kurtosis	2.0096	2.9007	1.6777	1.9262	3.71621	2.66405	3.41571	3.441727
Jarque-Bera	35.629	58.573	20.0276	13.1298	90.1270	41.3185	34.8305	37.69329
Probability	0	0	0.0000	0.0014	0	0	0	0
Observations	264	264	264	264	264	264	264	264

3.5.2.4. Correlation analysis

We perform the Pearson correlation as a prelude to wavelet analysis because it helps us ascertain the degree of association of exchange rates in the ECOWAS region. From Table 3.3, the coefficients of the Pearson correlation show that there is an inverse weak relationship between Ghana and Sierra Leone (-0.12), and Gambia and Sierra Leone (-0.01). There is also an inverse association between Nigeria and Guinea (-0.04), Guinea and Gambia (-0.07), Guinea and Liberia (-0.02), and Guinea and WAEMU (-0.16). The rest are Gambia and Liberia (-0.05), Liberia and Sierra Leone (-0.08), Liberia and Cape Verde (-0.04), Liberia and WAEMU (-0.06), Sierra Leone and Cape Verde (-0.02), and Sierra Leone and WAEMU (-0.01). The rest show positive correlations with each other, specifically, the highest, which is (0.87), is between Cape Verde and WAEMU, while the lowest is between Nigeria and WAEMU (-0.002). Our findings on the correlation of the series are similar to Owusu-junior et al. (2017) whose study found significant co-movement in the monetary zone. The limitation of Owusu-junior et al. (2017) study was based on only four countries. We found important levels of correlations of exchange rates among the countries in the proposed monetary zone, where the superior wavelet techniques can be used to further explore co-movements among the variables.

Table 3.3: Correlation of exchange rates in the ECOWAS region

VARIABLES	GHANA	NIGERIA	GUINEA	GAMBIA	LIBERIA	SIERRA_ LEONE	CABO_VERDE	WAEMU
GHANA	1							

NIGERIA	0.1150	1						
	*0.0624	-----						
GUINEA	0.0319	-0.0492	1					
	*0.6055	*0.427	-----					
GAMBIA	0.0672	0.0227	-0.0711	1				
	*0.277	*0.7141	*0.2503	-----				
LIBERIA	0.0114	0.0341	-0.0203	-0.0567	1			
	*0.8537	*0.5821	*0.7433	*0.3597	----			
SIERRA_LEONE	-0.1244	-0.0318	0.0619	-0.0173	-0.0806	1		
	*0.0438	*0.6079	*0.3168	*0.7797	*0.1923	-----		
CABO_VERDE	0.0526	-0.0365	0.0267	0.1148	-0.0455	-0.0218	1	
	*0.3951	*0.5557	*0.6657	*0.0629	*0.462	*0.7254	-----	
WAEMU	0.0510	-0.0023	-0.0162	0.0595	-0.0618	-0.0189	0.8709	1
	*0.4099	*0.9702	*0.7942	*0.3363	*0.3177	*0.7597	*0.0000	---

Note: * denotes probability values

3. 6. Results and discussions

To assess the level of association between individual currencies in the WAMZ and the CFA Franc which is used by the WAEMU countries, we first of all, examined the bivariate relationship between the currencies that are used by WAMZ and that of the CFA Franc. In examining bivariate co-movement, we selected Ghana, Nigeria, Guinea, Gambia, and Sierra Leone from the WAMZ countries. The maximal overlap discrete wavelet transform (MODWT) with Daubechies least asymmetric (LA) wavelet filter of length 8 entails parsimony in selecting variables. Cape Verde and Liberia have the lowest annual GDP growth in the WAMZ (WAMI, 2022). We excluded these countries from the bivariate analysis. We then combined all seven countries' currencies in the WAMZ and the CFA Franc used by the WAEMU countries and analyzed their multivariate correlation as well as their cross-correlation by employing superior wavelet multiple correlations (WMC) and cross-correlation (WMCC). MODWT was adopted because it can generate accurate coefficients than Discrete Wavelet Transform (DWT).

3. 6.1. Bivariate analysis of exchange rates

First, in analyzing the pairwise correlations of currencies in the WAMZ and the WAEMU, the returns series are broken down into distinct time scales by applying the W2CWM2C approach proposed by Polance-Martinez and Fernandez-Macho (2012) together with MODWT adopting a 4-scale with Daubechies Least Asymmetric wavelet into short, medium, and long-term. The countries codes are WAEMU (C1), Ghana (C2), Nigeria (C3), Guinea (4), Gambia (C5), and Sierra Leone (C6). These are shown in Fig 3.2 below with Wavelet bivariate correlations matrix (01/01/2000–31/12/2021).

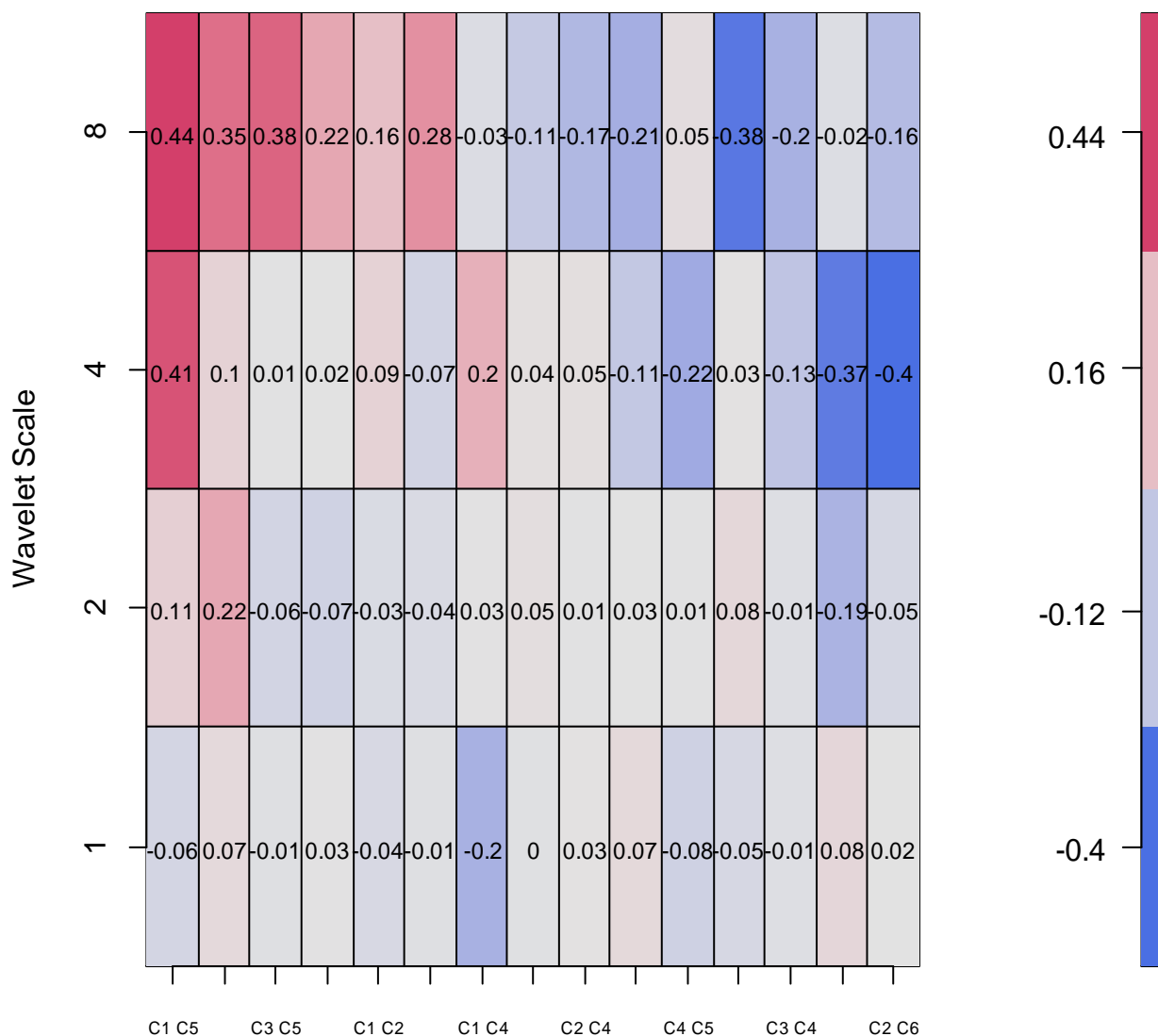


Fig 3.2 above is the exchange rates wavelet bivariate correlation matrix (01/01/2000-31/12/2021). The codes are WAEMU (C1) Ghana (C2) Nigeria (C3) Guinea (C4) Gambia (C5) and Sierra Leone (C6).

The combinations used for the estimation of the wavelet correlation coefficients are displayed on the horizontal axis. The correlations among pairs of exchange rates begin to turn feeble as one navigates to the right from the left. The vertical axis on the wavelet scale indicates the time

periods. The color scale used in the figure indicates the strength of the bivariate wavelet correlation coefficients, from weak correlations in blue to strong correlations in red.

The results show that the level of correlation varies across various timescales. C1, C5 which represent WAEMU and Gambia has the highest levels of association with coefficients which range from 0.41 to 0.44 at distinct time-scales with an average of 0.26. The next in terms of high correlation is C3, C5 which represented Nigeria and Gambia, with an average correlation of 0.32 (from -0.01 to 0.38). The next which is C1, C2 represents WAEMU and Ghana which has average correlation of 0.05 (from 0.09 to 0.16), WAEMU and Guinea, which is C1, C4 has a correlation averaging 0.00 (from 0.2 to -0.03). This result is very surprising since Guinea is the only French speaking country among the WAMZ, however, it has no or less correlation with her French speaking countries, though at scale 4 which is the medium term, it has a reasonable correlation with the CFA Franc at 0.2. The study observed that C4, which is Guinea, has an inverse correlation with or shows somewhat lower levels of correlation with most of the countries, namely Ghana, Gambia, and Nigeria with average correlations of around -0.08, -0.24, and -0.35, respectively. Again, this result shows that multilateral trade between Guinea and most West African countries is relatively low.

In the short term, bivariate correlations between the WAEMU and the WAMZ are weak; for example, WAEMU has a negative or inverse correlation with Gambia, Ghana, and Guinea, with correlations of -0.06, -0.04, and -0.2, respectively. Assessing the bivariate correlation from the lower scale, which is at the highest frequency, one can observe that the degree of correlation is very low, but in the medium term, that is, around scale 4, WAEMU has a high correlation with Gambia and Guinea representing 0.41 and 0.2, respectively, while the rest in the medium term still exhibits low levels of correlation. In the long term, which is at a lower frequency (higher

scale), at Scale 8, WAEMU and Gambia, C1, C5 had the highest correlation of 0.44, followed by Nigeria and Gambia, which is represented by C3, C5 had 0.38. WAEMU and Ghana has a correlation of 0.16 in the long run. The results show that, in the long run, some countries in the WAMZ have trade relations with the WAEMU. This supports the findings of Frankel and Rose (1998), who document that when countries trade with each other, business cycles among such countries are likely to synchronize in the long run.

3.6.2 Multivariate co-movement between WAMZ and WAEMU exchange rates

To analyze the multivariate co-movement of WAMZ and WAEMU exchange rates and obtain the overall level of integration across time, we employed wavelet multiple correlation (WMC) and wavelet multiple cross-correlation (WMCC). The exchange rates returns were decomposed into wavelet coefficients $D1$ to $D4$. The oscillations periods of the series were 0–1, 1–2, 2–4 and 4–8 days which is denoted by wavelet scales $j1$, $j2$, $j3$ and $j4$ respectively. In this study, we demarcated the time periods into three cycles which denotesthe short, medium, and long-time movements. We used cycle 1-2 to be the first cycle to represent the lower scales and the lower scale is known as the higher frequencies. We used 2-4 to represent the middle scales and it represents medium-term movement. We used 4-8 to represent the highest scale which is the lowest frequency and it portrays the movement in the long term as used by Fern´andez-Macho (2012) and Gallegati (2012) for longer scales where j is 7.

3.6.2.1 WMC for WAMZ and WAEMU exchange rates

The findings from the wavelet multiple correlations (WMC) for the WAMZ and WAEMU exchange rate series are shown in Table 3.4, and the corresponding plot is shown in Figure 3.3. Our findings suggest that the correlations among the variables are weak at the lower scale, which

are also known as higher frequencies. The intensity of correlation among the variables begins to show signs of growth at a higher scale, which is known as lower frequency. Elaborating further on the intensity of correlations among the variables, we realized that, the correlations at higher frequencies ($j = 1, j = 2$) begins to show an upward trend from 0.228 to 0.287. The medium frequencies ($j = 2, j = 3$) continues to show an increasing trend in terms of the degree of association among the series from 0.287 to 0.546. The upward trajectory in interdependence increases scantily in magnitude at lower frequency which is the highest scale ($j = 4$) climbing to 0.578. Our results evidence that, WAMZ and WAEMU exchange rates exhibit poor integration during the short-term period, however, this poor integration of the series begins to dissipate as it reaches the medium term and continues to show an upwards trend when it gets to the long-term. This finding is consistent with the results of the bivariate correlations of the WAEMU and the WAMZ exchange rates. This is probably mainly caused by long-term fundamental reasons between the markets.

The discrepancies between the WAMZ and the WAEMU exchange rates are high in the short to medium term, but they tend to dissipate in the long-term horizons. Overall, our findings indicated that the correlations of WAMZ and WAEMU exchange rates are strong in the medium term, and this relationship grows high at long time scales. This result shows that ex-post monetary integration is more favorable for currency introduction in the ECOWAS sub-region than ex-ante because there is evidence that, in the long term, exchange rates in the region can become perfectly integrated and that a fixed exchange rate regime can be introduced, which is in line with the OCA criteria. This increasing trend in the WAMZ and WAEMU exchange rates could be due to the strong fundamental linkages between both blocs, which may include trade

linkages, financial linkages, and spill-over effects, confirming the fundamental-based theory under the broader contagion theory tested in this study.

Table 3.4: WMC for WAMZ and WAEMU exchange rates with the 95% confidence interval

Scale	Cor	Lower bound	Upper bound
<i>J=1</i>	0.228	0.058	0.384
<i>J=2</i>	0.287	0.047	0.496
<i>J=3</i>	0.546	0.244	0.751
<i>J=4</i>	0.578	0.116	0.834

Note: Cor = correlation coefficient

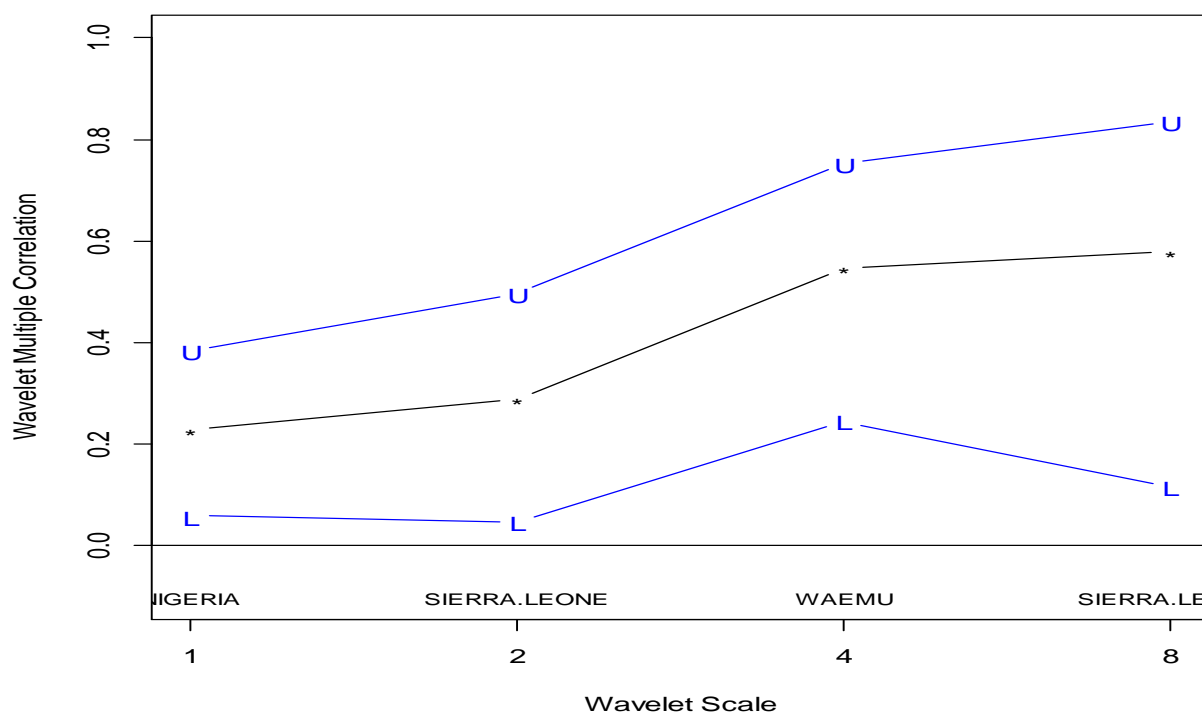


Figure 3.3: WMC for WAMZ and WAEMU exchange rates. The (U) and (L) lines correspond to the Upper and Lower bounds respectively of the 95% confidence interval

3.6.2.2 WMCC for WAMZ and WAEMU exchange rates

The results of the multivariate cross-correlation of the WAMZ and WAEMU exchange rates are presented in Table 3.5, and their plots are presented in Figure 3.4. The exchange rate that maximizes multiple cross-correlations is shown on the right-hand side of each wavelet scale.

The exchange rate of the country that maximizes multiple cross-correlations against the linear combination of the entire region is described as the potential leader or follower for the rest of the markets at varying scales. The dashed lines (Figure 3.4) show the time lag at which the strongest or exact wavelet correlation coefficients are localized. The findings indicate that the cross-correlations are weaker at lower scales ($j=1, j=2$), which represent higher frequencies. This confirms our earlier findings from bivariate wavelet correlation and WMC. By examining the localizations in relation to their time lags, we observe that spillover effects are realized at every scale ($j=1, j=2, j=3$ and $j=4$) because at every scale, localizations do not occur at the point of symmetry (i.e., zero time lag). Thus, positive time lags are indicative of a country in which the exchange rate lags the markets at a particular scale, and negative time lags are also indicative of a country whose exchange rate leads the markets at a particular scale.

In specifics, during the short and medium as well as the longer scales ($j = 1$ to $j = 4$), there is evidence that localizations do not occur at the point of symmetry (i.e. No zero time lag symmetry). This is an indication of a spillover effects from other market in the short-term to medium-term and the long term. The short, medium and long scales ($j = 1, j = 2, j = 3$ and $j=4$) indicates that Guinea, Nigeria, Sierra Leone and WAEMU maximizes the multiple cross correlation against the linear combination of other markets. Guinea shows negative lag at 23 days (0.228), Nigeria shows positive lag at 11 days (0.287), Sierra Leone depicts positive lag at 19 days (0.546) and WAEMU also depict positive lag at 19 days (0.578). This finding portrays

the long-term associations between the WAMZ and the WAEMU exchange rates. Nigeria, Sierra Leone and WAEMU has the potential to lag the rest of the markets at scale ($j = 2, J=3$ and $J=4$), Guinea is a potential market leader at scale ($j= 1$). WAEMU has the potential to lag other markets at the lowest frequencies which is the highest scale ($j= 4$).

Table 3.5: WMCC for WAMZ and WAEMU exchange rates

Scale	Localisation	Time lag	Leading/Lagging
$J=1$	0.228	-23	Guinea
$J=2$	0.287	11	Nigeria
$J=3$	0.546	19	Sierra Leone
$J=4$	0.578	19	WAEMU

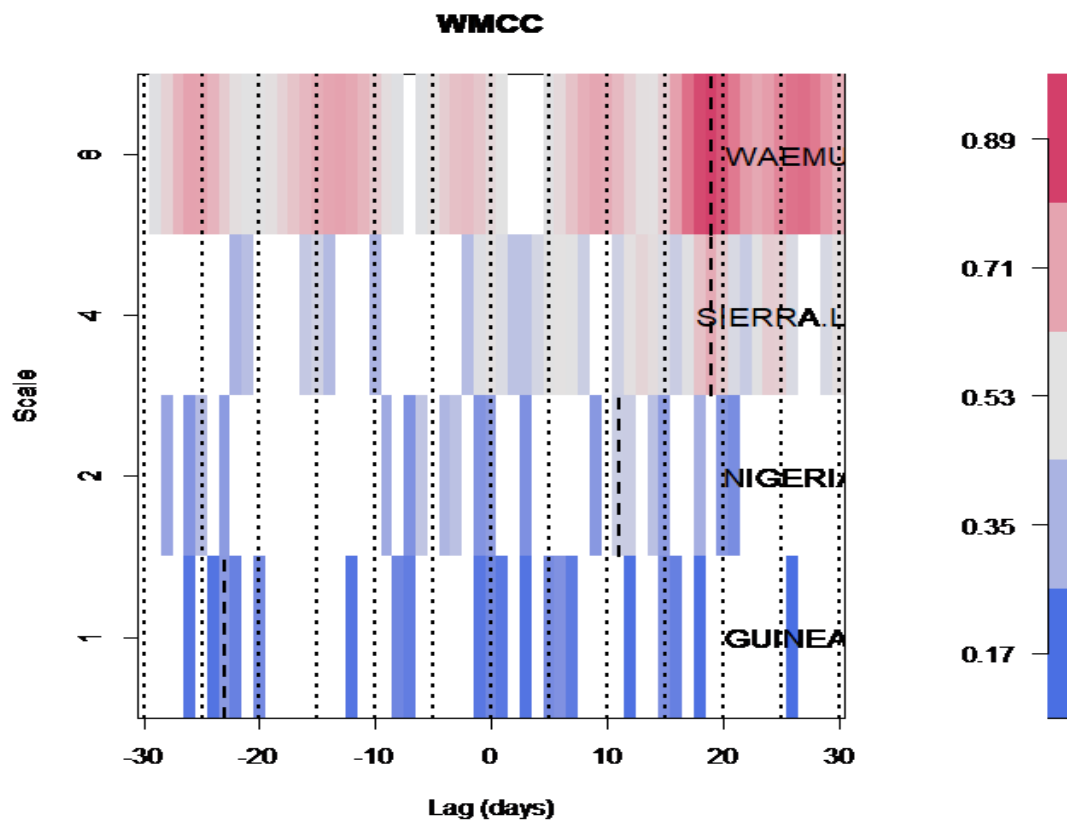


Figure 3.4: WMCC for WAMZ and WAEMU exchange rates. The vertical long dotted lines indicate where the strongest wavelet correlation values are located. Areas in the plot in which the 95% interval extends to zero are indicated in white.

In summary, when our findings are juxtaposed to other studies on exchange rate comovement that concentrated particularly on only the WAMZ using the same methodology, our results are different from those of Alagidede et al. (2008), Adam et al. (2010), Tweneboah et al. (2016) and Owusu-Junior (2017, 2019). These studies report that exchange rate integration in the WAMZ is weak and does not present a good picture of monetary integration in the WAMZ. However, when the currencies in the WAMZ and WAEMU are examined, there is an indication that exchange rates in the ECOWAS sub-region can integrate in the long run. From the OCA conditions, strong exchange rate comovement is an ingredient for the introduction of a fixed exchange rate regime.

3.7 Conclusion and policy implication

Examining the level of correlation between the WAMZ and WAEMU exchange rates on multiple time scales, we employed the wavelet multiple correlation and cross-correlation of Fernández Macho (2012). These methods of WMC and WMCC do serve as robustness purposes for each other because they complement the other in terms of results and also address the shortcomings of the bivariate wavelet correlations. The study employed seven currencies used by countries that belong to the WAMZ. The countries are Ghana, Nigeria, Guinea, Gambia, Sierra Leone, Liberia, and Cape Verde and the currency used by the WAEMU, which is the CFA for the period 2000-2021 to achieve the set objective. The level of integration (co-movement) of currencies among prospective member countries plays an important role in the introduction of monetary integration. In addition, each country's currency market operates at different frequencies; hence, inter-market linkages are not necessarily the same over different time-scales and frequencies. This motivated the study to examine the inter-market linkages of the WAMZ and WAEMU exchange rates in a time-frequency space.

We first of all, examined the bivariate co-movement between the leading currencies in the WAMZ and the CFA Franc which is used by the WAEMU. Evidence shows that the level of integration between the WAMZ and WAEMU exchange rates gradually becomes stronger as it navigates from a higher frequency (lower scale) to a lower frequency (higher scale). In other words, the findings show that in the short run, co-movement of exchange rates among the WAMZ and the WAEMU are weak; thus, multiple correlations are seen to have moved up with the passage of time; that is, there is a clear observation of movement from weak correlations in the short run, to moderate correlations and stronger interdependence for the medium to the long runs respectively. This shows that in the long run, the level of integration between the two blocs is high. This generally indicates the vulnerability of the WAMZ currency market to discrepancies in the WAEMU currency market from the medium term to the long term.

For bivariate specificity, WAEMU and Gambia had the highest degree of correlation, with coefficients ranging from 0.41 to 0.44. Nigeria and Gambia had the next highest correlation with an average correlation coefficient of 0.32. In general, correlations between WAMZ and WAEMU in the short term are weak; however, in the medium to long term, the degree of integration accelerates.

We then combined all currencies that belong to the WAMZ and the CFA Franc which is used by the WAEMU countries and examined their overall correlation and cross-correlation by employing wavelet multiple correlations and cross correlation. The results of the wavelet multiple correlations show that the WAMZ and WAEMU exchange rates are poorly integrated at lower scale. However, this integration grows stronger at medium frequencies, and shows a considerable level of interdependence at the lowest frequency. The result based on the multivariate cross-correlation of WAMZ and WAEMU exchange rate markets shows that in the

long term, WAEMU has the potential to lag other markets at the highest scale, Guinea is a potential market leader at the lowest scale and Nigeria has the potential to lag other markets when transitioning from the short to medium term, while Sierra Leone has the potential to lag at the medium term.

The empirical results of this study contribute to the existing literature because, to the best of our knowledge, this is the first study to examine the integration of exchange rates between the WAMZ and WAEMU in the context of ECOWAS monetary integration. Alagidede et al. (2008), Adam et al. (2010), Tweneboah et al. (2016), and Owusu-Junior et al (2017, 2019) have undertaken studies on exchange rate comovement in the ECOWAS sub-region, but these studies focused only on the WAMZ. In summary, our results suggest that the WAMZ and WAEMU exchange rate markets are lowly integrated in the short term. However, we find that medium to long terms currencies in the region are highly integrated. These findings underscore the prospects of economic integration in the ECOWAS region. The results provide evidence of convergence of exchange rates in the long run in the region, as this variable behaves similarly in the long run albeit inconsistencies in the short run. The consistencies observed in exchange rates in the long run suggest harmonious relationships of exchange rates in the ECOWAS markets over the long run.

Based on these results, the study recommends that the heads of state of ECOWAS member countries consider ex-post monetary integration. We again recommend that member states establish a regional surveillance mechanism that can monitor the macroeconomic indicators in the region. The effective implementation of this mechanism can aid in the identification of macroeconomic imbalances and potential risks to macroeconomic stability and convergence. The findings of the study also suggest that there is no particular currency leader in the ECOWAS sub-

region. Different currencies have the potential to lead at some point on the scales, suggesting that the exchange rates of any of the countries under consideration can drive price changes in other markets.

As policymakers aim to garner considerable gains from the African Continental Free Trade Agreement (AfCFTA), strengthening regional economic communities (RECs) and ensuring the implementation of the "eco" by WAMZ and WAEMU countries is crucial. This will contribute to the realization and application of the AfCFTA, considering that intra-African trade primarily occurs within RECs. Policymakers should take pragmatic steps to strengthen RECs in the region, and WAMZ members must be willing to relinquish individual monetary policies to promote integration. To succeed in introducing a single currency, ECOWAS countries should enhance their monetary and exchange rate policies, as well as improve their fiscal performances. The results for the integration between the WAMZ and WAEMU exchange rates are the exclusive contributions of this study.

Future studies could examine the integration between the WAMZ and WAEMU exchange rates not covered in this study to enhance our understanding of how currencies in the ECOWAS region behave. Future studies could also look at the regulatory and supervisory aspects of currencies in the ECOWAS sub-region to allow for successful implementation of the "ECO" in the sub-region.

Future studies could extend the analysis beyond the year 2020 to assess the current state of the relationship between this macroeconomic variable and evaluate the feasibility of the "eco," given that the original 2020 deadline was not met. Furthermore, as the wavelet methodology has limitations in determining causality, spillover dynamics, and quantifying information flow among variables, we recommend further research in these areas.

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CHAPTER FOUR

STOCK MARKET DEVELOPMENT AND ECONOMIC GROWTH AMONG ECOWAS COUNTRIES

4.1 Introduction

Several factors have been identified to be important in providing an enabling environment necessary for promoting economic growth. Stock market development is one of the conduits that bring growth to nations (Demetriades & Hook Law, 2006). A study by Adusei (2014) revealed that stock market development helps economies to experience an appreciable growth through the transfer of funds from lenders and creditors for investments. Though investment is identified to have direct influence on economic growth, external factors like institutional quality and its various constituents such as control of corruption, government effectiveness, voice and accountability, rule of law, regulatory quality, and political stability have also been found to be important in promoting growth. Though institutional quality variables such as the aforementioned have generally been perceived to indirectly influence growth as compared to investments, such external factors in the area of institutional quality cannot be underestimated when it comes to the stock market development and economic growth discourse. Studies have established that good institutions are perceived to create an enabling environment which is necessary for economies to flourish. Therefore, all things being equal, economies that have good institutional structures stand in a better position to experienced growth. It is therefore anticipated that countries with weak institutional structures may experience difficulty in growing their economies (see Assadzadeh & Pourqoly, 2013; Ogbuabor et al., 2020).

The institutional quality and its various constituents serving as mediating role in the relationship between stock market development and economic growth has been understudied in the context of ECOWAS. Papaioannou (2009), Anyanwu (2017) and Wanjiru and Prime (2020) have reported that countries with a weak judicial systems, and an unstable political system suffer from economic growth. Several empirical studies have also shown that for stock market development to have a greater positive impact on economies depend on the type of governance being practised by such countries (see Ghardallou & Sridi, 2020; Yu & Jong-A-Pin, 2020).

Several studies have hypothesized that; there is a positive relationship between stock market development and economic growth in the context of ECOWAS (see for example, Adusei, 2014; Nabieu & Banor. 2016; Okoh & Eke, 2015; Abina & Maria. 2019; and among others) whiles other studies have reported of negative association between these two variables (see for instance, Owusu & Odhiambo, 2014; Ofori-Abebrese, Kamasa & Pickson, 2016; and among others). Okoh and Eke (2015) find a positive correlation between stock market development and economic growth in Nigeria. Abina and Maria (2019), and Nwamuo (2018) in country-specific studies found positive relationship between stock market development and economic growth in Nigeria, West Africa most populous nation, whiles; in Ghana, Owusu and Odhiambo (2014) study find no positive significant relationship between stock market development and economic growth.

This study, unlike the studies reviewed in the context of ECOWAS, is designed to examine the mediating role of institutional quality in the stock market development and economic growth relationship. We do so by assessing how institutional quality and its disaggregated components influence the stock market development and growth relationship.

A critical review of existing studies on stock market development and economic growth relationship in the context of ECOWAS mostly has concentrated on stock market development

variables such as market capitalization, stock turnover ratio, and stock traded value as proxy for stock market development and the economic growth nexus; with no inquiry on the specific assessment of institutional quality, and its disaggregated components/constituents serving as a mediating role in this relationship. Since this is not replete in the extant literature in the context of ECOWAS constitute the motivation of the current enquiry to examine this relationship in question.

This study reviews the extent to which institutional quality and its disaggregated components influence the relationship between stock market development and economic growth in the ECOWAS region. The approach of this study has the potential to uncover unique underlying interactions such as how control of corruption, government effectiveness, voice and accountability, rule of law, regulatory quality, and political stability uniquely influences operations as well as the performance of the stock market development and the economic growth nexus. The findings from this study can then help prominent key stakeholders to implement policies geared towards the improvement of the stock markets to bring the needed growth. Aside the supposed contribution to the extant literature based on the approach, this study has important strategic policies that stakeholders in the stock markets can harness to make the capital markets more attractive and profitable.

The rest of the chapter is as follows: the next section provides a review of the theory underpinning this objective while section 4.3 reviews the empirical literature. Section 4.4 outlines the data and empirical strategy while section 4.5 presents the findings. Section 4.6 highlights the policy implications and concludes the study.

4.2 Theoretical literature

The existing literature on financial development has furnished the academic community with theoretical explanations of the finance-growth nexus. The consensus among academics is that, financial systems can induce growth. This section discusses theories of the relationship between financial development and economic growth.

1. Supply-Leading Hypothesis: The supply leading hypothesis explicitly states that financial deepening can promote growth. The proliferation and creation of financial systems can increase savings and investment. When savings and investments increased, the effective accumulation of capital is enhanced. The supply leading hypothesis contends that when there is a well-functioning financial institution, it can bring economic efficiency; it can also lead to the creation and expansion of liquidity, savings mobilization, and enhancement of capital accumulation. Well-functioning financial institutions can lead to the transfer of available resources to more contemporary growth-inducing sectors from traditional or non-growth sectors. Robust financial institutions can promote skilled entrepreneurial response in these contemporary sectors of the economy. Modern theories concerning this relationship by applying various analytical methods in finance literature have established strong evidence that financial development promotes growth (Dernirguc-Kunt & Levine, 1996). According to Dernirguc-Kunt and Levine (1996), it is important to encourage policymakers to prioritize financial sector policies and pay attention to the policy determinants of financial development as a mechanism for promoting economic growth.

2. Demand-Following Hypothesis: The demand-following hypothesis on the development of the financial market is nothing more a lagged response to economic growth. In other words, when there is growth, it generates demand for financial products. This shows that there is no

need to develop financial markets because this may lead to a waste of resources. At this stage, resources can be channeled to a more useful purpose during the early stages of growth. The demand-following hypothesis suggests that once the economy advances, it will trigger an increased demand for financial products, which will invariably result in greater financial development. Some studies on the finance-growth nexus postulate that economic growth is a causal factor in the development of financial institutions. Some researchers believe that, as the real sector grows, there will be an increased demand for financial services that will stimulate the financial sector. One school of thought contends that the growth of the financial sector is an outcome of an economy experiencing a surge in output, an assertion that was recently renewed by Ireland (1994), and Demetriades and Hussein (1996). According to this alternative opinion, when there is any development in financial institutions, it is merely a response to a growing economy.

3. Stage of Development Theory: According to Patrick (1966), the direction of causality between financial development and economic growth is dependent on the course of development. He explains that during the initial stages of development, financial development spurs growth; however, as real growth begins to appear in the economy, it will naturally create demand for financial services. The development theory stage suggests a demand-following association between financial sector and economic growth. When there is high economic growth, there is a demand for contemporary financial institutions/products. Thus, the financial market responds to such demands, and the level of demand for services in the financial sector is largely dependent on the growth of real output, monetization of agriculture, commercialization, and other traditional substance sectors.

4. Financial Liberalization Theory: According to McKinnon and Shaw (1973), government interventions in financial markets are seen as the major obstacle to the mobilization of savings, investment drive, and ultimately the growth of economies. The major criticism of financial liberalization theory emanates from the imperfect information paradigm. Some authors disagree with the assertion that an imperfect information paradigm examines financial development problems in the context of asymmetric information. They suggested that this is costly and can lead to credit rationing. According to Stiglitz and Weiss (1981), asymmetric information, can result in adverse selection and moral hazard. When there is adverse selection and moral hazard, it implies that when there are information asymmetries that bother on high interest rates, it can actually follow reforms in the financial sector as well as the implementation of policies that bother on financial liberalization in particular, which can cause investors to take risk on how to use their capital and eventually threaten the stable nature of the financial system. This can result in a financial crisis, although the feedback theory proposes two-way causality between financial development and economic growth.

5. Financial Repression Theory: This theory suggests that when there are a number of government regulations, laws, and some restrictions that are not market related, it hinders the effective functioning of financial intermediaries in their operations. Government policies that normally cause repression in the financial sector include ceilings in interest rates, liquidity ratio requirements, capital controls, high bank reserve requirements, credit ceilings, and market entry restrictions, government directions on credit allocations, and sometimes government ownership and domination of banks. Most economists believe that financial repression can prevent efficient capital allocation, which can negatively affect economic growth (Okpara, 2010; Darrat & Siowadi, 2010; Ezzo, 2010).

4.3 Empirical literature

4.3.1 Studies in ECOWAS

Empirical studies on the relationship between stock market development and economic growth have been relatively limited in the ECOWAS region. Theoretically, this relationship has been a subject of discussion in the academic space which has resulted in opposing opinions. Some studies have empirically documents that stock market development spurs economic growth while others contend that it prevents growth.

In the West African region, studies on the relationship between stock market development and economic growth are mixed (see: Owusu & Odhiambo, 2014; Owusu, 2016; Abdullahi & Fakunmoju, 2019; Asamoah, 2018; Nabieu & Barnor, 2016; Abina & Maria, 2019; Adefeso et al., 2013; Okonkwo et al., 2014; Onuora, 2019; Echekeba et al., 2016; Ofori-Abebrese, Kamasa & Pickson (2016); and among others)

Some studies report of positive effect of stock market development on economic growth. Abdullahi and Fakunmoju (2019) examined the nexus between stock market development and the performance of economic activities in the West African countries. The study employed secondary data and applied the panel regression method of estimation within the period of seven years across some selected countries in the region. Findings from the study revealed that stock market indicators, that is, ratio of market capitalization to gross domestic product, all share index and stock turnover have positive effect on economic performance while corruption perception index have negative effect on economic performance at 5% level of significance.

Abina and Maria (2019) studied for the period 1985-2017 on the relationship between stock market development and economic growth in Nigeria and found that capital market is a strong determinant of economic development. Furthermore, Nwamuo (2018) reveals that capitalization

and the number of deals have a positive effect on economic growth in Nigeria. Okoh and Eke (2015) assessed the link between capital markets and GDP growth in Nigeria and revealed in their study that capital market variables are positively correlated and have a significant association with economic growth.

Asamoah (2018) investigated the impact the Ghana stock exchange has on economic growth by using the Vector Error Correction Models (VECM) and Granger causality models on monthly time series economic data between 2000 and 2012. The study revealed that the development of the Ghana Stock Exchange had both short-run and long-run impacts on economic growth and that there was a bi-directional causality between stock market development and economic growth. This study provides evidence in support of the mutual impact or feedback hypothesis, which argues that financial sector development stimulates economic growth and economic growth promotes financial sector performance as found by a few studies in other contexts

Nabieu and Barnor (2016) examined the relationship between stock market development and economic growth in Ghana by employing time series data from 2000 to 2012. The study used Granger causality and Vector Error Correction Model (VECM) estimation techniques and revealed that stock market has a positive effect on economic growth in Ghana both in the short term and in the long term, while the causality test showed a bidirectional relationship between the two variables, implying that there is a correlation between capital market development and economic growth in Ghana.

A study conducted in Cote d'Ivoire and Nigeria by Ehigiamusoe and Lean (2015) on stock market development and economic growth report in their findings the presence of a long-run cointegration between stock market/financial development and economic growth in the studied countries. The study revealed that stock market development/financial development granger

causes economic growth in Cote d'Ivoire while the reverse is the case for Nigeria. Thus, the supply-leading hypothesis is established for Cote d'Ivoire while the demand-following hypothesis is also established for Nigeria. The study therefore suggests that Cote d'Ivoire should make the financial sector more robust in order to make it more growth-enhancing, and in Nigeria, there should be a re-evaluation of the policies in the financial sector as well as reforms with a view to repositioning the sector to help improve the growth of the economy.

Using Johansen co-integration test, Okonkwo et al. (2014) investigated whether the role and contributions of the stock market in Nigeria thus induce growth in the economy. The data for the study was from 1981 to 2012 and the Johansen co-integration methodology was used to estimate the long-term equilibrium relationship among the variables. The study concluded that, the stock market size being one of the important indicators when it comes to how stock market impact on economic growth, indeed exerts significant influence on economic growth. The study on the other hand revealed that stock market capitalization and economic growth have no causal relationship. This study supports the no feedback hypothesis.

Adusei (2014) used data from 2006 to 2013 to assess how the stock market contributes to economic growth in Ghana. The study employed the bounds cointegration and Granger causality methods, and the results of the cointegration test shows that there is a long-term relationship between stock market development and economic growth, while the findings of the causality test revealed unidirectional causality from stock market development to economic growth. Adusei's (2014) study ended in 2013; therefore we found a gap in knowledge based on the study period to confirm these results if it is the same as in 2023.

Employing the Ordinary Least Squares regression (OLS) and using data that span from 1984 to 2008, Popoola (2014) examined the effects of stock market development on economic growth in

Nigeria. The results of the estimation show that the explanatory variables accounted for approximately 95.77% variation in economic growth. The study revealed that growth of market capitalization, total market turnover, all share-index, and openness of the Nigerian economy to foreign investment; have a significant positive effect on economic growth at 5% level of significance.

In Nigeria, Adefeso et al. (2013) investigated the association between the development of the stock market and economic growth by using data that span from 1980 to 2010. The study used the Vector Error Correction Model and co-integration techniques for the estimation analysis. The study finds that there is a long-term relationship between stock market development as well as banking activity variables in Nigeria. The study further concluded that, economic growth granger causes both stock market development and banking activity in Nigeria, thus supporting the demand-following hypothesis. The study sturdily suggests that policy makers should focus their attention on economic growth through the implementation of suitable regulatory and macroeconomic policies to mitigate the foresable problems that will lead to the faster sustainability of economic growth and development in Nigeria.

Kolapo and Adaramola (2012) examined the impact of capital market development on economic growth in Nigeria. The evidence from the study revealed that the activities in the capital market drive economic growth. The causality test results suggest a bi-directional causation between economic growth and the value of transactions in the stock market and a unidirectional causality from market capitalisation to economic growth.

In a related development, Gries et al. (2009) used Granger Causality technique to investigate the causal relationship between stock market development and economic growth in some countries in Africa which included Cote d'Ivoire and Nigeria. The study discovered stock market/financial

development and economic growth in Nigeria exhibit a bidirectional relationship while in Cote d'Ivoire, the study finds no causal relationship.

In a related study, Ezu and Egbunike (2013) investigated the relationship between stock market development and economic growth in Nigeria. The study was conducted under a democratic rule. The study used time series data for the period that ranged from 1999 and 2011 and apply a multivariate regression model for the estimation. The study revealed that total market capitalization and all share indexes have positive effect on economic growth as captured by the gross domestic product (GDP). Osuala, Okereke and Nwansi (2013) used Granger causality test to investigate the relationship between stock market performance and economic growth in Nigeria. The variables for the study include Gross Domestic Product which represents economic growth, turnover ratio, market capitalization, and total number of deals ratio. These variables were used to represent stock market performance indicators. The finding of the study was that, there exist an empirical evidence of long-run cointegration between economic growth and stock market performance. Additionally, in the long run, the study report of a unidirectional causality from stock market performance indicators to GDP. In the short run, the study reports that, there was no causal relationship between economic growth and stock market performance.

In Cote d'Ivoire, Nzue (2006) examined the relationship between the development of the Ivorian stock market and the country's economic performance. The study reports that gross domestic product which is proxy for economic growth and stock market development have a long run association. The result also indicates a unidirectional causality which runs from stock market development to economic growth which confirms the supply leading hypothesis in this study.

There are some studies also that report that stock market development has little or no positive effect on economic growth in the West African region. In Ghana, Owusu and Odhiambo (2014)

examined the relationship that exists between stock market development and sustainable economic growth. This study employs the recently developed ARDL bounds testing approach and multi-dimensional stock market development proxies to examine this linkage. The study finds that in the long run, stock market development and capital account liberalization policies have no positive effect on economic growth in Ghana. However the study concluded that it is the increase in credit to the private sector, rather than stock market development that drives the real sector development in Ghana. Similarly in Nigeria, Owusu (2016) examines the relationship between stock market evolution and sustainable economic growth in Nigeria by employing Autoregressive Distributed Lag (ARDL)-bounds testing approach and a combined stock market indicators index to examine the relationship. The study finds that in the long run, the stock market has no positive and at the best-mixed effect on economic growth in Nigeria.

In Nigeria, Onuora (2019) found no significant positive effect of capital market on GDP growth. Moreover, Ailemen et al. (2016) found that all share indices were inversely correlated with economic growth, whereas capitalization, value of transactions, and number of deals exhibited positive associations with economic advancement. Adigwe et al. (2015) empirically examined whether the stage of development in the Nigerian stock market has accelerated growth in the economy from 1985 to 2014. The study used ordinary least square (OLS) estimation, and the findings revealed that the development of the stock market in Nigeria contributes poorly to economic growth. Echekoba et al. (2016) study the short and long dynamics of the causal relationship between the Nigerian stock market and growth from 1981 to 2015. This study utilized two stock market development indicators, market capitalization and the value of the stock traded ratio, and used gross domestic product changes as proxy for economic growth. The

Granger causality test revealed no causal association between the Nigerian stock market and economic growth.

Ofori-Abebrese, Kamasa and Pickson (2016) investigated the association between stock exchange and economic growth in Ghana. This study used ARDL model coupled with Granger causality test to examine the linkage for the period from 1991 to 2011. The finding of the study was that, in the long run, stock market development has a negative effect on economic growth and this was confirmed by the causality test that there is no relationship between stock market development and economic growth in Ghana for the study period.

Menyah et al (2014) used panel causality to examine the causal relations between stock market development and economic growth for some countries in in Sub-Sahara Africa which has Cote d'Ivoire and Nigeria included in the study. The study reports of absence of any causality running from stock market development to economic growth in Cote d'Ivoire and Nigeria. The study of Jibril, Salihi, Wambai, Ibrahim, Muhammad and Ahmad (2015) when they examined the impact of stock exchange development in Nigeria on economic growth used data that span for 20years from 1990-2010. Their study applied the Ordinary Least Square (OLS) techniques. The stock market capitalization ratio was adopted as a proxy for market size while value traded ratio and turnover ratio were used to capture market liquidity. The study revealed that market capitalization and value traded ratio have a negative correlation with economic growth while turnover ratio has a strong positive correlation with economic growth.

4.3.2 Studies in ECOWAS where institutional quality serves as mediating variable

Few studies have examined the connection between financial development and economic growth where institutional quality serves as a mediating variable in the context of ECOWAS. Djeri et al.

(2020) conducted a study on economies in the West Africa Economic and Monetary Union to analyze how institutions play a role in the financial development and economic growth relationship. The study included stock market in the financial development variables and concluded that institutions play a significant role on how financial development influences growth. Suleman et al. (2022) examined the relationship between financial development and economic growth for countries that belong to the Economic Community of West African States (ECOWAS) and the countries that constitute the Southern African Development Community (SADC). Suleman et al. (2022) included stock market variables in the financial development indicators and reported in their findings that, financial development has a positive effect on economic growth in SADC countries, but its effect was statistically insignificant in the case of ECOWAS. The study further revealed that institutional quality helps to strengthen the existence of this effect through its complementary role.

4.3.3 Gaps in literature

The study identified some limitations from the above review. One, most of the studies conducted in the ECOWAS region have not considered the role of institutional quality in the stock market development and economic growth nexus (see for instance, Owusu & Odhiambo, 2014; Owusu, 2016; Ofori-Abebrese, Kamasa & Pickson, 2016; Asamoah, 2018 and among others). However, studies such as Effiong (2015) and Omoteso and Ishola Mobolaji (2014) in other jurisdictions have considered institutional quality as control variables when dealing with the finance-growth nexus. Their studies employed the GMM method and fixed and random effects method respectively and realized that institutional quality, when coupled with stock market development can promote economic growth.

Secondly, most of the studies on stock market development and economic growth in the ECOWAS region have been concentrating on country specifics. Though fresh evidence suggests that panel studies is preferable to country-specific studies (Arestis & Demetriades, 1997). While this study acknowledged the works of Djeri et al. (2020) and Suleman et al. (2022) on the finance-growth nexus in the ECOWAS region where institutional quality serves as a mediating variable in this relationship, this study pursues a different approach by concentrating on the stock market development by examining the effect of institutional quality and its various constituents on the stock market development and economic growth relationship in a panel study of member countries. Another important feature which makes our approach different from Djeri et al. (2020) and Suleman et al. (2022), and other previous studies is by examining the threshold effect of institutional quality and its various constituents in its mediating role in this relationship by using the Hansen threshold regression estimation method that has not been considered by most literature on the subject matter in the ECOWAS context, thus introducing a methodological novelty. Based on our approach used in this study, it has the potential to add to the extant literature on the relationship under study in the context of ECOWAS.

4.4 Empirical Methodology

4.4.1 Threshold regression (Hansen, 1996, 2000)

The estimation of threshold regression has in the past been dominated by the use of quadratic terms; however, one disadvantage with the application of the quadratic terms was that the exact relationship and form at the point of inflection is ambiguous to identify because the validity of such results is generally not reliable. Hansen's (1996, 2000) threshold regression estimation overcomes this deficiency because the nature of the nonlinear relationship is not imposed on the model. Another advantage of the Hansen threshold estimation is that the statistical significance of

the identified thresholds can be empirically verified. The uniqueness of Hansen threshold regression is that it is based on asymptotic distribution theory (Papageorgiou, 2002).

We begin by specifying a basic economic growth model as;

$$GDP = f(SMD (MC, STO, TVL), IQ) \quad (4.1)$$

GDP is GDP per capita, SMD is a vector of stock market development indicators (market capitalization, stock turnover ratio, and stock traded value), and IQ is the institutional quality variable. We augment this functional relationship to include; foreign direct investment, inflation and domestic credit to the private sector, equation 1 becomes,

$$LogGDP = LogSMD, IQ, LogINF, LogFDI, LogDCPS \quad (4.2)$$

We compactly rewrite equation 2 as;

$$LogGDP = \theta LogSMD_t + \alpha V_i + \mu_t \quad (4.3)$$

Where V_i is a vector of the other control variables as indicated in equation 4.2 (including a constant term), θ , and α are the parameters to be estimated, and μ_t is the idiosyncratic error term. ' θ ' measures the effect of the stock market development (SMD) on economic growth (GDP per capita); we augment equation 4.2 so that the growth effect of stock market development is refereed by institutional quality. Therefore, institutional quality is our threshold variable given as ' π ', which is a continuous distribution. The parameters in the equation are therefore split into two (2) regimes conditional on ' π '. We specify this as;

$$LogGDP_t = (\theta_1 LogSMD_t + \alpha_1 V_{it} + \mu_t) I_t \{ \pi < \gamma \} + (\theta_2 LogSMD_t + \alpha_2 V_{it} + \mu_t) I_t \{ \pi > \gamma \} + \varepsilon_t \quad (4.4)$$

Where $I(\cdot)$ denotes the indicator function of the dummy variable that adopts the value of 1 when the argument of the indicator function is satisfied and 0 when the argument is not satisfied. The

threshold variable is represented by π while the value of the threshold is denoted by ' γ '. Equation 4.3 permits for the effect of stock market development on economic growth to be disintegrated into two (2). The first effect assesses the impact when the level of stock market development is below the threshold, and the second analyzes the impact when stock market development is beyond the threshold. θ_1 and θ_2 measure the effect of stock market development on economic growth in both low regime and high regime periods respectively. Where $\pi \leq \gamma$ and $\pi \geq \gamma$ denotes both regimes respectively.

Ibrahim and Alagidede (2018) and Alagidede et al. (2018), began by testing the existence of a threshold against linearity. In this study, we followed the procedure of Alagidede et al. (2018) and Ibrahim and Alagidede (2018) by testing the significance of the threshold parameter, which is expressed in equation form as $\theta_{i1} = \theta_{i2}$ and $\theta_{i1} \neq \theta_{i2}$

We therefore rewrite equation 4.3 as

$$y_t = \hat{\theta}X_i + \hat{\delta}_n X_i (\gamma) + \varepsilon_i \quad (4.5)$$

where $\delta_n = \theta_{i2} = \theta_{i1}$ denotes the threshold effect. We therefore solve it as $\gamma_n \rightarrow 0$ when $n \rightarrow \infty$, $\theta_{i1} \rightarrow \theta_{i2}$. We again specify equation 3 in a matrix form as an $n \times 1$ vector of Y and ε by stacking them and then in an $n \times m$ matrices X and Y respectively. We therefore estimate again equation 4.4 as;

$$Y = X\theta + X_y \delta_n + \varepsilon \quad (4.6)$$

θ , δ , and γ is derived by the least-squares estimator $(\theta, \delta, \hat{\gamma})$. This derivation therefore reduces the sum of squares errors in equation 6 as;

$$SSE_n (\theta, \delta, \gamma) = (Y - X\theta - X_y \delta_n)' (Y - X\theta - X_y \delta_n) \quad (4.7)$$

The threshold test is therefore restricted to be a bounded set $[\underline{\gamma}, \bar{\gamma}] = \psi$ in the minimization process. This study therefore employ the concentration approach application to evaluate the least square estimate $(\theta, \delta, \hat{\gamma})$ where $\hat{\gamma}$ minimizes $SSE_n(\hat{\gamma})$ which is uniquely determined as;

$$\hat{\gamma} = \frac{\underset{\gamma \in \psi}{\operatorname{argmin}} SSE_n(\gamma)}{\gamma \in \psi} \quad (4.8)$$

Where $\bar{\psi} = \bar{\psi}_n \{ \delta_1, \delta_2, \dots, \delta_n \}$ the slopes are estimated as $\hat{\theta} = \hat{\theta}(\hat{\gamma})$ and $\hat{\delta} = \hat{\delta}(\hat{\gamma})$ the likelihood ratio test is therefore employed by this study, we therefore test the hypothesis

$H_0 : \gamma = \gamma_0$ applying the likelihood test ratio

$$LR_n(\gamma) = \frac{SSE_n(\gamma) - SSE_n(\hat{\gamma})}{SSE_n(\hat{\gamma})} \quad (4.9)$$

The null hypothesis was rejected for large values of $LR_n(\gamma_0)$, the reliability of the threshold was mainly determined by the values of the confidence interval. Its determination is by employing the Wald or 't' test statistics. Hansen (2000) posits that asymptotic sampling distribution depends on unknown estimators. The Wald statistics may not be an adequate determinant because it has finite sample performance, which is likely to exacerbate if the parameter has a region with a failed identification. Therefore, we resort to Hansen's (2000) newly developed threshold technique to mitigate this problem. An asymptotic confidence level (c) for Υ employing the $LR_n(\Upsilon)$ set at $\hat{\psi} = \{ \Upsilon : LR_n(\Upsilon) \leq C \}$

One of the preconditions of Hansen's (2000) threshold regression estimate is that the variables under study should be stationary. Therefore, we determine the order of integration of the variables using Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), ADF-Fisher chi-square, and PP-Fisher chi-square.

4.4.2 Data, samples, and preliminary analysis

In this study, we utilized three ECOWAS member states (Ghana, Côte d'Ivoire, and Nigeria) for the period 2000-2020 for the analysis due to the availability of consistent data for these countries. These countries are chosen because they have the most developed stock markets in West Africa and are considered the frontier markets in the sub-region. The annual data were sourced from the World Bank's World Development Indicators. We employed stock market capitalization (MC), stock turnover ratio (STO), and stock traded value (TVL) to represent stock market development, and per capita gross domestic product (GDP) to represent economic growth as used by Ibrahim and Alagidede (2018), and Alagidede et al. (2018). Following King and Levine (1993), and Demetriades and Hussein (1996), we also introduce some control variables. These are inflation (INF), the ratio of foreign direct investment (FDI) to GDP, and domestic credit to the private sector. The inclusion of domestic credit to the private sector measures the overall relationship between financial development and economic growth.

We employed Principal Component Analysis (PCA) to develop one index to represent institutional quality (IQ) from the six indicators gleaned from the World Governors' Indicators (WGI), which is shown in Appendix 1.

4.4.2.1 Descriptive statistics

This section discusses the summary statistics of the variables involved in investigating the relationship between stock market development and economic growth in ECOWAS. Table 4.0 presents the statistics. From Table 4.0, it can be observed that all variables have positive average values. The summary statistics indicate that among the ECOWAS sub-regions, domestic credit to the private sector has the highest mean value (13.03), while stock traded value has the lowest (0.728). GDP has a mean of 2.31 with the highest value of 3.00 and the lowest value of -7.60.

This means that the contributions of GDP to economic growth among the ECOWAS member countries are not encouraging. Market capitalization has a mean value of 12.13% of GDP, with the highest/lowest values of 30.80% and 2.48% respectively. This shows that in the sub-region, the stock market is still in its infancy since market capitalization is relatively small. The stock turn over ratio has a mean value of 6.90%, with a maximum of 34.78% and minimum of 0.35%. Inflation has a mean value of 10.15%, which means that it is difficult to achieve single-digit inflation, which is one of the conditions for the introduction of a single currency.

This justifies the reason for exploring the introduction of the 'ECO' from an ex-post perspective. Foreign direct investment in the sub-region is relatively low; the mean value recorded for FDI is 2.55%, with a maximum value of 9.46% and a minimum value of 0.19%. Domestic credit to the private sector (DCPS) is 13.03%, which indicates that the private sector has been regarded as the engine of growth in West Africa.

The mean value of 13.03% for domestic credit to the private sector is relatively high, with a maximum value of 21.13% and a minimum value of 8.08% whereas the institutional quality variable has a mean of 1.4% with a maximum value of 3.5% and a minimum value of -3.2%. This implies that the institutional structures in the sub-region are relatively weak. In other words, institutional structures are not as robust as they are in the developed countries. Based on the standard deviation, inflation is the most volatile (8.40%), while the total value traded on the stock market is the least volatile (0.98%).

In addition, the results indicate that, with the exception of GDP, all the variables have positive skewness. Furthermore, with the exception of GDP and domestic credit to the private sector,

which have a normal distribution, all other series failed to conform to the Gaussian distribution.

In general, data are not normally distributed based on skewness and kurtosis.

Table 4.0: Basic statistics of the variables under study

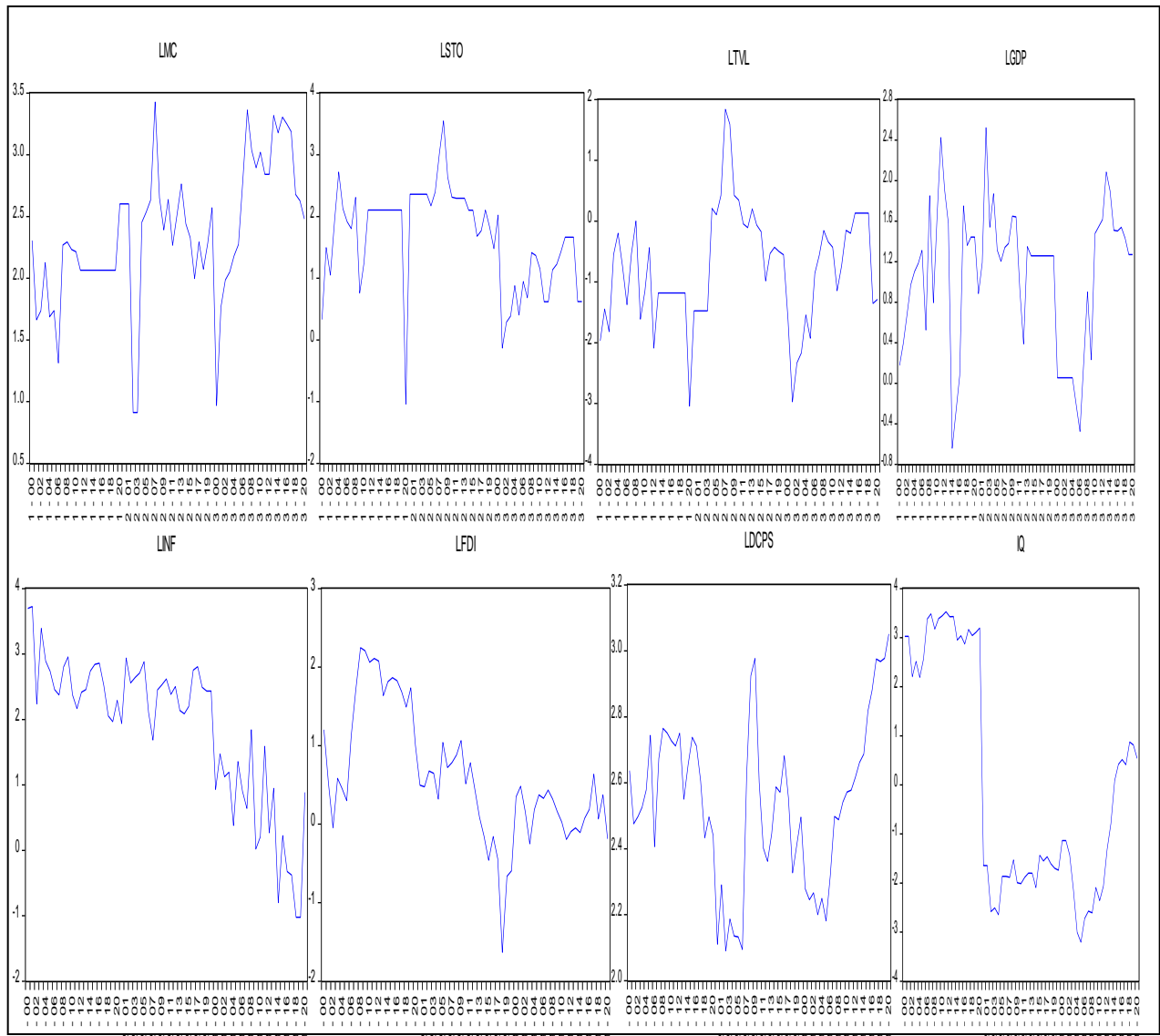
	GDP	MC	STO	TVL	INF	FDI	DCPS	IQ
Mean	2.310	12.135	6.901	0.728	10.158	2.557	13.035	1.43
Median	3.008	9.918	6.789	0.479	9.887	1.568	12.852	-1.312
Maximum	12.457	30.800	34.785	6.298	41.509	9.466	21.136	3.529
Minimum	-7.601	2.488	0.353	0.047	-1.106	0.195	8.084	-3.207
Std.Dev	3.783	6.663	5.301	0.982	8.407	2.349	3.196	2.352
Skewness	-0.267	1.112	2.526	4.196	1.574	1.547	0.535	0.390
Kurtosis	3.735	3.695	13.689	22.467	6.805	4.262	2.827	1.466
Jarque-Bera	2.170	14.260	366.930	1179.680	64.047	29.317	3.091	7.768
Probability	0.337	0.000	0.000	0.000	0.000	0.000	0.213	0.020
Sum	145.559	764.530	434.769	45.909	639.989	161.099	821.252	9.00
Sum Sq.Dev	887.646	2752.741	1742.257	59.811	4382.071	342.107	633.511	343.109
Observation	63	63	63	63	63	63	63	63

Note: GDP, gross domestic product; MC, market capitalization; STO, stock turnover ratio; TVL, total value of stocks traded; INF, inflation; FDI, foreign direct investment; DCPS, domestic credit to the private sector; IQ, institutional quality.

4.4.2.2 Graphical representation of levels variables

According to Hansen (2000), one of the assumptions of this technique is that the variables employed in the model should be stationary. In this study, we utilized the Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), ADF-Fisher chi-square, and PP-Fisher chi-square to test for the stationarity or otherwise of the variables in the model. The null hypothesis under LLC, IPS, ADF-Fisher chi-square, and PP-Fisher chi-square is that the series contains a unit root against the alternative hypothesis that the series are stationary.

Before undertaking the unit root test to ascertain the order of integration of the variables, the study first present a graphical representation of the variables in their level forms. This is exhibited in Figure 4.0 which portrays non-normality by visual inspection. Formal tests of normality are provided in Table 4.1 to give further clarity to the visual inspections at their level forms.



Figures 4.1: Graphical representation of the variables in their level forms

4.4.2.3 Stationarity test results

The Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), ADF-Fisher chi-square, and PP-Fisher chi-square unit root test results are presented in Table 4.1. We utilized the panel unit root tests to examine the stationarity properties of the variables because the weakness or the limitation of one is duly compensated for by the other. The null hypothesis of the presence of unit roots in GDP per capita, stock turnover ratio, stock traded value, foreign direct investment, and domestic credit

to the private sector variables cannot be rejected by using the Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), ADF-Fisher chi-square, and PP-Fisher chi-square at levels with intercepts only and with intercepts and trends. This indicates that at the 5 percent significance level, all the variables are not stationary at levels except for market capitalization and inflation, which are stationary at levels. This makes it possible for all the other variables, with the exception of market capitalization and inflation, to be differenced to make the variables stationary. However, when all the variables are differenced once, they become stationary. This is manifested by a p-value of less than 5%. These results, confirm that GDP per capita, stock turnover ratio, stock traded value, foreign direct investment and domestic credit to the private sector variables are I (1) variables, unlike the other two variables, market capitalization and inflation.

Table 4.1: Stationarity test

Variables	levels		First difference	
	Intercept	With trend	Intercept	With trend
LLC				
GDP per capita	-0.932(0.1755)	-0.424(0.3357)	-7.444(0.0000)**	-4.428(0.0000)**
MC	-4.967(0.0000)**	-4.589(0.0000)**	-5.365(0.0000)**	-4.274(0.0000)**
STO	-0.231(0.4085)	3.146(0.9992)	-7.284(0.0000)**	-6.626(0.0000)**
TVL	-0.75642(0.2247)	0.06002(0.5239)	-5.553(0.0000)**	-5.423(0.0000)**
INF	-3.411(0.0003)**	-3.469(0.0003)**	-2.420(0.0078)**	1.288(0.9013)**
FDI	-0.617(0.2683)	-0.305(0.3800)	-2.975(0.0015)**	-4.798(0.0000)**
DCPS	0.475(0.6827)	-0.660(0.2545)	-6.322(0.0000)**	-4.453(0.0000)**
IQ	0.666(0.7475)	-0.578(0.2815)	-5.006(0.0000)**	-4.340(0.0000)**
IPS				
GDP per capita	-1.607(0.0540)	-1.385(0.0829)	-7.030(0.0000)**	-4.984(0.0000)**
MC	-5.126(0.0000)**	-3.887(0.0001)**	-6.044(0.0000)**	-4.436(0.0000)**
STO	-1.841(0.0328)	-0.652(0.2572)	-6.570(0.0000)**	-5.901(0.0000)**
TVL	-1.386(0.0829)	0.138(0.5551)	-6.112(0.0000)**	-6.330(0.0000)**
INF	-3.684(0.0001)**	-4.076(0.0003)**	-4.616(0.0000)**	-2.669(0.0038)**
FDI	-0.620(0.2675)	-0.212(0.4160)	-3.937(0.0000)**	-5.250(0.0000)**
DCPS	-0.028(0.4885)	-1.532(0.0627)	-4.961(0.0000)**	-4.119(0.0000)**
IQ	-0.059(0.4764)	-0.888(0.1871)	-4.925(0.0000)**	-3.797(0.0001)**
ADF^{Fisher chi-square}				
GDP per capita	12.211(0.0574)	11.381(0.0773)	46.379(0.0000)**	30.954(0.0000)**
MC	33.362(0.0000)**	24.871(0.0004)**	40.511(0.0000)**	28.173(0.0001)**
STO	13.826(0.0316)	6.466(0.3730)	43.688(0.0000)**	35.154(0.0000)**
TVL	10.771(0.0957)	4.840(0.5644)	40.193(0.0000)**	38.180(0.0000)**
INF	24.153(0.0005)**	26.030(0.0002)**	30.741(0.0000)**	16.601(0.0109)**
FDI	7.817(0.2518)	6.643(0.3551)	25.931(0.0002)**	31.830(0.0000)**
DCPS	8.387(0.2111)	10.867(0.0926)	33.612(0.0000)**	25.314(0.0003)**
IQ	6.803(0.3394)	8.425(0.2086)	32.351(0.0000)**	23.713(0.0006)

ppFisher chi-square				
GDP per capita	14.580(0.0238)	11.590(0.0717)	56.815(0.0000)**	41.517(0.0000)**
MC	19.939(0.0028)**	11.770(0.0673)	52.481(0.0000)**	49.395(0.0000)**
STO	13.849(0.0314)	11.310(0.0792)	41.637(0.0000)**	38.477(0.0000)**
TVL	10.446(0.1071)	4.921(0.5539)	46.378(0.0000)**	50.571(0.0000)**
INF	23.099(0.0008)**	27.338(0.0001)**	328.162(0.0000)**	64.169(0.0000)**
FDI	7.337(0.2908)	6.379(0.3821)	45.511(0.0000)**	43.974(0.0000)**
DCPS	7.195(0.3032)	7.418(0.2839)	41.823(0.0000)**	31.970(0.0000)**
IQ	7.263(0.2972)	8.408(0.2097)	32.400(0.0000)**	23.851(0.0006)**

*Note: GDP, gross domestic product; MC, market capitalization; STO, stock turnover ratio; TVL, stock traded value; INF, inflation; FDI, foreign direct investment; DCPS, domestic credit to the private sector. P-values are in parentheses. . ** indicate rejection at the 5% significance level*

4.4.2.4 Correlation analysis

Correlation analysis mitigates the problems of multicollinearity and endogeneity (when the independent variables themselves affect each other) associated with a number of econometric models. Therefore, this study conducted a correlation analysis to critically examine the magnitude, strength, and nature of co-movements between and among stock market development and economic growth variables in the ECOWAS sub-region. Correlation coefficients can take any value from +1 to -1, with the sign of the coefficient indicating the direction of the relationship between the variables used to establish the relationship between stock market development and economic growth. A positive coefficient implies that the variables move in the same direction whereas a negative coefficient indicates the movement of variables in opposite directions (Stead, 2007). Table 4.2 presents the empirical correlation matrix between stock market development and economic growth indicators in the ECOWAS sub-region from 2000-2020.

Table 4.2: Correlation Matrix

Variables	1	2	3	4	5	6	7	8
1	1							
2	0.122 (0.3369)	1						
3	0.308 (0.0139)	-0.146 (0.2504)	1					
4	0.359 (0.0038)	0.515 (0.0000)	0.645 (0.0000)	1				
5	-0.020 (0.8758)	-0.497 (0.0000)	0.372 (0.0026)	-0.094 (0.4633)	1			
6	0.012 (0.9219)	-0.216 (0.0886)	0.191 (0.1326)	-0.137 (0.2839)	0.343 (0.0059)	1		
7	0.243 (0.0543)	0.340 (0.0063)	0.037 (0.7712)	0.305 (0.0149)	-0.249 (0.0488)	0.198 (0.1194)	1	
8	0.069 (0.5884)	-0.270 (0.0320)	-0.011 (0.9285)	-0.276 (0.0284)	0.276 (0.0283)	0.669 (0.0000)	0.442 (0.0003)	1

Note: 1 represents GDP; GDP per capita, 2 represents MC; market capitalisation; 3 represents STO; stock turnover ratio, 4 represents TVL; stock traded value; 5 represents INF; inflation, 6 represents FDI; foreign direct investment, 7 represents DCPS; domestic credit to the private sector, 8 represents IQ; institutional quality. P-values are in parentheses. All variables in their natural logarithm form

As shown in Table 4.2, GDP correlates significantly and positively with the stock turnover ratio and stock traded value in the ECOWAS sub-region. GDP has a positive but insignificant relationship with market capitalization, foreign direct investment and domestic credit to the private sector. However, it had a negative and insignificant relationship with inflation. Market capitalization, stock turnover ratio, and stock traded value, which represent stock market development, have a positive and significant relationship with domestic credit to the private sector, which is used as proxy for financial development. However, the impact of the stock turnover ratio on domestic credit to the private sector is not significant in the ECOWAS region. These results indicate a positive correlation between banking sector development and stock market development indicators. This can be explained by the positive coefficients found in co-movements between market capitalization (MCAP) with a coefficient value of 0.34 (0.0063),

stock traded value of 0.30 (0.0149) and banking credit to the private sector. Therefore these results validate the findings of Dermiguc-Kunt and Levine (1999) and Levine and Zervos (1998), who postulated that stock market development measures were positively correlated with banking sector development measures. There is a negative and insignificant correlation between GDP and inflation. There is a negative and statistically significant relationship between market capitalization (MC), stock traded value (TVL) and institutional quality (IQ) with coefficients of -0.270 (0.0320) and -0.276 (0.0284) respectively. Stock turnover ratio (STO) also has a negative correlation with IQ, albeit with an insignificant P-value. This shows that stock market development is affected by institutional quality within the sub-region. Inflation, foreign direct investment and domestic credit to the private sector have positive and statistically significant correlations with institutional quality (IQ) with coefficients of 0.276 (0.0283), 0.009 (0.0000), and 0.442 (0.0003) respectively. This shows that when institutional quality is good, FDI and financial institutions thrive in the sub region. Since most of the correlation coefficients were at most 66%, it can be confirmed that no multicollinearity existed between or among the variables used to establish the relationship between stock market development and economic growth in ECOWAS. P-values are reported in the parentheses.

4.4.2.5 Cross-section independence test

In this study, since we employed three countries (Ghana, Nigeria and Cote d'Ivoire), we tested for cross sectional dependence in our data generating process to ascertain whether there was any cross sectional dependence. Pesaran (2004) suggests that when dealing with panel cross-sectional dataset, it is important to conduct cross-sectional dependence test. Pesaran argued that, in order to avoid spurious outcome from the estimations, it is pertinent to conduct cross-sectional dependence test prior to estimation analysis. Pesaran suggest the cross section in the panel data is

independent to allow for consistent coefficient estimates. The type of test is dependent on the ratio between the time series observations (T) and the cross-sectional units (N). Since our study includes 21 years' time period (T) and 15 cross-sectional units (N), the study adopted the Breusch-Pagan LM test, the Pesaran scaled LM, and the Pesaran CD test. The null hypothesis of these tests is that, there is no cross-sectional dependence in the residuals. Our evidence suggests that, since the P-values are higher than 5% level of significance, we accept the null hypothesis of no cross-sectional dependence. This means that the data generating process is free from cross-sectional dependence.

Table 4.3: Cross-sectional Dependence Test

Test	Test Statistic	d.f	Probability
Breusch-Pagan LM	3.030273	3	0.3870
Pesaran scaled LM	0.012359		0.9901
Pesaran CD	-0.727444		0.4670

4.4.2.6 Pedroni cointegration test

In this study, we utilized the Pedroni cointegration test to assess whether there is a long run relationship among the variables used to determine the relationship between stock market development and economic growth in the ECOWAS region. This study used the Kao residual cointegration test as a robustness check for the cointegration test. However, we did so by taking into consideration that, under the Pedroni cointegration test, all variables must be integrated of order one, that is, $I(1)$ variables. Therefore this study thus excludes the variables that were not integrated of order one which is market capitalization, and inflation. These variables were integrated at levels. We employed EViews to perform the Pedroni cointegration test; this led to eleven panel statistic being generated. In addition, the lag length selection for the Pedroni

cointegration tests was automatic based on the Schwarz Information Criteria (SIC) and the Newey-West automatic bandwidth selection and Bartlett kernel were employed.

Table 4.4: Panel cointegration tests results

Tests	Statistics	Prob.	Weighted statistic	Prob.
Within dimension				
Panel v-Statistic	-1.875780	0.9697	-2.114296	0.9828
Panel rho-Statistic	-0.157902	0.4373	-0.311060	0.3779
Panel PP-Statistic	-3.994455	0.0000**	-4.696631	0.0000**
Panel-ADF-Statistic	-3.913042	0.0000**	-4.544897	0.0000**
Between dimension				
Group rho-Statistic	0.420068	0.6628		
Group PP-Statistic	-4.820813	0.0000**		
Group-ADF-Statistic	-4.439142	0.0000**		
Kao Residual Cointegration test				
ADF	-1.794265	0.0364**		

Note: ** indicates 5% significance level.

Results from Pedroni tests shows that, there is a sign of cointegration between economic growth and the variables used to represent stock market development when we assume common autoregressive coefficients. However, the Panel-v test and Panel rho-statistics shows no level of cointegration among the variables. When individual autoregressive coefficients are assumed, only the Group-rho test shows no evidence of cointegration among economic growth and the stock market development indicators. The Group PP-statistics and the Group ADF-statistics shows evidence of cointegration between economic growth and the regressors. Hence, the Pedroni test shows that there is cointegration between economic growth and the variables that are used to proxy for stock market development. The Kao test also reveals that, there is a long run

relationship between the variables given the lower P-value. Thus, our results generally show evidence of cointegration among economic growth and its associated covariates.

4.5 Results and discussion

4.5.1 Threshold estimation results

This section discusses the results of the relationship between stock market development and economic growth when the institutional quality index is the threshold variable. First, we attempt to establish the statistical significance of the threshold estimate through the P-value by employing the bootstrap method with 5000 replications and 15 percent trimming. The results of the threshold model are displayed in Table 4.5. We find the threshold in the model estimated because the bootstrap p-value indicates that the p-value is statistically significant at any conventional level of significance (0.0018). This means that we are unable to rely on the global OLS estimator, which we use as a comparator in Table 4 because of the existence of asymmetry.

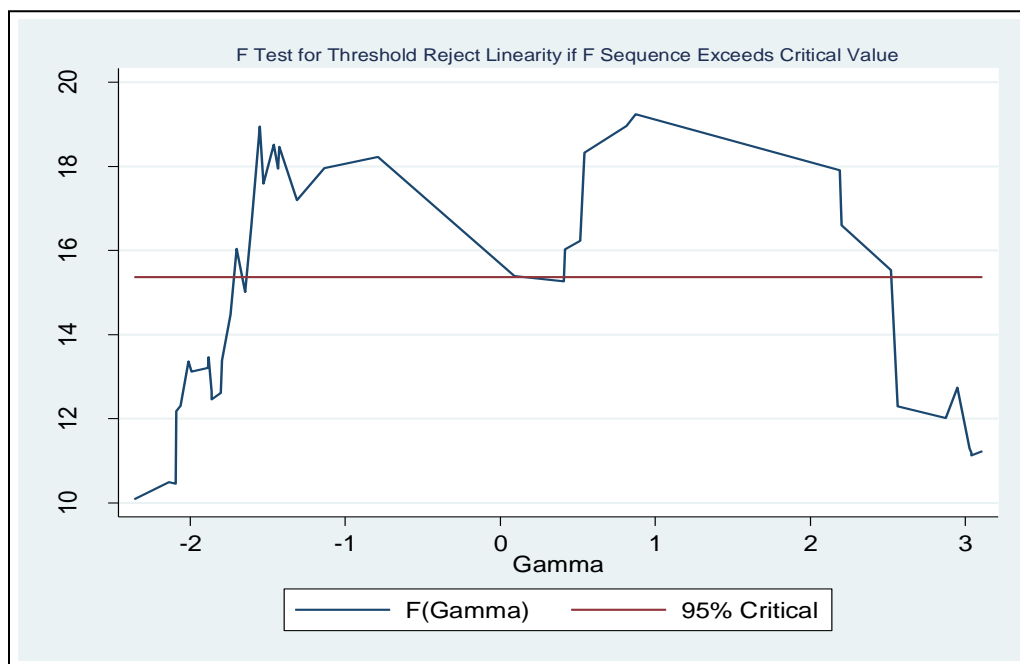


Figure 4.2: F Test for the existence of a threshold (Institutional Quality Index)

Source: Figure generated from Stata 14

Figure 4.2 provides a graphical representation of the F-test for the existence of a threshold in a model. In the Figure, the F-statistics cross the critical line in the model, which indicates the existence of a threshold in the model. We can ascertain that there are discontinuities in the relationship between stock market development and economic growth in the ECOWAS sub region when the institutional quality index is the threshold variable.

Table 4.5: Results of the threshold regression when Institutional Quality Index is the threshold variable (dependent variable- GDP)

VARIABLES	Linear model	Threshold model	
	OLS without threshold	Regime 1 INS<-2.092	Regime 2 INS>-2.092
Constant	-0.363 (1.740)	-90.943 (36.647)**	-0.389 (1.606)
MC	-0.340 (0.268)	-21.357 (8.702)**	0.343 (0.020)***
STO	0.173 (0.202)	-21.011 (8.247)**	0.280 (0.109)**
TVL	0.134 (0.193)	-20.095 (8.154)**	0.311 (0.120)**
INF	-0.020 (0.087)	0.077 (0.181)	-0.046 (0.067)
FDI	-0.029 (0.095)	-1.863 (0.841)**	0.016 (0.096)
DCPS	0.548 (0.358)*	-2.206 (1.441)*	1.620 (1.010)**
R-squared	0.169	0.806	0.247
No of observations	63	12	51
Heteroskedasticity Test (P-Value):	0.117		
Bootstrap P-value	0.0018		
95%-Confidence interval for threshold	[-2.36113811,3.16721511]		

Notes: MC = market capitalisation; STO = stock turnover ratio; TVL= stocks traded value; INF=inflation; FDI= foreign direct investment; DCPS= domestic credit to the private sector; OLS= ordinary least squares; the standard errors are reported in parentheses (Whitecorrected for heteroskedasticity). Results correspond to trimming percentage of 15. *** Significance at the 1 percent level; ** significance at the 5 percent level, *Significance at the 10 percent level.

From Table 4.5, the point estimate of the threshold value of institutional quality for the three countries under study is -2.092, with a corresponding 95 percent confidence interval [-2.36113811, 3.16721511] for the West African region. This implies that when the region has a threshold value less than -2.092, the region is classified as having weak institutions and therefore categorized into the low institutional quality regime, while values greater than -2.092 are classified as having a high institutional quality regime. First, we discuss the threshold model, which uses the overall level of economic growth as a dependent variable, as demonstrated in Figure 4.2 and reported in Table 4.5. The dictate of this model is that any improvement towards the institutional structures in the region would enable the development of the stock market to promote growth. Concerning the moderating effect of institutional quality on stock market development and the economic growth nexus, beginning with our variable of interest, we establish that market capitalization (MC), stock turnover ratio (STO), and stock traded value (TVL) have a negative and statistically significant relationship with economic growth when institutional quality is below the threshold variable. The coefficients of market capitalization, stock turnover ratio, and stock traded value with their corresponding standard errors are -21.357(8.702) -21.011(8.247) -20.095 (8.154), respectively, implying that a 1% increase in market capitalization, stock turnover ratio, and stock traded value will reduce GDP by 21.35%, 21.01%, and 20.09%, respectively, below the threshold level. However, when institutional quality is above the threshold, market capitalization {0.343 (0.220)}, stock turnover ratio {0.280 (0.109)}, and stock traded value {0.311 (0.120)} have positive and statistically significant relationships with economic growth. This finding indicates that higher institutional structures in the ECOWAS sub-region can help stock market development to promote economic growth. This

is consistent with McKinnon (1973) and Shaw (1973) financial development theories which posit that financial development enhance growth.

Concerning the other control variables, we find no relationship between inflation and economic growth for both regimes, which is below the threshold level and above the threshold level; however, when the effect on economic growth is positive below the threshold, it has a negative effect above the threshold, albeit insignificant. We establish that below the threshold, FDI has a negative and statistically significant relationship with GDP, but no relationship exists beyond the threshold. This implies that when institutions are weak, a 1% increase in FDI will reduce GDP by 1.86%. This observation can be attributed to weaker regulations on capital flights since, in West Africa; our regulations on capital flights are not strong enough to prevent investors from such activities.

Domestic credit to the private sector, which is used here to gauge the overall effect on financial development, has a negative and statistically significant relationship with GDP when institutional quality is below the threshold; however, it has a strong and positive relationship with economic growth beyond the threshold, that is, a 1% increase in domestic credit to the private sector, increases GDP in the sub-region by 1.62% above the threshold. This implies that good institutions help financial institutions to promote economic growth in the ECOWAS region. The relationship between financial development, which is proxy in this study as domestic credit to the private sector, and economic growth was asserted authoritatively in the theoretical foundation of the financial development model propounded by McKinnon (1973) and Shaw (1973), which states that financial development promotes growth, which invariably accounts for the strong positive relationship between these two variables in the sub-region when better institutional

structures are instituted. We present the graphical presentation of the confidence interval construction of the thresholds in Figure 4.3.

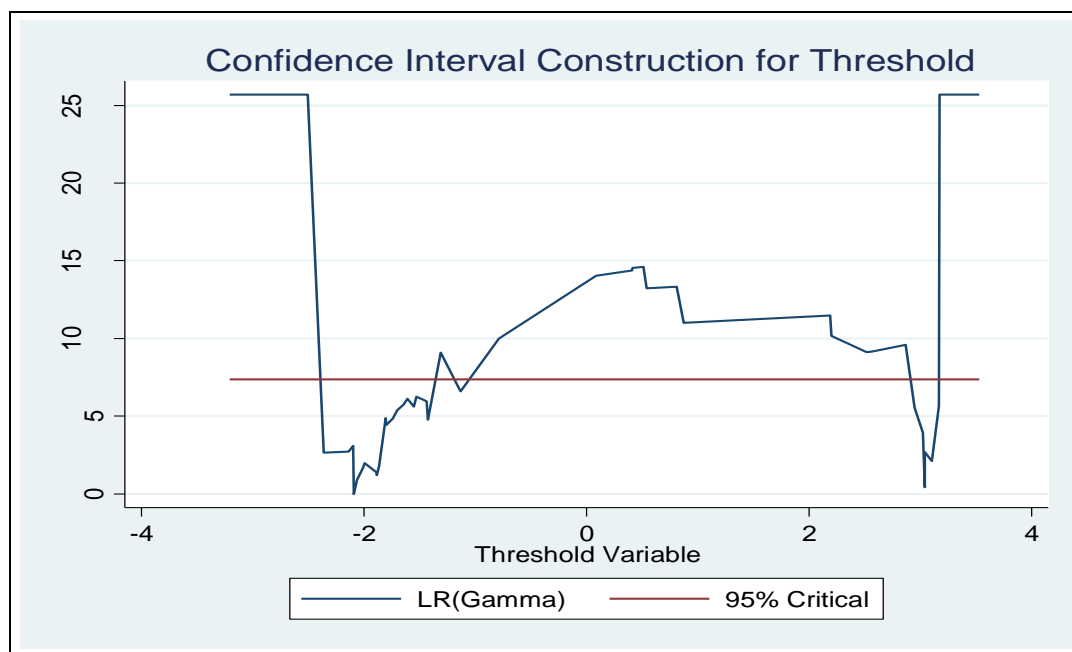


Figure 4.3: Graphical representation of the confidence interval construction of the threshold

Source: Figure 4.3 generated by stata 14

To verify the sensitivity of the estimated threshold value, we disaggregate the institutional quality variables into different dimensions to allow us to study whether some dimensions of institutional quality matter for stock market development to have positive impact on economic growth while others do not. We do so by constructing a stock market development index (SMDI) from the three variables (market capitalisation, stock turnover ratio and stock traded value) used to proxy for stock market development. Our decision to construct a stock market development index is informed by the correlation output since some correlation coefficient of the stock market development variables had 0.66, though not a multicollinearity problem.

The results from the six threshold models are graphically shown in Figure 4.4 below.

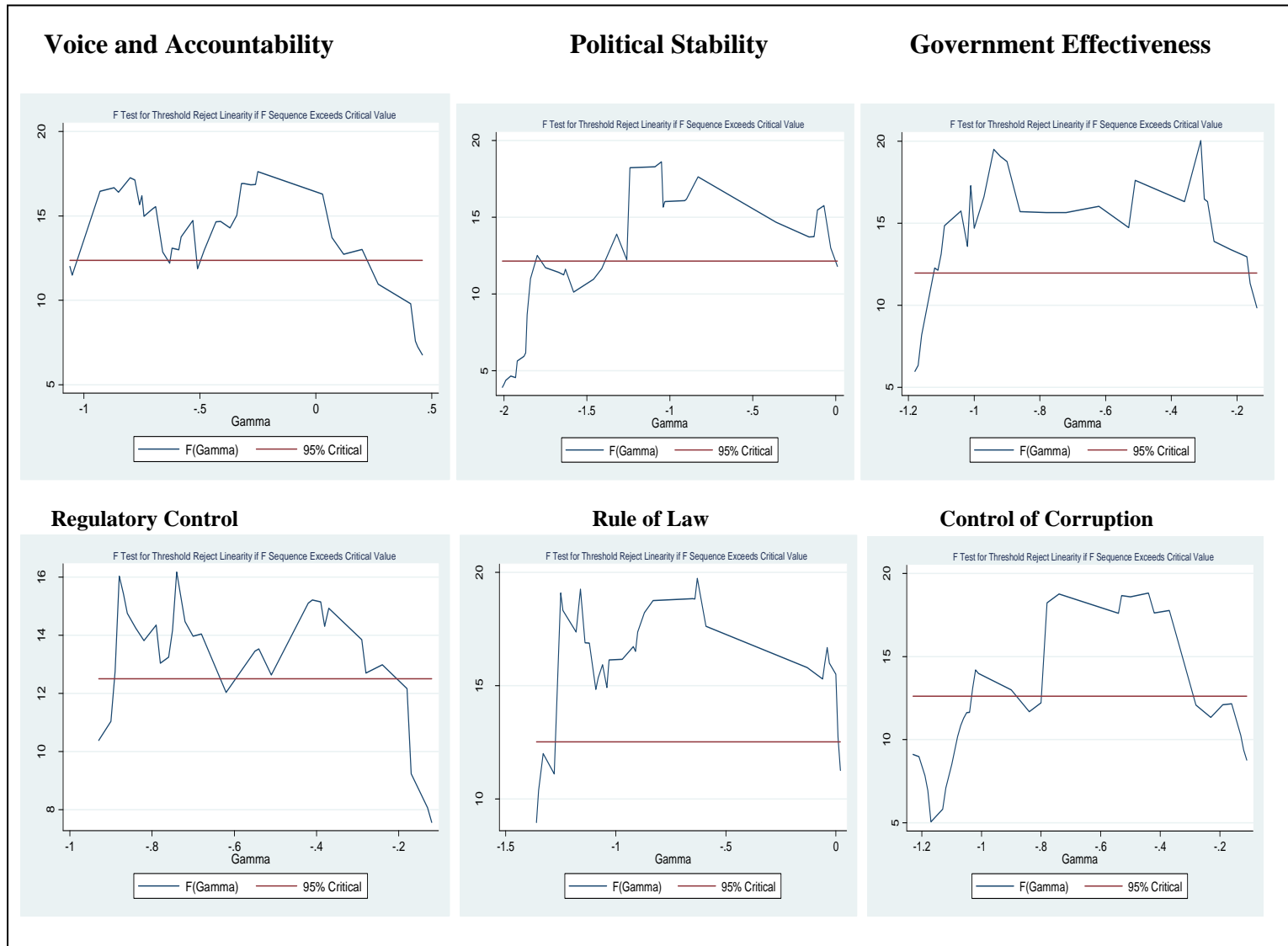


Figure 4.4: F Test for the existence of a threshold (Dimensions of Institutional Quality)

We evaluated the statistical significance of the threshold estimate by using the P-value which is estimated by employing the bootstrap method with 5,000 replications and 15 percent trimming similar to the institutional quality index procedure. As shown in all models, the bootstrap P-values indicate that the test of no threshold effect can be rejected. We therefore argue that, the sample can be split into two regimes since the F-statistics as shown above cross the critical lines in all the models, which is an indication of the existence of a threshold in the entire model.

The results from the study when institutional quality variables are disaggregated when the stock market development index is constructed are displayed in Table 4.6. First, we discuss the results by dwelling on our variable of interest, which is the stock market development index, and establish that when voice and accountability are the threshold variables, stock market development has a negative and significant relationship with economic growth below the threshold level. This means that when voice and accountability are weak in the region, it hinders how the stock market impacts growth. However, beyond the estimated threshold, the effect disappears. In other words, beyond this threshold, the relationship between stock market development and economic growth is insignificant. Concentrating on political stability as our threshold variable, we realized that below the threshold, stock market development has no relationship with economic growth, whereas it has a positive and significant relationship with growth beyond the threshold. This means that political stability in the sub-region is a necessary condition for member countries to benefit from finance-enhancing growth relationships. This is because according to Öhler and Nunnenkamp (2014), when there is stronger political stability and higher government effectiveness, countries are likely to receive a higher share of World Bank funds. We find a positive and significant relationship between stock market development and economic growth when government effectiveness is below the threshold level in the

ECOWAS sub-region but no relationship beyond the threshold. This finding is consistent with the financial repression theory championed by Okpara (2010), Darrat and Siowadi (2010), and Esso (2010) who argued that too much government intervention can prevent efficient capital allocation, which can negatively affect economic growth. It is, therefore, not a surprise to witness no relationship beyond the threshold but a 1% positive significance when government effectiveness is not very strong.

When regulatory control is the threshold variable, stock market development has a positive and significant relationship with economic growth below the threshold, although this significance dissipates flatly with time since it is significant at the 5% level. However, when regulatory control is above this threshold, it has a negative and significant effect on growth. This finding is consistent with McKinnon and Shaw's (1973) financial liberalization theory, which posits that excessive regulation and control hinders the stock market from having a positive impact on growth. When the rule of law is the threshold variable, stock market development has a positive and significant relationship with economic growth below the threshold at the 10% significance level. Again in regime 2 which is above the threshold, stock market development has a positive and significant relationship with growth at the 5% significance level. This indicates that although both regimes experienced a positive effect on growth, regime 2, which is beyond the threshold, has a greater effect on growth. Therefore, when the rule of law is high, it helps the stock market to influence growth. This finding is consistent with Cherif and Dreger (2016), and Aluko and Ibrahim (2020) who postulates that rule of law is a significant determinant on how stock market influences growth.

We find strong and negative significance at 1% below the threshold level when control of corruption is the threshold variable in the sub-region. Specifically, when corruption control is

below the threshold, a 1% increase in stock market development decreases GDP by 0.23% while above the threshold, whereas stock market development has no relationship with GDP. This finding indicates that corruption hinders economic growth. This finding is supported by Khan et al. (2020) who revealed in their study that corruption control is important in this relationship.

Table 4.6.I: Results of the threshold regression when disaggregated Institutional Quality is the threshold variable (dependent variable-GDP)

Variables	VOICE AND ACCOUNTABILITY			POLITICAL STABILITY			GOVERNMENT EFFECTIVENESS		
	Linear model	Threshold model		Linear model	Threshold model		Linear model	Threshold model	
	OLS without threshold	Regime 1 INS< -0.930	Regime 2 INS>- 0.930	OLS without threshold	Regime 1 INS< - 0.029	Regime 2 INS> - 0.029	OLS without threshold	Regime 1 INS< - 0.219	Regime 2 INS> - 0.219
Constant	-0.182 (1.006)	-9.594 (1.934)***	3.117 (1.055)***	-0.182 (1.006)	0.268 (1.024)	1.900 (1.986)	-0.182 (1.006)	0.341 (1.009)	6.674 (1.947)***
SMDI	0.169 (0.053)***	-0.135 (0.077)**	0.063 (0.047)	0.169 (0.053)***	0.100 (0.084)	0.254 (0.046)***	0.169 (0.053)***	0.232 (0.055)***	0.080 (0.114)
INF	0.025 (0.064)	0.252 (0.171)*	-0.221 (0.057)***	0.025 (0.064)	0.023 (0.061)	-0.802 (0.336)**	0.025 (0.064)	0.026 (0.067)	-0.659 (0.158)***
FDI	-0.013 (0.099)	-0.802 (0.221)***	0.038 (0.095)	-0.013 (0.099)	-0.297 (0.126)**	0.089 (0.139)	-0.013 (0.099)	-0.314 (0.137)**	0.652 (0.141)***
DCPS	0.480 (0.361)*	4.101 (0.819)***	-0.561 (0.371)*	0.480 (0.361)*	0.303 (0.374)	0.591 (0.610)	0.480 (0.361)*	0.280 (0.365)	1.749 (0.829)**
R-squared	0.155	0.802	0.157	0.155	0.319	0.618	0.155	0.285	0.652
No of observation	63	12	51	63	51	12	63	50	13
Heteroskedasticity Test (P-Value):	0.0101			0.363			0.201		
Bootstrap P-value	0.002			0.000			0.000		
95%-Confidence interval for threshold	[-.930000007,-.930000007]			[-1.86000001,.039999999]			[-1.159999997,-.159999996]		

Notes: SMDI = stock market development index; INF=inflation; FDI= foreign direct investment; DCPS= domestic credit to the private sector; OLS= ordinary least squares; the standard errors are reported in parentheses (Whitecorrected for heteroskedasticity). Results correspond to trimming percentage of 15. *** Significance at the 1 percent level; ** significance at the 5 percent level, *Significance at the 10 percent level

Table 4.6.II: Results of the threshold regression when disaggregated Institutional Quality is the threshold variable (dependent variable-GDP)

Variables	REGULATORY CONTROL			RULE OF LAW			CONTROL OF CORRUPTION		
	Linear model	Threshold model		Linear model	Threshold model		Linear model	Threshold model	
	OLS without threshold	Regime 1 INS< -0.109	Regime 2 INS> -0.109	OLS without threshold	Regime 1 INS< -1.25	Regime 2 INS>-1.25	OLS without threshold	Regime 1 INS< -0.159	Regime 2 INS> -0.159
Constant	-0.182 (1.006)	-0.841 (0.996)	9.201 (6.997)*	-0.182 (1.006)	-2.916 (2.157)*	1.636 (0.731)**	-0.182 (1.006)	0.059 (1.020)	1.245 (6.269)
SMDI	0.169 (0.053)***	0.131 (0.057)**	-1.263 (0.514)**	0.169 (0.053)***	0.101 (0.070)*	0.079 (0.047)**	0.169 (0.053)***	-0.229 (0.052)***	0.030 (0.149)
INF	0.025 (0.064)	0.107 (0.068)*	-3.862 (0.960)***	0.025 (0.064)	0.932 (0.181)**	-0.184 (0.048)***	0.025 (0.064)	0.045 (0.064)	-0.719 (0.596)
FDI	-0.013 (0.099)	-0.040 (0.093)	-2.180 (1.332)*	-0.013 (0.099)	-0.362 (0.314)	0.015 (0.097)	-0.013 (0.099)	-0.356 (0.149)**	0.203 (1.158)
DCPS	0.480 (0.361)*	0.701 (0.356)**	2.046 (4.133)	0.480 (0.361)*	1.038 (0.856)	-0.034 (0.260)	0.480 (0.361)*	0.379 (0.371)	0.618 (3.744)
R-squared	0.155	0.216	0.682	0.155	0.703	0.184	0.155	0.302	0.564
No of observation	63	54	9	63	15	48	63	50	13
Heteroskedasticity Test (P-Value):	0.259			0.0088			0.326		
Bootstrap P-value	0.0022			0.000			0.0002		
95%-Confidence interval for threshold	[-.959999979,-.050000001]			[-1.25,-1.25]			[-1.25,-.119999997]		

Notes: SMDI = stock market development index; INF=inflation; FDI= foreign direct investment; DCPS= domestic credit to the private sector; OLS= ordinary least squares; the standard errors are reported in parentheses (Whitecorrected for heteroskedasticity). Results correspond to trimming percentage of 15. *** Significance at the 1 percent level; ** significance at the 5 percent level, *Significance at the 10 percent level

Dwelling on other control variables, in sub-region, inflation has a positive and significant relationship with GDP below the threshold when voice and accountability, and regulatory control are the threshold variables respectively though this effect dissipates with the passage of time since it is significant at 10%, we however observed that beyond the threshold when voice and accountability, political stability, government effectiveness, and rule of law are the threshold variables respectively, inflation has negative and statistically significant relationship with economic growth albeit no relationship with economic growth when political stability and government effectiveness is below the estimated threshold. This means that a 1% increase in inflation will reduce GDP by 0.22%, 0.80% and 0.65% when voice and accountability, political stability, and government effectiveness are the threshold variables. We further establish that inflation has a positive and significant relationship with growth when the rule of law is below the threshold. However, we found no relationship between stock market development and growth when control of corruption was the threshold variable for inflation. This finding indicates that inflation is detrimental to growth.

Regarding FDI, when voice and accountability, political stability, government effectiveness, and control of corruption are the threshold variables, FDI has a negative and statistically significant relationship with economic growth below the estimated threshold variable. We observed that a 1% increase in FDI reduces GDP by 0.80%, 0.29%, 0.31%, and 0.35% respectively. However, FDI has a strong positive and significant relationship with growth when government effectiveness is above the threshold. This indicates that when government institutions are strong, FDI can have a positive effect on growth. In other words beyond the threshold of government effectiveness, FDI has a significant effect on economic growth at the 1% significance level. However, we find no relationship between FDI and economic growth when the rule of law is the

estimated threshold variable. This indicates that weak institutions hinder the positive effect of FDI on economic growth in the ECOWAS sub-region. Members should institute measures to reap the full benefits of FDI in the sub-region.

The domestic credit to the private sector used in this study as a proxy for financial development has a positive relationship with GDP above the threshold when government effectiveness is the estimated threshold variable; however, it has no relationship below the threshold. We observed that when political stability, the rule of law, and control of corruption are the threshold variables, domestic credit to the private sector has no relationship with growth. When voice and accountability, and regulatory control are the thresholds, domestic credit to the private sector has a positive relationship with growth below the threshold, but no relationship with growth above the estimated threshold. A significant takeaway from domestic credit to the private sector is that when government effectiveness is high, it promotes economic growth.

The linear OLS estimation results indicate that stock market development has a positive and statistically significant relationship with economic growth when voice and accountability, political stability, and government effectiveness, regulatory control, rule of law, and control of corruption are the threshold variables. This result corroborates the correlation test conducted earlier, which indicates an association between stock market development and economic growth in the ECOWAS sub-region. We present a graphical representation of the confidence interval construction of the thresholds in Figure 4.5 for all institutional quality variables.

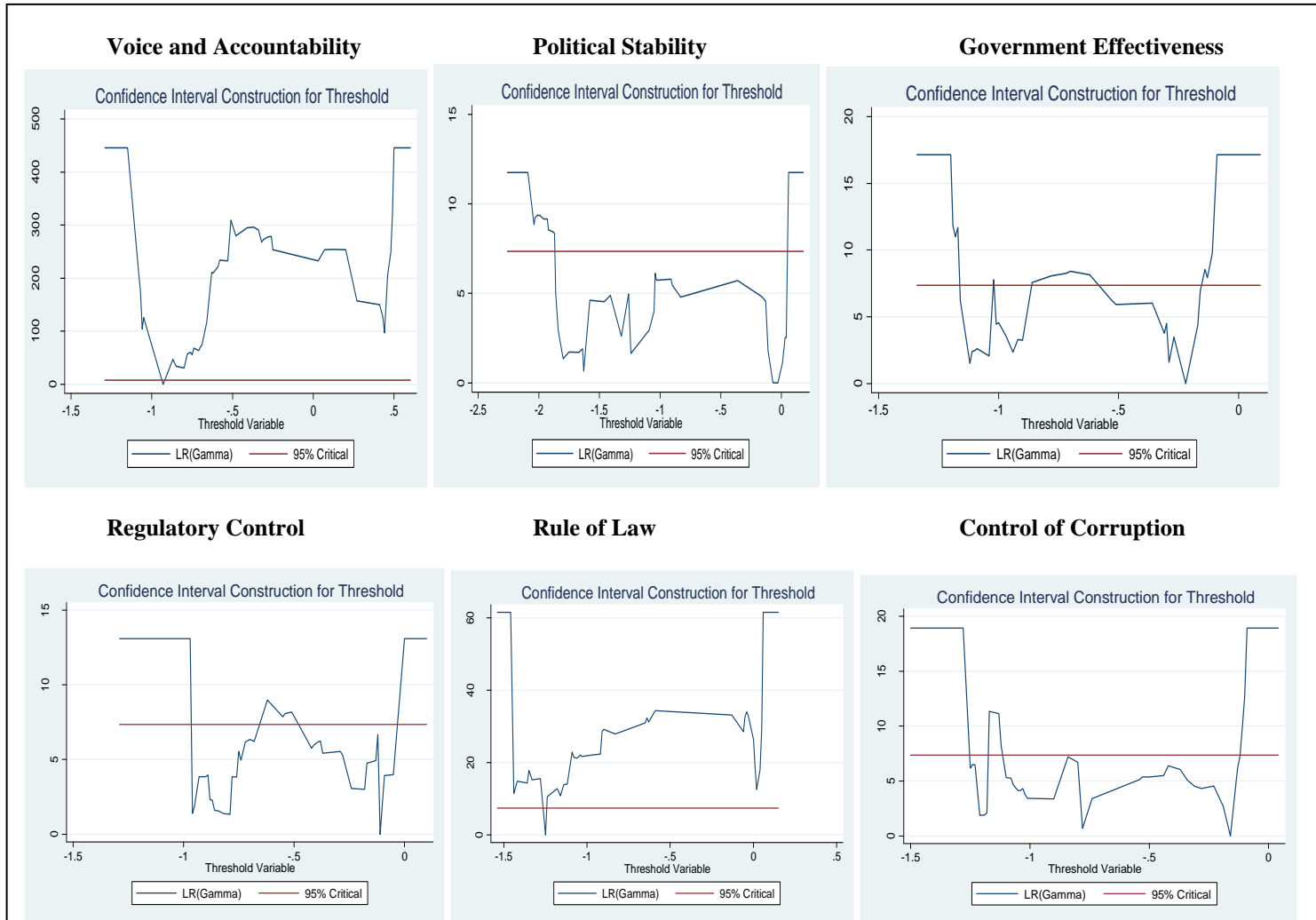


Figure 4.5: Graphical presentation of the confidence interval construction of the thresholds (Dimensions of Institutional Quality)

4.6 Policy imperatives and Conclusion

This study objective was to unravel whether the relationship between stock market development and economic growth in ECOWAS is conditioned on institutional quality. By unravelling this relationship, we set out two objectives from this objective, first to find the relationship between stock market development and economic growth when institutional quality index is the threshold variable in the ECOWAS sub-region, and secondly, to find the overall effect of stock market development index on economic growth when the institutional quality variables are disaggregated to examine whether some have more effect than the others.

In achieving this objective, we utilized the Hansen (2000) threshold regression method which is able to capture the rich dynamics in the relationship between stock market development and economic growth. The empirical results indicate a significant institutional quality threshold in the stock market development and economic growth nexus.

Concerning the study's objective, for institutions below the threshold, stock market development has a negative and significant effect on economic growth. However, stock market development has statistically significant influence on the growth of institutions above the threshold level. These findings suggest that the stock market development and economic growth nexus is contingent on institutional quality. Thus, the quality of the stock market is important for economic growth, and better institutional quality is effective in ensuring the efficiency of stock exchanges in promoting growth. The results also demonstrate that low-quality institutions tend to distort the ability of foreign direct investment (FDI) and domestic credit to the private sector, which is used in this study as a proxy for financial development, to have any positive significant effect on growth. We established that high-quality institutions enhance the ability of domestic credit to the private sector to positively influence growth while inflation is indifferent in the

relationship between stock market development and economic growth when institutions serve as mediating variables. The empirical findings are robust to alternative economic growth and the dimensions of institutional quality variables as well as the estimation technique used in this study. Given these results, we establish that there are discontinuities in the relationship between stock market development and economic growth in the ECOWAS sub-region.

Turning our attention to the second objective, which is stock market development and growth when institutional quality variables are disaggregated whiles stock market development index is created, we find significant discontinuities in the stock market development and growth nexus as well. We established that stock market development has a negative effect on growth when voice and accountability are below the threshold level and a positive and significant effect on growth when political stability is above the threshold level. This indicates that a higher level of political stability is an enabler for stock exchanges to influences growth. However, when government effectiveness is the threshold variable, stock market development has a positive and significant relationship with growth below the threshold, whiles higher regulatory control has a negative effect on how stock market development influences growth. This indicates that excessive government interference inhibits the development of the stock market to have a substantial positive influence on growth. This corroborates McKinnon and Shaw's (1973) financial repression and financial liberalization theories. We establish that when the rule of law is high, it enables the stock market to have a positive and significant effect on growth, whereas a weaker control of corruption has a negative and significant effect on how stock market development influences growth. In general, when institutions are weak, FDI has a negative and significant effect on growth, while too much government effectiveness enables domestic credit to the private sector to influence growth.

As long as the institutional quality variables are below the threshold, it serves as an impediment for financial markets to drive growth in the West African sub-region. This is rightly so because, overall, as countries move beyond the institutional quality threshold, investors may demand for more financial services thereby improving the intermediation of the financial markets which invariably may be an enabler for the financial institutions to impact growth in West Africa.

This narrative supports the call for governments in West Africa to make the stock market more attractive for more organizations to be listed on the stock market to improve on the market capitalisation. This is because the financial market in West Africa is not fully developed. We therefore suggest that policies that promote enabling environment for businesses to operate in the region be implemented to improve the finance–growth relationship.

Another key implication is that the relationship between stock market development and economic growth in the West African sub-region is contemporaneous and that the development of the stock market is relevant in the developmental agenda in the sub-region. Therefore at the policy level, countries in West Africa should design strategies that can improve on the allocation of credit, increasing competition and the implementation of proper regulations that will make it possible for the financial markets to stimulate economic growth as these seem to be important condition to drive growth in the long run.

In specifics, concerning the various constituents of institutional quality, we postulate that disaggregation of institutional quality variables are critical for tailored policies to be made by policy makers in the region. In the area of political stability and higher government effectiveness, member countries should promote democratic principles and also ensure effective accountability from government appointees and state institutions. When this is achieved, it has the tendency for

member countries within the sub-region to receive a higher share of World Bank funds. This argument is supported by Öhler and Nunnenkamp (2014).

Member countries should also institute pragmatic measures to entrench rule of law since a good legal system has the propensity to promote investment in the region. According to Chinn and Ito (2006), when rule of law is not adhered to in the area of contract enforcement and property rights, the incentives for lending can be restricted.

ECOWAS members should institute a flexible but stringent regulatory framework which is investor friendly to attract more investors and FDI into the region since ambiguous and too much regulation hinders the West African economies to enjoy the full potential benefits of stock market developments to record high growth rates.

ECOWAS member countries should intensify control of corruption since it is evidenced in the empirical findings to retard how stock market development influences growth by introducing stiffer penalties in the laws against corruption and thereby helping it to play effective moderating role on the stock market development and growth nexus.

While the stock market development and economic growth relationship is well documented in extant literature, empirical literature is silent on the nonlinearities in stock market development and economic growth relationship caused by the threshold variables in the West African sub-region. Our findings are of crucial importance to heads of ECOWAS states with regard to the optimum level of institutional quality that is needed to vigorously improve the economy through the financial markets. From critical policy decision making, these three leading countries in ECOWAS should make frantic efforts to make their institutions work effectively and become robust, which will allow these economies to reap the full anticipated benefits of stock markets to

induce higher growth. That is, considering that financial systems accelerate economic growth when controlling for corruption, government effectiveness, political stability, rule of law, regulatory quality, voice and accountability are improved, it is recommended that policy makers and governments in ECOWAS institute policy measures geared toward improving the effectiveness and performance of institutions in the sub-region

Future studies can answer the threshold level of IQ concerning the banking sector, lending and economic growth in the West African sub-region. Since the study focuses on ECOWAS region, it would therefore be interesting for future studies to consider a panel approach to explore the moderating role of institutional quality on stock market development and economic growth nexus in Sub-Saharan Africa.

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APPENDIX

APPENDIX 4.1: Definition of institutional quality indicators

Table A: Definition of institutional quality indicators (Kaufmann et al., 2008)

Indicators	Definition
Voice and Accountability (VA)	The extent to which country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media
Political Stability (PS)	The perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism
Government Effectiveness (GE)	The quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies
Regulatory Control (RC)	The ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development
Rule of Law (RL)	The extent to which agents have confidence in and abide by the rules of society, in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence
Control of Corruption	The extent to which public power is exercised for private gain, including petty and grand forms of corruption, as well as "capture" of the state by elites and private interests

CHAPTER FIVE

LABOR MOBILITY AND ECONOMIC GROWTH AMONG ECOWAS COUNTRIES

5.1 Introduction

Since time immemorial, migration has occurred from one generation to another. The main reason for migration is the search for greater opportunities and better life. Although migration is said to be motivated by numerous factors, one of the driving factors of migration is to earn a better living and live in a more agreeable environment, while others also join family or friends abroad (World Migration Report, 2013:23).

Migration is regarded as a global phenomenon, which has seen its scope to grow in size and is becoming increasingly complex. Thus, migration is both a cause and effect of a broader development process and an intrinsic characteristic of our ever-globalizing world (UNCTAD, 2011).

In Africa, migration plays a significant role in sustaining people's livelihoods. Although migration can have both positive and negative effects on the economic, social, and cultural lives of the countries of origin as well as the destination countries, extant literature has documented that remittances to the origin countries can represent a major vehicle for reducing the severity of poverty in developing countries (DilipRatha, 2013). Thus, remittance inflows to the origin countries are an important source of income for the individual and to the country in general.

Although, remittance inflows through migration to developing countries are difficult to estimate, the World Bank estimated that in 2012, international remittance in Africa stood at US \$114 billion and projected that, in the year 2015, it was estimated to be around US \$401 billion.

In sub-Saharan Africa, remittances from migration have substantially increased over the years, and many countries from the Economic Community of West African States (ECOWAS) region are among the largest recipients of these remittances relative to their individual GDP (Singh et al, 2009). For instance, according to the World Bank (2009), remittances to developing countries amounted to US \$317billion in 2009, which representing about 93% growth over the last five years (World Bank, 2009). The remittance inflows to developing countries through migration help spur economic growth and help reduce poverty by stimulating the income of the recipient country, reducing credit constraints, and accelerating investment. It helps to enhance human development and finance better education and health (Calaro 2008; Stark & Lucas, 1988; Taylor, 1992).

Some of the channels through which migration impacts economic growth in the receiving or destination country's are through labor market, trade, and innovation. The presence of migrants in the receiving or destination countries can improve trade by reducing information costs or creating additional demand for the goods produced in the receiving countries (Felbermayr & Toubal, 2012). Labor migration can stimulate knowledge transfer to the destination countries (Bahar et al., 2019). As migrants move across countries, they bring along productive knowledge that is an essential element in boosting the production and trade capacity of the country (Bahar & Rapoport, 2018). Labor Immigration to the destination countries can cause an increase in the diversity of productive skills, leading to a rise in total factor productivity and thus its competitiveness in the international markets (Ortega & Peri, 2014).

Although a sizeable number of studies have discussed the effect of labor migration on origin countries through remittances on development and growth in developing countries, the effect of labor migration on growth for both the origin and destination countries in the West African sub-

region is almost negligible. To fill this gap in the literature, this study focuses on the impact of labor migration in the areas of remittance for the origin countries and how international migrant stock in the area of trade, labor market, and innovation impacts the growth of the economies of the destination countries. We achieve this objective by using the NARDL by Shin et al. (2014). This method represents the simplest way of modelling combined short and long-run asymmetries. This bounds testing framework adopted means that it can be applied to stationary and non-stationary time series, or combinations of both. This makes it superior to the conventional ARDL by Pesaran, Shin, and Smith (2001).

The rest of the chapter is organized as follows: The next section provides a review of the theory underpinning this study, while Section 5.3 reviews the empirical literature. Section 5.4 outlines the data and the empirical strategy, and Section 5.5 presents the findings. Section 5.6 highlights policy implications and concludes the study.

5.2 Theoretical literature

5.2.1 The Solow growth theory

It is evident from the extant literature that economic output can be enhanced by the direct impact of migration, which intrinsically increases the labor supply indirectly, and that labor migration can impact economic growth through the possession of skills and knowledge, which acts as a supplement to the natives in the host country.

Two main theories explain the relationship between labor migration and economic growth. The first is the neoclassical view, which puts more emphasis on the changes in a country's population coupled with the advancement in technology as the key determinants of long-run economic growth (Solow, 1956). The Solow Growth Theory has received a fair share of criticism from academics and policy-makers. They argued that numerous factors are unexplained in Solow's

growth theory. Some concerns are that the Solow growth theory is silent on the skills, knowledge, and abilities of migrant labor as the real factors that promote economic growth (Lucas, 1998; Romer, 1994; Hunt, 2011; Per, 2012).

Solow (1956) challenged these criticisms by arguing that when there is an increase in a country's population, the intended benefits are not only the supply of labor but also result in population diversity, which invariably leads to an increase in innovation and advancement in technology. In addition to the position of Solow growth theory, Kremer (1993) posits that large populations help them share ideas and knowledge, leading to the creation of new technologies and always being innovative in their activities, which ultimately leads to economic growth. In contrast to neoclassical theory, endogenous theory places more emphasis on human capital as the main factor that leads to economic growth.

5.3 Empirical review

The empirical results on labor mobility and its impact on the growth of economies in the ECOWAS region are mixed. Akinyede and Williams (2018) investigated the relationship between labor mobility and regional development in the ECOWAS region from 1991 to 2015. This study used seven countries from the region and employed multiple regression techniques for the analysis. The study reports that a one percent increase in the average net migration (NM) leads to an approximately 0.34 percent increase in gross national income. However, the positive coefficient of unemployment of 0.72 shows that as labor mobility tends to stretch out from the ECOWAS region, unemployment tends to decline on arithmetic progression, which positively affects gross net income.

Most studies on the relationship between labor mobility and economic growth in ECOWAS have concentrated on the relationship between migrant remittances and economic growth in origin/sending countries. Adarkwa (2015) studied the relationship between remittances and economic growth in selected countries in the ECOWAS from 2000 to 2010. The countries under study were Cameroon, Cape Verde, Nigeria, and Senegal, and linear regression was used for the estimation. The findings of the study were that the inflow of remittances to Senegal and Nigeria had a positive effect on these countries' gross domestic product, whereas for Cape Verde and Cameroon, it had a negative effect. Cameroon benefitted the least from remittances, and Nigeria benefitted the most within this period. This may be due to the fact that Nigeria has the highest population in the sub region. The limitation of this study is that it includes only four countries in the region and cannot be used as a true reflection of the West African region.

In a related study, Nyeadi and Atiga (2014) applied Cointegration tests and Granger-causality under the Vector Autoregression (VAR) framework to examine the link between remittances and economic growth in Ghana from 1980 to 2012. The variables for the study were changes in exports per capita, remittances per capita received, imports per capita, and Gross Domestic Product per capita. The results indicate that the direction of influence is unidirectional. They report that remittances lead to economic growth, albeit marginal, while economic growth does not lead to remittances. The limitation of this study is that it is a country-specific study and cannot be generalized to the West African region.

In a similar study, Nyeadi et al. (2014) investigated whether there is a causal relationship between the flows of remittance and growth in selected African countries that belong to the ECOWAS region: Nigeria, Senegal, and Togo. The study used data that ranged from 1980 to 2012, and the study used Johansen Cointegration and Granger Causality under a bivariate VAR

framework; the findings of the study report unidirectional causality running from remittance flows to growth in Nigeria and Senegal. The study finds no causal relationship between remittances and growth for Togo.

A study of 10 ECOWAS countries by Barnes et al. (2015) investigated the effect of migrant worker remittance inflows on economic growth in the sub-region. The study used panel data for the period 2000 to 2013 and employed the Generalized Method of Moments (GMM) to address the problem of endogeneity among the explanatory variables. This study suggests that remittances have a positive effect on the economic growth of ECOWAS member countries. Specifically, the study finds that a 1% increase in migrant remittances leads to approximately 17% increase in growth.

Lartey (2011) investigates the association between remittances and per capita growth by assessing whether the effect of remittances on growth is through capital accumulation or through other means. The study used data from Sub-Saharan African countries, which included countries from West Africa, in the analysis and applied dynamic empirical models. The findings reveal a positive relationship between remittances and growth, as well as a positive interaction effect between remittances and financial depth on growth. The findings reveal threshold values for the two main indicators of financial development, above which the total effect of remittances on growth is positive.

In a country-specific study, Oladapo et al. (2016) examined the effect of fluctuation in the flows of remittance on the Nigerian economy. The study period was from 1986 to 2014, and OLS estimation was used. This study reports the positive effect of remittances on Nigeria's economic growth. However, their main study used the Autoregressive Conditional Heteroscedasticity

(ARCH) model and discovered that the fluctuation of remittance inflows to Nigeria has no effect on economic growth in the country.

Some studies have argued that remittances have no impact on the economic growth of some countries. Adams (2010) reviewed recent empirical studies on the effect of remittances on economic growth for some developing countries, including ECOWAS countries, which were based on household survey data. The study initially reviewed the significant methodological problems confronting economic studies on international remittances. The study further assessed the strengths and weaknesses of various economic studies that have been conducted on the impact of remittances in the developing world in these areas: health and education, poverty and inequality, labor supply and participation, investment, savings, and economic growth. The study revealed that while international remittances have a positive effect on poverty and health in the developing world, they can have negative effects on education, labor supply, and economic growth.

In Ghana, Ustarz, and Issahaku (2017) applied OLS and Quantile regression estimation techniques to assess the effect of remittances on total factor productivity for the period 1975 to 2013. Their study used stepwise OLS regression and the 25th, 50th, and 75th quantiles of remittances for quantile regression. The results from their study revealed that all estimation methods report similar results, in that remittances significantly retard the Ghanaian economy. The limitation of this study is that it is country-specific and cannot be used to represent the West African region.

A summary of the review of labor mobility and economic growth in the ECOWAS region is mostly assessed from the direction of the origin or sending country, and remittance is the main variable used to determine its impact on economies. This has left an important gap in labor

mobility and economic growth for the destination/receiving country. This study addresses this lacuna by examining the association between labor mobility and economic growth in the destination country in the context of ECOWAS. Most studies on labor mobility and economic growth have considered this relationship in a linear framework. This study assesses this relationship in a non-linear framework, which is lacking in studies in the ECOWAS region, thereby making a modest contribution to the extant literature.

5.4 Empirical Methodology

5.4.1 Non-linear autogressive distributed lag approach to cointegration (NARDL)

Shin et al. (2014) begin by taking into account an asymmetric long-run regression:

$$y_t = \beta^+ x_t + \beta^- x_t + u_t, \quad (5.1)$$

$$\Delta x_t = v_t, \quad (5.2)$$

Where y_t and x_t are scalar I(1) variables, and x_t is disintegrated as $x_t = x_0 + x_t^+ + x_t^-$, where x_t^+ and x_t^- are partial sum processes of positive and negative changes in x_t :

$$x_t^+ = \sum_{j=1}^t \Delta x_j^+ = \sum_{j=1}^t \max(\Delta x_j, 0), \quad x_t^- = \sum_{j=1}^t \Delta x_j^- = \sum_{j=1}^t \min(\Delta x_j, 0). \quad (5.3)$$

The above equation provides a simple way of modelling asymmetric cointegration, which is based on partial sum decompositions. Schorderet (2001) made a general application to this concept and defined the following stationary linear combination of the partial sum components:

$$Z_t = \beta_0^+ y_t^+ + \beta_0^- y_t^- + \beta_1^+ x_t^+ + \beta_1^- x_t^- \quad (5.4)$$

If Z_t is stationary, then y_t and x_t are said to be ‘asymmetrically cointegrated’. It follows that standard linear (symmetric) cointegration is a special case of (4), derived only if $\beta_0^+ = \beta_0^-$ and

$\beta_1^+ = \beta_1^-$. Shin et al. (2014) opine the case where the following restriction holds: $\beta_0^+ = \beta_0^- = \beta_0$.

In expression (5.4), this implies that $\beta^+ = -\beta_1^+/\beta_0$ and $\beta^- = -\beta_1^-/\beta_0$.

Shin et al. (2014) use this basis to suggest the following nonlinear ARDL (p, q) model:

$$y_t = \sum_{j=1}^p \theta_j y_{t-j} + \sum_{j=0}^q (\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-) + \varepsilon_t \quad (5.5)$$

Where x_t is a $k \times 1$ vector of multiple regressors, defined such that $x_t = x_0 + x_t^+ + x_t^-$, θ_j is the autoregressive parameter, θ_j^+ and θ_j^- are the asymmetric distributed lag parameters, and ε_t is an i.i.d. process with zero mean and constant variance, σ_ε^2 . Shin et al. (2014) concentrated on the case in which x_t is disintegrated into x_t^+ and x_t^- around a threshold of zero, thereby differentiating between positive and negative changes in the rate of growth of x_t .

Shin et al. (2014) follow Pesaran et al. (2001) and write (5.5) in the error correction form as:

$$\Delta y_t = \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\varphi_j^+ \Delta x_{t-j}^+ + \varphi_j^- \Delta x_{t-j}^-) = PS_{t-1}^T + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\varphi_j^+ \Delta x_{t-j}^+ + \varphi_j^- \Delta x_{t-j}^-), \quad (5.6)$$

Where $\rho = \sum_{j=1}^p \theta_{j-1}$, $\gamma_j = -\sum_{i=j+1}^p \theta_i$ for $j=1, \dots, p-1$, $\theta^+ = \sum_{j=0}^q \theta_j^+$, $\theta^- = \sum_{j=0}^q \theta_j^-$, $\varphi_0^+ = \theta_0^+$, $\varphi_j^+ = -\sum_{i=j+1}^p \theta_i^+$ for $j=1, \dots, q-1$, $\varphi_0^- = \theta_0^-$, $\varphi_j^- = -\sum_{i=j+1}^p \theta_i^-$ for $j=1, \dots, p-1$, and $s^T t = y_t - \beta^+ x_t^+ - \beta^- x_t^-$ is the nonlinear error correction term, where $\beta^+ = -\theta^+/\rho$ and $\beta^- = -\theta^-/\rho$ are the associated asymmetric long-run parameters. To deal with the possibility of non-zero contemporaneous correlation between the regressors and the residuals in (5.6), they suggested the following reduced-form data generation process for Δx_t :

$$\Delta x_t = \sum_{j=1}^{q-1} \Lambda_j \Delta x_{t-j} + v_t, \quad (5.7)$$

Where $v_t \sim \text{iid}(0, \Sigma_v)$, with Σ_v being a $k \times k$ positive definite covariance matrix. In focusing on conditional modelling, Shin et al. (2014) express ε_t in terms of v_t as:

$$\varepsilon_t = \omega' v_t + e_t = \omega' (\Delta x_t - \sum_{j=1}^{q-1} \Lambda_j \Delta x_{t-j}) + e_t \quad (5.8)$$

Where e_t is uncorrelated with v_t , by construction. If we substitute (5.8) into (5.6) and rearrange, we obtain a nonlinear conditional ECM:

$$\Delta y_t = \rho S_{t-1}^r + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta_{t-j}^+ + \pi_j^- \Delta_{t-j}^-) + e_t, \quad (5.9)$$

Where $\pi_0^+ = \theta_0^+ + \omega$, $\pi_0^- = \theta_0^- + \omega$, $\pi_j^+ = \varphi_j^+ + \omega' \Lambda_j$, and $\pi_j^- = \varphi_j^- + \omega' \Lambda_j$ for $j = 1, \dots, q-1$.

It becomes obvious now that equation (5.9) corrects for the weak endogeneity of any nonstationary explanatory variables, and that the model will be free from any residual correlation if appropriate lag selection is exercised. The model can explain both long and short-run asymmetries, and, as it is linear in all the parameters, can be estimated by OLS.

5.4.2 Data, samples, and preliminary analysis

This study employed the following variables: gross domestic product (GDP) per capita to proxy for economic growth; workers' remittances (REM), which is measured by migrant remittance inflows (US\$ million); labor migration (LMR), proxied by international migrant stock; unemployment rate (UEM), the unemployed labor force, which is expressed as the percentage of total labor force, is used to represent unemployment. The rest of the variables are human capital development (HCD), which is measured by secondary school enrollment as a percentage of the total population; household consumption (HC), final household consumption of goods and services as a percentage of GDP is used as a proxy for household consumption, while investment (INV) is represented by gross fixed capital formation as a percentage of GDP, and domestic

savings (DS) is represented by gross domestic savings as a percentage of GDP (Jawaid & Raza, 2012). The data sample period for this study was from 2000 to 2020. We utilize annual data due to the availability of consistent data for these countries. Data for remittance and international migrant stock is sourced from the International Organization of Migration (IOM) of the United Nations (UN), while the rest of the data are obtained from the World Development Indicators (WDI) of the World Bank. Preliminary tests included descriptive statistics, a unit root test, correlation analysis, optimal lag selection, and a cointegration test (optional).

5.4.2.1 Descriptive/summary statistics

This is a summary of the descriptive statistics of the economic variables used to measure the relationship between labor mobility/migration and economic growth for the ECOWAS countries. The statistics presented by this study are the mean, median, maximum, and minimum values; standard deviations, skewness, and kurtosis of the variables.

Table 5.1: Descriptive statistics for the labor mobility and economic growth for ECOWAS

Statistics	GDP	REM	LMR	UEM	HCD	HC	INV	DS
Mean	1.516	1375.543	3.416	5.292	40.3215	80.989	20.496	6.329
Median	1.919	163.238	2.365	4.653	39.212	77.261	19.454	10.246
Maximum	21.027	2431.02	13.8509	15.306	96.659	228.364	52.418	57.160
Minimum	-31.333	0.000	0.398	0.320	6.487	40.716	1.096	-141.97
Std. Dev	4.372	4364.62	3.253	3.009	17.735	22.047	7.993	22.268
Skewness	-1.591	4.049	1.805	0.609	0.812	3.670	1.118	-3.604
Kurtosis	17.360	18.073	5.120	2.645	4.164	21.366	4.966	20.775
Jarque-Bera	2839.911	3843.310	230.231	21.161	52.419	5134.894	116.468	4829.28
Probability	0.00000	0.000000	0.000000	0.000025	0.000000	0.000000	0.000000	0.00000
Observations	315	315	315	315	315	315	315	315

Note: GDP, gross domestic product; REM, remittance; LMR, labor migration; UEM, unemployment; HCD, human capital development; HC, household consumption; INV, investment; DS, domestic savings

Table 5.1 represents the variables used for the study, which are averaged over the sample period (2000-2020) and presented in percentage terms. The average GDP per capita is 1.52%, which shows that the income status of the ECOWAS member countries is very low. Remittance is estimated at about 1375.5%, with a maximum of 2431.0% and a minimum of 0.00%, which means that member countries always send money home. Labor migration is averaged at 3.41%, with a maximum of 13.85% and a minimum of 0.39%, means intra-labor mobility among ECOWAS member countries is relatively low. Unemployment in the sub-region is averaged at 5.29%, with a maximum value of 15.30% and a minimum of 0.32%. This implies that there is higher unemployment in this region. The descriptive statistics show that, with regarding to secondary school enrolment, it reveals an average of 40.32%, which suggests that the mean quality of education over the sample period at the secondary school level is relatively good, with a maximum of 96.65% and a minimum of 6.48%. Household consumption is averaged at 80.98%, with a maximum of 228.36% and a minimum of 40.71%, which supports the assertion that majority of the countries under consideration use remittances for consumption rather than investment which is averaging at 20.49%, with a maximum of 52.41% and a minimum of 1.09%. Our domestic savings indicators recorded 6.32%, with a maximum of 57.1% and a minimum of -141.9%, which means that majority in the ECOWAS region are not saving which might be due to the fragile nature of our financial system. Our findings, based on the standard deviation, reveal that remittance is the most volatile variable, while the least volatile variable is the composition of unemployment. Interestingly, all variables are skewed to the right, with the exception of GDP per capita and domestic savings, which are negatively skewed. The coefficient values of skewness and kurtosis reveal that our variables are not normally distributed and are largely

leptokurtic. Again, the Jarque-Bera statistics reject normality at all conventional levels of significance.

5.4.2.2 Statistical Properties of the Variables

This sub-section presents investigation of statistical properties of the data, specifically, by performing panel unit root test to assess the order of integration of the variables under study. Again we establish whether the variables used to examine the relationship between labor mobility/migration and economic growth in the ECOWAS region have a problem of multicollinearity and cross sectional dependence.

5.4.2.2.1 Graphical representation of levels series

This section shows the graphical representation of the variables that are used to establish the relationship between labor mobility and economic growth in the ECOWAS region. The variables which are presented in the level forms portrays that GDP per capita is stationary at levels whiles all other other variables require first differencing to be stationary by visual inspection. Formal tests of normality are provided in Table 5.2.

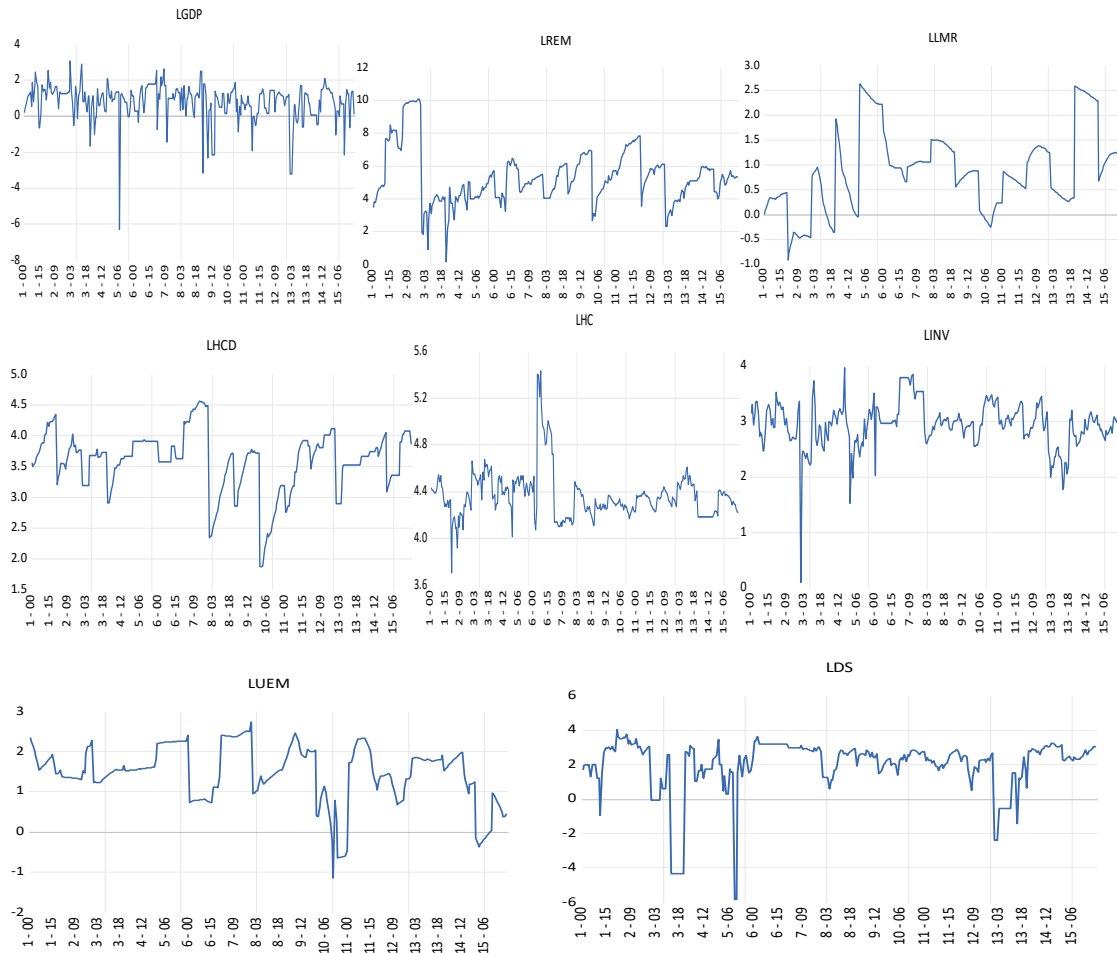


Figure 5.0: Variables in Levels Form

5.4.2.2.2 Panel Unit Root Tests

Several unit root tests were performed to test the order of integration of the series (see Table 5.2). The Levin, Lin, and Chu test (2002), Im, Pesaran, and Shin test (2003), the Augmented Dickey-Fuller (ADF) Fisher chi-square test developed by Maddala and Wu (1999), and Phillips-Perron (PP) Fisher chi-square test were used.

Table 5.2 Panel unit root tests for the relationship between labor mobility and economic growth

Variables	levels		First difference	
	Intercept	With trend	Intercept	With trend
LLC				
GDP per capita	-6.75(0.0000)**	-3.41(0.0003)**	-14.58(0.000)**	-11.13(0.000)**
REM	-5.06 (0.0000)**	-0.59 (0.2765)	-10.55(0.000)**	-10.86(0.000)**
LMR	-3.43 (0.0030)**	-0.51 (0.3036)	-4.10(0.000)**	2.14(0.0484)**
UEM	2.42 (0.9922)	1.67 (0.9531)	-4.96(0.000)**	-3.68(0.000)**
HCD	-3.59 (0.0002)**	1.66 (0.9515)	-8.73(0.000)**	-10.85(0.000)**
HC	1.49 (0.9323)	-5.33 (0.0000)**	-11.53(0.000)**	-9.78(0.000)**
INV	-3.44 (0.0003)**	3.19 (0.9993)	-20.06(0.000)**	-7.39(0.000)**
DS	-1.90 (0.0285)**	-1.50 (0.0665)	-6.05(0.000)**	-4.69(0.000)**
IPS				
GDP per capita	-7.24 (0.0000)**	-5.86 (0.0000)**	-15.64(0.000)**	-13.47(0.000)**
REM	-2.42 (0.0076)**	-1.43 (0.0759)	-10.62(0.000)**	-10.15(0.000)**
LMR	-2.74 (0.0030)**	0.45 (0.6740)	-4.41(0.000)**	2.38(0.9910)
UEM	3.08 (0.9990)	-0.33 (0.3689)	-5.79(0.000)**	-3.13(0.000)**
HCD	-1.84 (0.0322)	1.44 (0.9258)	-8.71(0.000)**	-9.69(0.000)**
HC	0.344 (0.6348)	-4.26 (0.0000)**	-12.01(0.000)**	-11.87(0.000)**
INV	-2.70 (0.0034)**	-1.35 (0.0877)	-13.16(0.000)**	-9.07(0.000)**
DS	-1.24 (0.1069)	-2.83 (0.0023)**	-8.26(0.000)**	-6.33(0.000)**
ADF Fisher chi-square				
GDP per capita	108.66(0.0000)**	87.27(0.0000)**	242.14(0.000)**	185.82(0.000)**
REM	62.82 (0.0004)**	42.27 (0.0678)	157.44(0.000)**	139.42(0.000)**
LMR	57.84 (0.0017)**	59.85 (0.0010)**	76.96(0.000)**	15.25(0.009)**
UEM	29.15 (0.5095)	44.77 (0.0405)	101.69(0.000)**	70.37(0.000)**
HCD	47.55 (0.0120)**	27.73 (0.4788)	121.73(0.000)**	133.72(0.000)**
HC	36.56 (0.1289)	64.89 (0.0001)**	175.95(0.000)**	162.46(0.000)**
INV	78.21 (0.0000)**	44.87 (0.0396)**	411.47(0.000)**	125.21(0.000)**
DS	36.36 (0.1334)	49.53 (0.0073)**	123.92(0.000)**	93.92(0.000)**
pp Fisher chi-square				
GDP per capita	112.98(0.0000)**	97.39(0.0000)**	740.89(0.000)**	286.08(0.000)**
REM	108.32(0.0000)**	619.91(0.0005)**	200.62(0.000)**	198.99(0.000)**
LMR	108.37(0.0000)**	30.83 (0.4237)	24.76(0.0.000)**	15.38(0.9874)
UEM	11.96 (0.9986)	11.53 (0.9990)	91.44(0.000)**	66.35(0.000)**
HCD	40.14 (0.0642)	22.29 (0.7672)	130.05(0.000)**	154.24(0.000)**
HC	41.02 (0.0534)	39.14 (0.0785)	230.31(0.000)**	206.99(0.000)**
INV	67.52 (0.0001)**	66.79 (0.0001)**	541.98(0.000)**	213.59(0.000)**
DS	32.36 (0.2601)	38.94 (0.0818)	293.23(0.000)**	225.73(0.000)**

Note: GDP, gross domestic product; REM, remittance; LMR, labor migration; UEM, unemployment, HCD, human capital development; HC, household consumption; INV, investment; DS, domestic savings. ** denotes 5% significance level, P-Values reported in parenthesis

Table 5.2 presents the findings of the panel unit root test to ascertain the order of integration of the variables. We used four distinct panel unit root tests to obtain the results. We employed Levin-Lin-Chu's (LLC), Im-Pesaran-Shin (IPS), ADF Fisher chi-squared, and PP-Fisher chi-squared statistics. Our choice to use these panel unit root tests to examine the stationarity properties of the variables is situated on the ground construction of the individual test, where the weakness or the limitation of one is duly compensated for by the other. For instance, the LLC test relies on the assumption of a common unit root process, in the estimation process with identical autocorrelation coefficients for the tested series. On the other hand, the IPS, ADF, and PP Fisher chi-square tests use individual unit root processes in the estimation process on the assumption that the autocorrelation coefficients differ across cross-sections. We chose an automatic lag selection based on the Akaike information criterion (AIC). We further apply the Bartlett kernel approach to estimate long-run variance in the LLC test by relying on the automatic maximum lag length, which was determined by the Newey–West bandwidth selection algorithm.

The results from the LLC, IPS, ADF, and PP tests provide strong evidence that the GDP per capita series is stationary at levels because it has probability values that are significant at all conventional levels. The results from the LLC test provide mixed results at levels when the intercept and intercept with the trend are used. When the series are estimated using only the intercept at levels, Remittance, labor migration, human capital development, investment, and domestic savings become stationary because they have low P-values; however, when intercept with trend is used at levels, the series becomes nonstationary because higher P-values are reported, which fails to reject the null of the unit root. The results from the IPS test at levels show that remittance, labor migration, and investment are stationary when the only intercept is

employed; however, they become nonstationary when an intercept with a trend is used for the estimation. Household consumption becomes stationary at levels for both the LLC and IPS tests when the intercept and trend is used; however, when only the intercept is used, it becomes nonstationary, whereas the other variables are nonstationary.

Results from the ADF Fisher chi-square test show that remittance and human capital development are stationary at levels when only the intercept is used; however, when intercept and trend are used, it becomes nonstationary when labor migration, and investment are stationary at levels using intercept and intercept with trend, whereas other series require differencing to become stationary. The results of the PP Fisher chi-square at levels show that remittance and investment are stationary when intercept and intercept and trend are used, while labor migration is stationary when only the intercept is used. All variables became stationary after first differencing.

The results of the unit root properties of the variables show evidence of a non-stationary series. In economics, the non-stationarity of the series is an indication that shocks to the variables demonstrates a permanent impact with no possibility of returning to their means. When OLS is estimated by employing nonstationary data, it tends to produce spurious results. However, in special cases, the results can be relied upon and validity can be proven, especially where the variables are cointegrated with strict exogenous regressors. Our decision to employ the NARDL framework is therefore appropriate, as it does not impose the assumption of strict exogeneity and permits estimations irrespective of whether the series shows different orders of integration, that is, $I(1)$ and $I(0)$. Though the above unit roots tests conspicuously present evidence that the variables under study are non-stationary, we additionally attempted to avoid the problem of generating spurious results from the regression output by conducting cointegration test. The

rationale for this was to establish stable long run equilibrium relationships among the variables. Table 5.3 below presents the results of the variables in connection with the cointegration status among them. We employed two types of panel cointegration tests, which is the Pedroni and Kao test, these test selects the appropriate lag lengths for the estimations by using Automatic lag length selection based on SIC with a maximum lag of 3. Our spectral estimations were conducted by resorting to the Bartlett kernel which employs the Newey–West algorithm in the selection of the bandwidth. The Pedroni and Kao tests of panel cointegration are based on the residuals of the long run static regression. All tests are however conducted under the null hypothesis of no cointegration. We included deterministic time trends in all the specifications.

Table 5.3: Panel cointegration tests results

Tests	Statistics	Prob.	Weighted statistic	Prob.
Within dimension				
Panel v-Statistic	-2.630089	0.9957	-4.142673	1.0000
Panel rho-Statistic	-4.290548	0.0000**	-4.359887	0.0000**
Panel PP-Statistic	-33.60303	0.0000**	-24.39276	0.0000**
Panel-ADF-Statistic	-17.36504	0.0000**	-16.86418	0.0000**
Between dimension				
Group rho-Statistic	-2.886043	0.0020**		
Group PP-Statistic	-38.54562	0.0000**		
Group-ADF-Statistic	-19.01864	0.0000**		
Kao Residual Cointegration				
ADF	-3.730692	0.0001**		

Note: ** indicates 5% significance level.

The panel co-integration test is significant to check whether there is a long-run relationship among the variables or not. The study used Pedroni co-integration test and Kao residual based cointegration tests under the null hypothesis of no cointegration. The majority of the results within and between dimensions are significant, as shown in Table 5.3, rejecting the null

hypothesis of no cointegration. As a result, the Pedroni co-integration test and Kao test reveal a long term relationship among the variables.

5.4.2.2.3 Correlation coefficients test

The correlation coefficient reveals a positive and significant association between GDP per capita (GDP) and remittance (REM), GDP per capita (GDP) and human capital development (HCD), and GDP per capita (GDP) and investment (INV), while GDP per capita has a negative and insignificant relationship with labor migration (LMR) and unemployment (UEM). Again, GDP per capita has a positive correlation with household consumption and domestic savings, although this is insignificant. Remittance has a negative and significant correlation with labor migration and household consumption, while, remittance has a positive and significant correlation with human capital development, investment, and domestic savings. It is also observed that remittances have a positive correlation albeit insignificant with unemployment. Labor migration has a positive and significant correlation with unemployment and human capital development, while it has a negative and insignificant correlation with household consumption (HC), and investment (INV). Unemployment has a positive and significant correlation with HCD, while it has a negative and significant relationship with domestic savings (DS). Human capital development (HCD) has a positive and significant correlation with investment (INV), and domestic savings (DS). The variables were free from multicollinearity as all correlations were below 50%. The correlation coefficient results are presented below, revealing the level of association between or among the variables (see Table 5.4 below).

Table 5.4. Correlation Matrix

Variables	GDP	REM	LMR	UEM	HCD	HC	INV	DS
GDP	1							
REM	0.156 (0.0053)	1						
LMR	-0.093 (0.0974)	-0.248 (0.0000)	1					
UEM	-0.066 (0.2398)	0.088 (0.1177)	0.155 (0.0056)	1				
HCD	0.142 (0.0115)	0.338 (0.0000)	0.226 (0.0001)	0.412 (0.0000)	1			
HC	0.030 (0.5855)	-0.301 (0.0000)	-0.001 (0.9806)	-0.127 (0.00234)	-0.084 (0.1349)	1	1	
INV	0.186 (0.0009)	0.289 (0.0000)	-0.093 (0.0965)	0.001 (0.9726)	0.291 (0.0000)	-0.353 (0.0000)	1	
DS	0.080 (0.1545)	0.398 (0.0000)	0.105 (0.0611)	-0.138 (0.0142)	0.111 (0.0487)	-0.317 (0.0000)	0.433 (0.0000)	1

Note: P values (), GDP: GDP per capita, REM: remittance, LMR: labor migration, UEM: unemployment, HCD: human capital development, HC: household consumption, INV: investment, DS: domestic savings

5.4.2.2.4 Cross sectional dependence

In this study, we started by performing cross-sectional dependence test on our data generating process to ensure consistent coefficient estimates, because the cross-sectional data should be independent from each other (Pesaran, 2004). In testing for cross-sectional dependence test, the time series span and the number of countries considered in the analysis are taken into consideration. The ratio between the two gives indication of which method to apply. In this study, since our time span is greater than the number of countries, we apply the Lagrange multiplier (LM)-test first used by Breusch and Pagan (1980) was used. The data exhibited cross sectional dependence as shown in Table 5.5A. We employed the cross-section seemingly unrelated regression to address the problem of cross-sectional dependence.

Table 5.5A: Cross-sectional Dependence Test

Test	Test Statistic	Probability
Breusch-Pagan LM	151.8999***	0.0019
Pesaran scaled LM	3.236398***	0.0012
Pesaran CD	-1.599414	0.1097

Note: ***Significance at the 1% level

Because the presence of cross-sectional dependence in panel data distorts estimation efficiencies when it is not resolved, this study has realized the presence of cross-section dependence among the data generating process for the ECOWAS countries employed the cross-section seemingly unrelated regression (cross-section SUR) to correct the problem of cross-sectional dependency in our data set. The table below shows that the problem of cross-section dependence in our data is resolved by estimating the cross-section SUR; thus the null hypothesis of no cross-section is not rejected for Breusch-Pagan LM and Pesaran CD test.

Table 5.5B: Cross-sectional Dependence Test using cross-section SUR

Test	Test Statistic	Probability
Breusch-Pagan LM	12.35401	1.0000
Pesaran scaled LM	-6.393181***	0.0000
Pesaran CD	-0.275136	0.7832

Note: ***Significance at the 1% level

5.4.2.2.5 Lag Selection Criteria

First, in estimating the NARDL, we selected the appropriate lag because the NARDL was estimated by first estimating the baseline ARDL. There are several pertinent assumptions regarding the classical linear regression estimation. Primarily, among classical linear regressions, the model in the analysis should be specified correctly. Friedman (1953), cited in Gujarati and Porter (2009), argued strongly that the only test of validity of a hypothesis (model) is comparison

of its predictions with experience (p.468). Therefore, in time series data analysis, it is relevant to bring the lagged values of the dependent variable in undertaking regression estimation. In econometric literature, there are several criteria that one can rely on when selecting the appropriate lag period for forecasting purposes.

The most popular ones documented in the extant literature are the Akaike Information Criteria (AIC), Schwartz Information Criterion (SIC), Hannan-Quinn Information Criteria (HIC), and the Final Prediction Error (FPE). The results of these criteria may sometimes yield conflicting results because there is a lack of consensus on the superiority of one criterion over the others. Pesaran, Shin, and Smith (1999) estimated the Fixed ARDL 1, 1, 1, model with the natural logs of consumption as a dependent variable and the logs of inflation and income as two dynamic regressors with a constant as a static regressor, and Pesaran et al. (1999), used a fixed single lag. We followed the lag selection criteria of Pesaran et al. (1999), although we relied on the automatic lag selection criterion, which was congruence with their selection procedure.

Table 5.6: Optimal lag selection using Schwarz Information Criterion (SIC)

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2323.230	NA	0.000776	15.54154	15.64030	15.58106
1	370.6563	5226.140*	1.89e-11*	-1.991042*	-1.102134*	-1.635300*

*indicates lag order selected by the criterion.

5.5 Results and discussion

5.5.1 PMG/ARDL estimation results

In estimating the NARDL, first, the baseline ARDL needs to be estimated; thus study first report the results of the ARDL, which is followed by the results of the NARDL. This will provide the basis for comparing the two results. Table 5.7 below presents the estimation results of the PMG/ARDL results for the relationship between labor migration and economic growth.

Table 5.7: Estimates of Panel Autoregressive Distributed Lag Model (Dependent variable: GDP)

Regressor	Coefficient	Standard error	t-statistics	Probability
Long-run Equation				
REM	-0.284650	0.096161	-2.960124	0.0035**
LMR	-0.663509	0.257198	-2.579762	0.0107**
UEM	-0.692720	0.124425	-5.567362	0.0000***
HCD	-0.229798	0.259627	-0.885109	0.3773
HC	3.572098	0.428207	8.341992	0.0000***
INV	0.899168	0.143486	6.266581	0.0000***
DS	0.174365	0.084747	2.057480	0.0411**
Short-run Equation				
COINTEQ01	-0.690564	0.099604	-6.933106	0.0000***
D(REM)	0.053610	0.599208	0.089469	0.9288
D(LMR)	-5.026684	4.482155	-1.121488	0.2636
D(UEM)	-0.114688	0.939337	-0.122094	0.9030
D(HCD)	7.736988	6.698182	1.155088	0.2496
D(HC)	4.189835	4.139564	1.012144	0.3129
D(INV)	0.765906	0.728200	1.051780	0.2944
D(DS)	0.732696	0.471311	1.554591	0.1219
C	-9.536073	1.317650	-7.237181	0.0000***
Root MSE	0.662038	Mean dependent var	0.010848	
S.D. dependent var	1.184216	S.E. of regression	0.893337	
Akaike info criterion	2.330134	Sum squared resid	138.0629	
Schwarz criterion	4.021770	Log likelihood	-224.9961	
Hannan-Quinn crit.	3.006006			

Note: ARDL (1, 1, 1, 1, 1, 1, 1, 1) was selected based on Schwarz Bayesian Criterion. GDP: GDP per capita, REM: remittance, LMR: labor migration, UEM: unemployment, HCD: human capital development, HC: household consumption, INV: investment, DS: domestic savings. **, *** denotes significance 5% and 1% respectively.

The short and long-run results of labor migration and economic growth are exhibited in Table 6. In this study, we selected one lag for both the dependent and the independent variables for the PMG/ARDL model estimations using the Schwarz Information Criterion (SIC). In the long-run, the coefficient of remittances is -0.284650, which is negative and statistically significant at 1% level, suggesting that, in the long run, a 1% increase in remittance inflows to ECOWAS member countries lead to 0.28% reduction in economic growth. This finding reveals that in the long run, remittance inflows to the region are mainly used for consumption. This finding is not consistent with Nyamongo et al. (2012), Adarkwa (2015), and Karikari et al. (2016) studies in Africa, where their findings support remittances to be one of the most pertinent sources of capital for development in the region. Similarly, labor migration has negative and significant effect on economic growth in the long-run for the ECOWAS countries, with coefficient of -0.663509 at 0.01% significance level. This result shows a 1% increase in the labor migration decreases economic growth by 0.66%. Similar to the results reported for remittance and labor migration in the long run, unemployment follows a similar pattern; it has a negative and significant effect on economic growth in the ECOWAS region. That is, a 1% increase in unemployment will bring about 0.69% decrease in economic growth. Its coefficient is -0.692720, with a probability value of 0.0000, which is statistically significant at any conventional level. However, the degree of human capital development has a negative and insignificant relationship with economic growth in the long-run. The coefficient value of -0.229798 implies that a 1% increase in human capital development would reduce economic growth by 0.22% in ECOWAS countries. Investment and household consumption with coefficient values of 0.899168 and 3.572098 respectively have positive and significant effects on growth at 1% significance level. This implies that a 1% increase in investment and household consumption would increase growth significantly by

0.89% and 3.57%, respectively. In the long term, domestic savings have a positive and significant effect on economic growth in the ECOWAS region. It has coefficient value of 0.174365 and significant at 5% level. This means that a 1% increase in domestic savings would increase economic growth by 0.17% in the long term.

In the short term, remittances have a positive and insignificant effect on economic growth. It has a coefficient value of 0.053610, which means that, in the short run, a 1% increase in remittance would bring about 0.053% increase in economic growth, albeit insignificant growth. In the short run, this finding is consistent with Kindleberger (1965), who argues that remittances is the main mechanism to bring development to migrant countries. Kindleberger (1965) asserted that remittances lead to increase in income and consumption. He further posits that it increases investment, and generate employment. Similar studies in this relationship in question with similar findings are Nyamongo et al. (2012), and Adarkwa (2015) for Sub Saharan Africa whiles in Nigeria, Akonji and Wakili (2013) obtained similar results, same findings are reported by Kumar and Vu (2014) for Kenya. The conclusions of these studies were that remittances have a positive and significant effect on growth. With respect to the effects of labor migration on economic growth, the results are similar to the long-run effect. The only difference is that, in the short run, the impact on economic growth is insignificant. In the short run, the coefficient of labor migration is -5.026684, which means that a 1% increase in labor migration in the short run would lead to 5.02% decrease in economic growth, although the effect may be insignificant. Unemployment also has a negative effect on economic growth in the short run, unlike in the long run, where the negative effect is significant, and in the short run, the effect is insignificant. Human capital development, household consumption, investment, and domestic savings have a positive effect on economic growth in the short run; however, their effect on economic growth is

insignificant is depicted by the higher P-value. The Error Correction term (ECT) which shows the speed of adjustment of shocks in the short-run to long run equilibrium is expected to have a negative coefficient. The parameter is expected to be significant as well. The coefficient of the ECT or the speed of adjustment towards equilibrium for the PMG/ARDL estimate is -0.690564, which is statistically significant at 1% level. This means deviation of variables occurring in the short run is significantly adjusted and corrected by 0.690% in the long run yearly for the ECOWAS countries.

5.5.2 NARDL estimation results

The cointegration tests on the relationship between labor mobility/migration and economic growth in the ECOWAS region were undertaken by performing the OLS estimation method, and the Non-linear Error Correction Model (ECM) under the NARDL model setting was estimated using the Stepwise Least Square regression method with backward unidirectional iteration to arrive at the model's final specification results. The maximum lag order considered for this estimation procedure has four lags. In the NARDL framework, to establish the existence of long-run cointegration, one must use Wald test restrictions to generate the F-statistics from the bounds test, as suggested by Shin et al. (2014). This F-statistic was then compared with the critical values provided by Pesaran et al. (2001) if the observation was not less than 100. However, if the observation is less than 100, the F-statistics are compared with the critical value provided by Narayan (2005). If the calculated F-statistic is greater than the upper-bound critical value, then there is evidence of cointegration. Table 5.8 summarizes the results of the model specifications.

Table 5.8: Nonlinear ARDL Estimation Results (Dependent Variable – GDP per Capita)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.046885	0.146219	-0.320650	0.7488
GDP(-1)	-2.560642	0.178830	-14.31888	0.0000**
REM_P(-1)	0.070079	0.128872	0.543790	0.5872
REM_N(-1)	0.157456	0.131122	1.200838	0.2312
LMR_P(-1)	-0.041575	1.760099	-0.023621	0.9812
LMR_N(-1)	-3.486951	2.131157	-1.636177	0.1034
UEM_P(-1)	-0.438521	0.319138	-1.374080	0.1709
UEM_N(-1)	-0.357668	0.331120	-1.080176	0.2814
HCD_P(-1)	1.452715	0.789540	1.839951	0.0673*
HCD_N(-1)	0.997426	0.731658	1.363240	0.1743
HC_P(-1)	1.341951	0.715406	1.875790	0.0621*
HC_N(-1)	1.295156	0.728720	1.777302	0.0770*
INV_P(-1)	0.261559	0.243312	1.074993	0.2837
INV_N(-1)	0.270880	0.170308	1.590535	0.1133
DS_P(-1)	-0.013347	0.068142	-0.195865	0.8449
DS_N(-1)	-0.024838	0.071551	-0.347129	0.7289
DGDP(-1)	1.015352	0.144216	7.040473	0.0000*
DGDP(-2)	0.659568	0.106819	6.174607	0.0000*
DGDP(-3)	0.268971	0.058425	4.603726	0.0000*
DINV_P(-4)	-2.029051	0.479620	-4.230536	0.0000*
DINV_N(-3)	-1.263588	0.451357	-2.799532	0.0056*
DHCD_P(-3)	-1.378733	0.837030	-1.647173	0.1011
DUEM_P(-3)	-0.581973	0.327074	-1.779332	0.0767*
DINV_P	0.755212	0.435670	1.733448	0.0845*
R-squared	0.780552	Mean dependent var		-0.018177
Adjusted R-squared	0.755441	S.D. dependent var		1.849272
S.E. of regression	0.914519	Akaike info criterion		2.759700
Sum squared resid	168.1053	Schwarz criterion		3.124084
Log likelihood	-286.4663	Hannan-Quinn criter.		2.906767
F-statistic	31.08410	Durbin-Watson stat		2.043389
Prob(F-statistic)	0.000000			

Notes: GDPC represents GDP per capita; REM, remittance; LMR, labor migration/mobility; UEM, unemployment; HCD, human capital development; HC, household consumption; INV, investment; DS, domestic savings. P-values (**, *) denotes statistical significance at levels (5% and 10%) respectively.

The results presented in Table 5.8 are not the long-run coefficients. To obtain the long-run coefficients, we divided the negative coefficient of each of the explanatory variables by the coefficient of the GDP (-1). To calculate the long run asymmetric coefficients, the equation is represented by $\frac{-\varphi_1^+}{\rho}, \frac{-\varphi_1^-}{\rho}, \frac{-\varphi_2^+}{\rho}, \frac{-\varphi_2^-}{\rho}$. Table 5.9 lists the long run coefficients of the explanatory variables.

Table 5.9: long run coefficients of Nonlinear ARDL Estimation Results (Dependent variable – GDP per Capita)

(Long run coefficients derived from $\frac{-\varphi_1^+}{\rho}, \frac{-\varphi_1^-}{\rho}, \frac{-\varphi_2^+}{\rho}, \frac{-\varphi_2^-}{\rho}$)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.046885	0.146219	-0.320650	0.7488
GDP(-1)	-2.560642	0.178830	-14.31888	0.0000**
REM_P(-1)	0.273677	0.128872	0.543790	0.5872
REM_N(-1)	0.061490	0.131122	1.200838	0.2312
LMR_P(-1)	-0.016236	1.760099	-0.023621	0.9812
LMR_N(-1)	-1.361748	2.131157	-1.636177	0.1034
UEM_P(-1)	-0.171254	0.319138	-1.374080	0.1709
UEM_N(-1)	-0.139679	0.331120	-1.080176	0.2814
HCD_P(-1)	0.567324	0.789540	1.839951	0.0673*
HCD_N(-1)	0.389521	0.731658	1.363240	0.1743
HC_P(-1)	0.524068	0.715406	1.875790	0.0621*
HC_N(-1)	0.505793	0.728720	1.777302	0.0770*
INV_P(-1)	0.102145	0.243312	1.074993	0.2837
INV_N(-1)	0.105785	0.170308	1.590535	0.1133
DS_P(-1)	-0.005212	0.068142	-0.195865	0.8449
DS_N(-1)	-0.009699	0.071551	-0.347129	0.7289

Note: (**, *) denotes statistical significance at levels (5% and 10%) respectively.

The coefficients shown in the levels Equation in the Nonlinear ARDL estimation results bounds test results shown above and are calculated as

TABLE 5.10: How the Asymmetry long run coefficient results were derived

Asymmetry long run coefficient (positive)	Asymmetry long run coefficient (negative)
Asymmetry long run coefficient for REM_POS $\frac{-\varphi_1^+}{\rho} = \frac{-0.070079}{-2.560642} = 0.273677$	Asymmetry long run coefficient for REM_NEG $\frac{-\varphi_1^-}{\rho} = \frac{-0.157456}{-2.560642} = 0.061490$
Asymmetry long run coefficient for LMR_POS $\frac{-\varphi_2^+}{\rho} = \frac{-(-0.041575)}{-2.560642} = -0.016236$	Asymmetry long run coefficient for LMR_NEG $\frac{-\varphi_2^-}{\rho} = \frac{-(-3.486951)}{-2.560642} = -1.361748$
Asymmetry long run coefficient for UEM_POS $\frac{-\varphi_2^+}{\rho} = \frac{-(-0.438521)}{-2.560642} = -0.171254$	Asymmetry long run coefficient for UEM_NEG $\frac{-\varphi_2^-}{\rho} = \frac{-(-0.357668)}{-2.560642} = -0.139679$
Asymmetry long run coefficient for HCD_POS $\frac{-\varphi_2^+}{\rho} = \frac{-1.452715}{-2.560642} = 0.567324$	Asymmetry long run coefficient for HCD_NEG $\frac{-\varphi_2^-}{\rho} = \frac{-0.997426}{-2.560642} = 0.389521$
Asymmetry long run coefficient for HC_POS $\frac{-\varphi_2^+}{\rho} = \frac{-1.341951}{-2.560642} = 0.524068$	Asymmetry long run coefficient for HC_NEG $\frac{-\varphi_2^-}{\rho} = \frac{-1.295156}{-2.560642} = 0.505793$
Asymmetry long run coefficient for INV_POS $\frac{-\varphi_2^+}{\rho} = \frac{-0.261559}{-2.560642} = 0.102145$	Asymmetry long run coefficient for INV_NEG $\frac{-\varphi_2^-}{\rho} = \frac{-0.270880}{-2.560642} = 0.105785$
Asymmetry long run coefficient for DS_POS $\frac{-\varphi_2^+}{\rho} = \frac{-(-0.013347)}{-2.560642} = -0.005212$	Asymmetry long run coefficient for DS_NEG $\frac{-\varphi_2^-}{\rho} = \frac{-(-0.024838)}{-2.560642} = -0.009699$

Notes: REM_POS, remittance positive; REM_NEG, remittance negative; LMR_POS, labor migration positive; LMR_NEG, labor migration negative; UEM_POS, unemployment positive; UEM_NEG, unemployment negative; HCD_POS, human capital development positive; HCD_NEG, human capital development negative; HC_POS, household consumption positive; HC_NEG, household consumption negative; INV_POS, investment positive; INV_NEG, investment negative; DS_POS, domestic savings positive; DS_NEG, domestic savings negative. Denominator value is gdp (-1)

5.5.2.1 Results of bounds test for co-integration

First, to accept the validity of the NARDL estimation results, there is a need to establish a long-run relationship among the variables. Thus, this study reports the results of the cointegration test before analyzing the results of the NARDL estimation.

The results of the bounds and the Wald tests of cointegration are reported in Tables 5.11 and 5.12, respectively. From Table 5.11, it can be observed that there is a strong evidence of co-integration at any conventional level of significance level. The value of the F statistics reported in Table 5.11 is greater than the upper critical value at the one percent significance level from Pesaran's (2001) critical values. From these results, it is evident that, a long-run relationship exists between the variables.

Table 5.11: Results of Wald test of co-integration for labor mobility

Test Statistics	Value	df	Probability
F-statistic	15.07349	(15, 201)	0.0000
Chi-square	226.1024	15	0.0000

Table 5.12: Bounds Co-integration Test

Model: $GDP=f(\text{REM, LMR, UEM, HCD, HC, INV, DS})$	F-Statistic = 15.07349	K=8
Critical value	Lower bound value	Upper bound value
1%	3.74	5.06
5%	2.86	4.01
10%	2.45	3.52

Note: Critical values are cited from Pesaran et al. (2001)

5.5.2.2 Results of the asymmetric relationship between labor mobility/migration and economic growth

With evidence of cointegration established between labor mobility/migration and economic growth, the long-run coefficients shown above are analyzed below.

Starting with long-run asymmetric impacts and with remittance, we find that its positive partial sum $REM_P(-1)$ increases economic growth (GDP per capita) by 0.27% when there is a 1% increase in remittance, albeit insignificant in the long run. The negative partial sum of remittances shows that a 1% decrease in remittances will also decrease GDP by 0.06% in the long run. However, both the positive and negative partial sum effects on economic growth in the long run are insignificant because the p-value is high. This shows that remittance inflows to the sub-region are not channelled to investment but largely for consumption. This finding is contrary to the findings of Nyamongo et al. (2012), and Adarkwa (2015) who report in their study that remittance inflows in the ECOWAS sub region leads to economic development. In the long run, a positive labor migration shock has a detrimental but insignificant impact on economic growth in destination countries (-0.016), suggesting that any positive labor migration shock hinders economic growth in the destination of the ECOWAS member country. However, a 1% decrease in labor migration in the destination country would lead 1.36% increase in economic growth (GDP per capita) in the destination country. The impact is insignificant in the long run; meaning that when people migrate to countries other than their country of origin, they send the capital accrued to their relatives there for their personal development and consumption. The control variables included in the model had a mixed impact on the measures of economic growth. In the Table 8, which reports the long run coefficients, it can be seen that an increase in unemployment has a negative effect on growth of economies among ECOWAS member countries; that is; a 1%

increase in unemployment would reduce GDP per capita by 0.17%, although the effect in the long run is insignificant. Again, a negative partial sum of unemployment causes economic growth (GDP per capita) to increase among ECOWAS member countries. This means that a 1% decrease in unemployment will increase growth in the sub region. However, an interesting observation is that both the positive partial sum and the negative partial sum have no significant effect on economic growth in the long run, which is established by the higher P-values recorded.

In HCD, which represents human capital development, the findings show that a lack of human capital development is a drag to economic growth for the ECOWAS sub-region in the long run. The study observed that, in the long run, a 1% increase in HCD would lead to 0.56% increase in growth, which is GDP per capita. The study also observed that the negative partial sum of HCD also decreases growth in the long run. Specifically, a 1% decrease in HCD will decrease growth among ECOWAS member countries by 0.50%. However, an intriguing observation from the positive and negative partial sum of HCD is that, in the long run, a positive increase in HCD has a positive and significant effect on economic growth among ECOWAS member countries, although its impact is difficult to measure because its effect is significant at 10% level, which would eventually dissipate. Still on the control variables, HC, which represents household consumption, shows that a 1% increase in household consumption will increase growth by 0.52%, while a 1% decrease in household consumption will also decrease growth by 0.50%. This result shows that the positive partial sum and the negative partial sum of household consumption are largely symmetric because the coefficient is almost the same, albeit with a significant impact in the long run. This means that, in the long run, household consumption has a significant effect on economic growth. The probability of the positive partial sum of investment (INV) is estimated at (0.2837) which shows that, in the long run, an increase in investment increases

growth in the sub-region; its impact is not significant. Specifically, a 1% increase in investment will lead to 0.10% increase in economic growth while a 1% decrease in investment will lead to 0.10% decrease in investment. The effect of both positive and negative partial sums on economic growth in the sub-region is not significant in the long run. This relationship also seems symmetric in the long run. Finally, a 1% increase in domestic savings (DS) decreases growth by 0.00% in the long run. This means that domestic savings have no effect on GDP per capita while a 1% decrease in domestic savings (DS) increases GDP per capita by 0.00%. This result shows that irrespective of whether domestic savings increase or decrease, it has no effect on the economic growth of ECOWAS member countries. This relationship also seems symmetrical in nature.

The short-term results show that GDP lags have a positive effect on GDP, and the effect is statistically significant in the short run. Specifically, GDP (-1), GDP (-2), and GDP (-3) had coefficients of 1.0153, 0.6595, and 0.268971, respectively with probability less than 1%. Lag of positive partial sum of unemployment has a negative effect on GDP; in particular, a 1% increase in unemployment will reduce GDP by 0.58%, which is significant at 10% level. On investment, it was realized that, in the short run, a 1% increase in investment will lead GDP to increase by 0.75% and significant at 10% level, although the lags of investment show different results. The variables that were not significant in the short run were not reported because of the estimation method of the Stepwise Least Square regression, which relies on choosing unidirectional, backward, and a P-value of 0.10. The interpretation of this setting is that it removes the variables that are not significant at 10%.

5.5.2.3 Testing the presence of asymmetry

Both positive and negative changes in remittance and labor migration have positive and negative effects on economic growth (GDP per capita). Are they (statistically) different? An asymmetry test tests whether the coefficients are equal. If they are equal, then there is no asymmetry; if they are not, then there is evidence of asymmetry. This study focused on the asymmetry test only on remittance and labor migration, since they are the main variables for the study, while the rest are control variables. The long-run asymmetry results from the Wald test were derived using this equation. The results are reported in table.

$$H_0: \text{No long run asymmetry} \quad H_0: \frac{-\varphi_1^+}{\rho} = \frac{-\varphi_1^-}{\rho} = \frac{-c(3)}{c(2)} = \frac{-c(4)}{c(2)}$$

$$H_A: \text{There is long run asymmetry} \quad H_A: \frac{-\varphi_2^+}{\rho} \neq \frac{-\varphi_2^-}{\rho} = \frac{-c(3)}{c(2)} \neq \frac{-c(4)}{c(2)}$$

Table 5.13.A: symmetry test for remittance (long run)

Test Statistic	Value	df	Probability
t-statistic	-0.965855	201	0.3353
F-statistic	0.932877	(1, 201)	0.3353
Chi-square	0.932877	1	0.3341

Clearly, the null hypothesis of equality or symmetry cannot be rejected, as P-value is greater than 0.05% significance level. The Wald test indicates symmetry in the long run impact of remittance on GDP per capita (economic growth) among ECOWAS member countries.

Table 5.13.B: symmetry test for labor migration (long run)

Test Statistic	Value	df	Probability
t-statistic	1.980976	201	0.0490
F-statistic	3.924264	(1, 201)	0.0490
Chi-square	3.924264	1	0.0476

Clearly, the null hypothesis of equality or symmetry is rejected, as P-value is less than 0.05% significance level. The Wald test indicates asymmetry in the long run impact of labor migration on GDP per capita (economic growth) among ECOWAS member countries.

Short run coefficients were also derived using the Wald test. The Wald test was used for the equality of the sum of the positive and negative lags of each of the regressor. This wald test of additive short run symmetry, that is, adding up the positive and the negative coefficients, was used by Akcay (2019), p.6; Bahmani-Oskooee and Harvey (2017), p,147 and most importantly by Shin et al , 2014; pp 16, 19, 25, 41 in TS.

$$H_0: \sum_{t=1}^q \sigma_i^+ = \sum_{t=1}^q \sigma_i^-$$

$$H_0: \sum_{t=1}^q \lambda_i^+ = \sum_{t=1}^q \lambda_i^-$$

In estimating the NARDL by using the Stepwise Least Square regression, we rely on choosing unidirectional, backwards and set the P-value at 0.10. The interpretation of this setting is that it removes the variables that are not significant at 10% while it retains the variables of the entire long run coefficient, even if it is not significant. Thus, in the short run, only investment has the partial sum of positives and partial sum of negatives; hence, symmetry test is conducted only on investment in the short run.

Table 5.13.C: symmetry test for investment (short run)

Test Statistic	Value	df	Probability
t-statistic	-0.015699	201	0.9875
F-statistic	0.000246	(1, 201)	0.9875
Chi-square	0.000246	1	0.9875

The results of the Wald test show no asymmetry in the short run impact of investment on economic growth among ECOWAS member countries. After conducting the symmetry test, we focused our attention on the stability of the model parameters, which were demonstrated by plotting the recursive CUSUM and CUSUMSQ statistics against the break points. We tested based on the null hypothesis that parameters are not stable. We present the graphical representation of the parameter stability test in Figures 5.1 and 5.2. The CUSUM and CUSUMSQ statistics stability test (Brown et al., 1975) are plotted to ascertain the significance of trajectory at the 95% confidence bounds. Figures 5.1 and 5.2 show the rejection of null hypothesis, therefore, our study conclude that parameters in this regression are stable

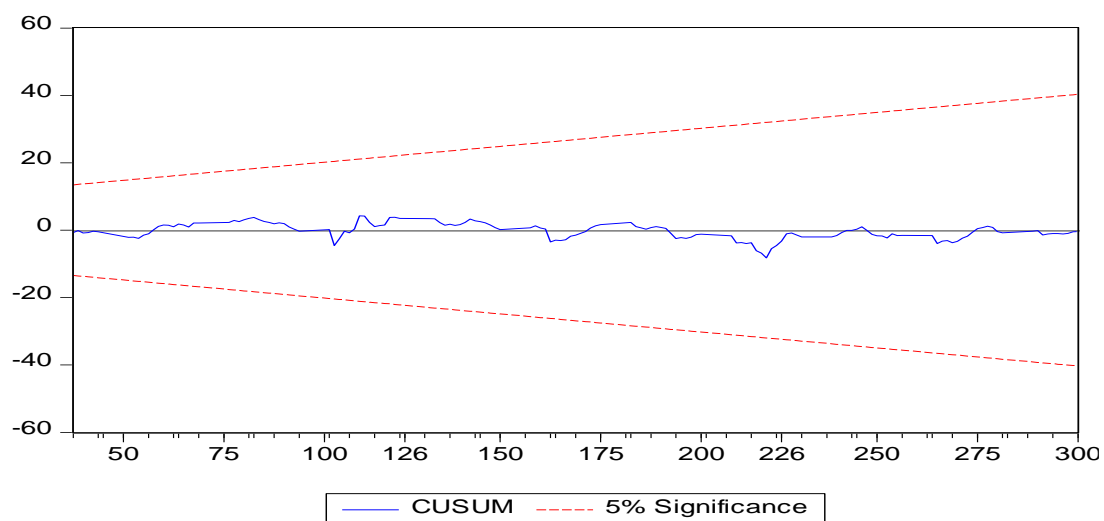


Figure 5.1: Cumulative sum test of stability

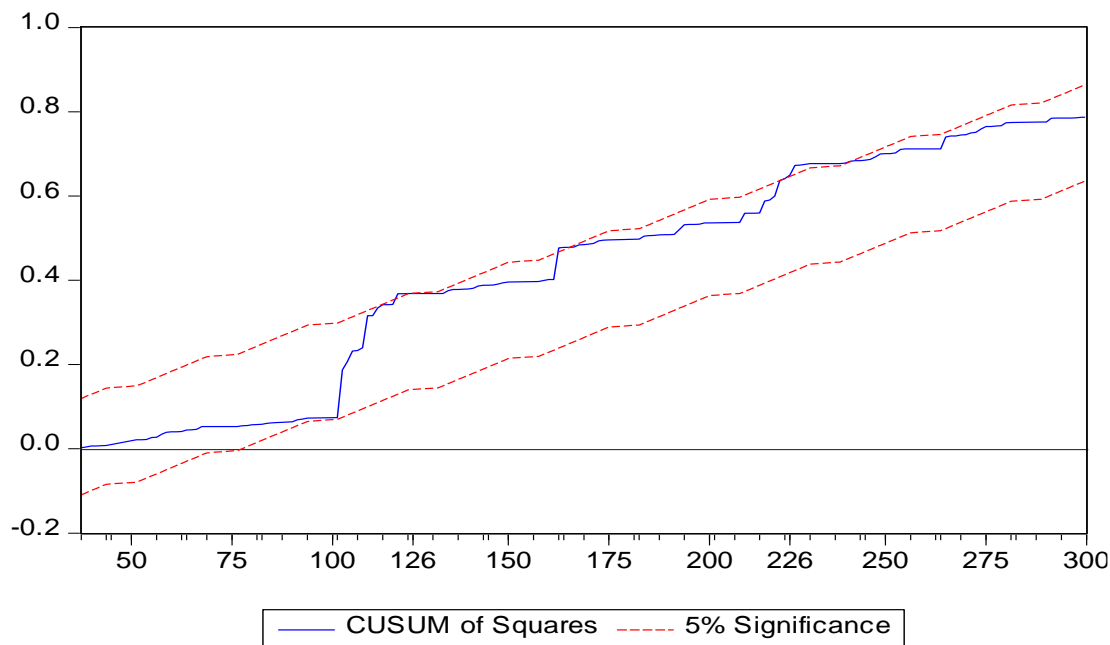


Figure 5.2: CUSUM sum of squares stability test

In addition, the robustness of the model is confirmed by a few diagnostic tests, as shown in Table 5.13 below, such as Autoregressive Conditional Heteroskedasticity (ARCH), Breusch Godfrey serial correlation Lagrange multiplier (LM), and the Jarque-Bera test. The Breusch-Godfrey serial correlation LM test indicates that there is no serial correlation problem in the model at the 5% significance level, that is, 95% confidence interval, while heteroscedasticity test also showed that there was no heteroskedasticity problem found. However, the Jarque–Bera (JB) test rejects the hypothesis that the residuals conform to a Gaussian distribution.

Table 5.14: Diagnostic test

Diagnostic Checking	F-Statistic	Probability
LM test	2.585248	0.0779
ARCH Test	0.196480	0.9399
Jarque-Bera Test	1037.401	0.0000

5.6 Conclusion and policy implication

This study aimed to examine the relationship between labor migration/mobility, and economic growth by relying on annual data for all 15 countries that belong to the ECOWAS sub-region spanning 2000–2020. Earlier studies that have attempted to investigate this relationship have always examined it in a linear framework, as they fail to decompose the various explanatory variables into positive and negative partial sums to assess the non-linearities in this labor mobility-economic growth nexus. This study first used LLC, IPS, ADF Fisher chi-square, and PP Fisher chi-square to examine the order of integration of the variables, since both ARDL and NARDL do not accommodate variables I (2). Although, this study focused on the non-linearities using NARDL, the baseline ARDL results were reported before the estimation of NARDL. Overall, our findings support the salutary effect of labor migration on economic growth in the ECOWAS sub-region. Specifically, the coefficient sign of the ARDL results from labor migration is the same as the positive partial sum of labor migration on economic growth in the NARDL model. That is, the ARDL results show that 1% increase in labor migration reduces GDP by 0.66% whiles the LMR_POS shows when there is an increase in labor migration, it reduces GDP by 0.16%. An intriguing observation is that its effect on economic growth in the long run is not significant in the NARDL model but is significant in the ARDL model. The conclusion on labor migration is that when such migration occurs, it affects the destination country. This is given credence from the results of the negative partial sum of labor migration (LMR_NEG) in the NARDL model, which shows that when there is a decrease in labor migration, it increases GDP by 1.36%, albeit insignificant in the long run. The relationship between labor migration and economic growth in the sub-region is asymmetrical. Regarding the effect of remittances on economic growth, the ARDL results show that a 1% increase in

remittances leads to a 0.28% reduction in GDP in the sub-region. Its impact is also very significant, however, the NARDL results show different pattern, which indicates that when there is a positive increase in remittance (REM_POS), it increases GDP by 0.06%, although its effect in the long run is not significant. It also shows that a decrease in remittance, leads to a reduction in GDP, although insignificant in the long run. The study observed that the impact of the explanatory variables on GDP are all significant in the ARDL model in the long run, except HCD, which represents human capital development, while the effect of all the explanatory variables on GDP in the NARDL is insignificant in the long run, except human capital development and household consumption at 10% significance level. The effect of HCD on economic growth is significant in the NARDL model but insignificant in the ARDL model. In the ARDL, the effect of investment on economic growth is positive and significant in the sub-region in the long run, while in the NARDL, the effect of investment on economic growth is only significant in the short run but not in the long run. Unemployment has a negative effect on GDP in the long run in both the ARDL and NARDL models; however, in the ARDL model, the effect on economic growth is significant while in the NARDL model; its effect is insignificant in the long run but significant in the short run. The effect of domestic savings (DS) is statistically insignificant in both the ARDL and NARDL models. The implication is that the financial system in the sub-region is not sufficiently robust to bring about financial inclusion. This shows that domestic savings are used for consumption rather than for investment. The results justify the examination of the relationship between labor migration/mobility and economic growth in a non-linear framework, since labor migration as the main explanatory variable has been seen to have an asymmetric effect on the growth of the economies of ECOWAS member countries. Our main conclusion is that irrespective of the model adopted, labor migration affects economic growth in

the long run, although its effect in the short run is minuscule. Policy-makers in the ECOWAS sub-region should institute pragmatic measures to reap the full benefits of migration. Notwithstanding this, our evidence reveals that irrespective of the time horizon, labor migration turns to help the origin countries more than the destination countries, since migrants remit money home rather than investing in the destination or receiving countries. From the findings, we can safely conclude that remittances sent to the origin countries are used to purchase food and consumer goods, pay for medicine and health care, pay for the education of the young, and invest in long-term capital projects such as paying for house/land rent, business, rebuilding of houses, and the purchase of land. The effect of remittances on economic growth among member countries is low; we therefore recommend that ECOWAS heads of state adopt policies that would encourage the use of remittances for physical and human capital investments to harness the full potential entrepreneurial and developmental goals. A deliberate policy by heads of state to encourage migrants to remit to their home country will be in the right direction, as it will contribute to the growth of their domestic economies. To reap the full benefits of remittance in the sub-region, the study recommends ECOWAS heads of state to strengthen their supervision role in aligning remittance towards a path consistent with long-run growth while adopting a flexible way to encourage remittance. These findings are robust to the labor migration proxy and estimation approach, and reaffirm our evidence on labor mobility and the economic growth nexus in the ECOWAS region. Future studies could also examine the regulatory and supervisory aspects of labor migration/mobility in the ECOWAS sub-region to allow for its full benefits in the region.

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APPENDICES

APPENDIX 5.1: Stepwise Least Square regression results

Dependent Variable: D(DGDP)
 Method: Stepwise Regression
 Date: 02/22/23 Time: 09:39
 Sample (adjusted): 2006 2020
 Included observations: 225 after adjustments
 Number of always included regressors: 16
 Number of search regressors: 64
 Selection method: Uni-directional
 Stopping criterion: p-value = 0.1

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.046885	0.146219	-0.320650	0.7488
DGDP(-1)	-2.560642	0.178830	-14.31888	0.0000
DREM_P(-1)	0.070079	0.128872	0.543790	0.5872
DREM_N(-1)	0.157456	0.131122	1.200838	0.2312
DLMR_P(-1)	-0.041575	1.760099	-0.023621	0.9812
DLMR_N(-1)	-3.486951	2.131157	-1.636177	0.1034
DUEM_P(-1)	-0.438521	0.319138	-1.374080	0.1709
DUEM_N(-1)	-0.357668	0.331120	-1.080176	0.2814
DHCD_P(-1)	1.452715	0.789540	1.839951	0.0673
DHCD_N(-1)	0.997426	0.731658	1.363240	0.1743
DHC_P(-1)	1.341951	0.715406	1.875790	0.0621
DHC_N(-1)	1.295156	0.728720	1.777302	0.0770
DINV_P(-1)	0.261559	0.243312	1.074993	0.2837
DINV_N(-1)	0.270880	0.170308	1.590535	0.1133
DDS_P(-1)	-0.013347	0.068142	-0.195865	0.8449
DDS_N(-1)	-0.024838	0.071551	-0.347129	0.7289
DDGDP(-1)	1.015352	0.144216	7.040473	0.0000
DDGDP(-2)	0.659568	0.106819	6.174607	0.0000
DDGDP(-3)	0.268971	0.058425	4.603726	0.0000
DDINV_P(-4)	-2.029051	0.479620	-4.230536	0.0000
DDINV_N(-3)	-1.263588	0.451357	-2.799532	0.0056
DDHCD_P(-3)	-1.378733	0.837030	-1.647173	0.1011
DDUEM_P(-3)	-0.581973	0.327074	-1.779332	0.0767
DDINV_P	0.755212	0.435670	1.733448	0.0845
R-squared	0.780552	Mean dependent var		-0.018177
Adjusted R-squared	0.755441	S.D. dependent var		1.849272
S.E. of regression	0.914519	Akaike info criterion		2.759700
Sum squared resid	168.1053	Schwarz criterion		3.124084
Log likelihood	-286.4663	Hannan-Quinn criter.		2.906767
F-statistic	31.08410	Durbin-Watson stat		2.043389
Prob(F-statistic)	0.000000			

Selection Summary

Removed DDREM_N(-1)
 Removed DDHCD_P(-4)
 Removed DDGDP(-4)
 Removed DDHCD_N(-4)
 Removed DDUEM_P(-1)

Removed DDREM_N
Removed DDUEM_P(-2)
Removed DDREM_P(-1)
Removed DDREM_P(-2)
Removed DDLMR_P(-2)
Removed DDINV_P(-1)
Removed DDHCD_N
Removed DDLMR_P(-3)
Removed DDLMR_N
Removed DDHCD_N(-1)
Removed DDHCD_N(-3)
Removed DDHC_N(-2)
Removed DDUEM_N(-2)
Removed DDREM_N(-4)
Removed DDUEM_N(-1)
Removed DDINV_N(-4)
Removed DDINV_N(-2)
Removed DDHC_P(-2)
Removed DDHC_N(-1)
Removed DDLMR_N(-2)
Removed DDLMR_N(-4)
Removed DDREM_P(-3)
Removed DDHC_P(-1)
Removed DDHC_N
Removed DDUEM_N
Removed DDUEM_P(-4)
Removed DDUEM_N(-3)
Removed DDINV_P(-3)
Removed DDINV_N
Removed DDHC_P
Removed DDLMR_P(-4)
Removed DDLMR_N(-3)
Removed DDHC_P(-3)
Removed DDHCD_P
Removed DDREM_P
Removed DDHCD_P(-1)
Removed DDINV_N(-1)
Removed DDINV_P(-2)
Removed DDLMR_P
Removed DDREM_N(-3)
Removed DDREM_N(-2)
Removed DDREM_P(-4)
Removed DDHC_N(-3)
Removed DDHC_P(-4)
Removed DDLMR_N(-1)
Removed DDUEM_N(-4)
Removed DDUEM_P
Removed DDLMR_P(-1)
Removed DDHCD_P(-2)
Removed DDHC_N(-4)
Removed DDHCD_N(-2)

*Note: p-values and subsequent tests do not account for stepwise selection.

APPENDIX 5.2: Cointegration results**Wald Test:**

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	15.07349	(15, 201)	0.0000
Chi-square	226.1024	15	0.0000

Null Hypothesis: $C(2)=C(3)=C(4)=C(5)=C(6)=C(7)=C(8)=C(9)=C(10)=C(11)=C(12)=C(13)=C(14)=C(15)=C(16)=0$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	-2.560642	0.178830
C(3)	0.070079	0.128872
C(4)	0.157456	0.131122
C(5)	-0.041575	1.760099
C(6)	-3.486951	2.131157
C(7)	-0.438521	0.319138
C(8)	-0.357668	0.331120
C(9)	1.452715	0.789540
C(10)	0.997426	0.731658
C(11)	1.341951	0.715406
C(12)	1.295156	0.728720
C(13)	0.261559	0.243312
C(14)	0.270880	0.170308
C(15)	-0.013347	0.068142
C(16)	-0.024838	0.071551

Restrictions are linear in coefficients.

APPENDIX 5.3.A: Symmetry test**Remittance (long run)**

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.965855	201	0.3353
F-statistic	0.932877	(1, 201)	0.3353
Chi-square	0.932877	1	0.3341

Null Hypothesis: $-C(3)/C(2)=-C(4)/C(2)$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
$-C(3)/C(2) + C(4)/C(2)$	-0.034123	0.035329

Delta method computed using analytic derivatives.

APPENDIX 5.3.B: Labor migration/mobility (long run)

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	1.980976	201	0.0490
F-statistic	3.924264	(1, 201)	0.0490
Chi-square	3.924264	1	0.0476

Null Hypothesis: $-C(5)/C(2)=-C(6)/C(2)$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
$-C(5)/C(2) + C(6)/C(2)$	15.53001	7.839576

Delta method computed using analytic derivatives.

APPENDIX 5.3.C: Investment (Short run)

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.015699	201	0.9875
F-statistic	0.000246	(1, 201)	0.9875
Chi-square	0.000246	1	0.9875

Null Hypothesis: $C(20)+C(24)=C(21)$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
$C(20) - C(21) + C(24)$	-0.010252	0.653004

Restrictions are linear in coefficients.

APPENDIX 5.4: Diagnostic tests**Breusch-Godfrey Serial Correlation LM Test:**

F-statistic	2.585248	Prob. F(2,199)	0.0779
Obs*R-squared	5.697991	Prob. Chi-Square(2)	0.0579

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 02/22/23 Time: 09:54

Sample: 2006 2020

Included observations: 225

Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005190	0.145106	0.035766	0.9715
DGDP(-1)	-0.067727	0.273213	-0.247889	0.8045
DREM_P(-1)	-0.016204	0.128180	-0.126414	0.8995
DREM_N(-1)	-0.021038	0.130445	-0.161277	0.8720
DLMR_P(-1)	-0.604300	1.766532	-0.342083	0.7326
DLMR_N(-1)	-0.442850	2.131576	-0.207757	0.8356
DUEM_P(-1)	-0.004014	0.316971	-0.012664	0.9899
DUEM_N(-1)	-0.003821	0.328543	-0.011629	0.9907
DHCD_P(-1)	0.047466	0.803047	0.059108	0.9529
DHCD_N(-1)	0.064385	0.741649	0.086814	0.9309
DHC_P(-1)	0.122776	0.714110	0.171928	0.8637
DHC_N(-1)	0.100245	0.726009	0.138077	0.8903
DINV_P(-1)	0.040359	0.242916	0.166142	0.8682
DINV_N(-1)	0.019252	0.169519	0.113572	0.9097
DDS_P(-1)	-0.008407	0.067826	-0.123948	0.9015
DDS_N(-1)	-0.008660	0.071249	-0.121543	0.9034
DDGDP(-1)	-0.119962	0.194957	-0.615325	0.5390
DDGDP(-2)	-0.014787	0.121667	-0.121539	0.9034
DDGDP(-3)	0.009223	0.063478	0.145298	0.8846
DDINV_P(-4)	-0.157031	0.481000	-0.326468	0.7444
DDINV_N(-3)	0.058679	0.450427	0.130274	0.8965
DDHCD_P(-3)	-0.378487	0.849472	-0.445555	0.6564
DDUEM_P(-3)	0.079926	0.326780	0.244585	0.8070
DDINV_P	-0.150711	0.437758	-0.344280	0.7310
RESID(-1)	0.226241	0.154525	1.464105	0.1447
RESID(-2)	-0.285602	0.133040	-2.146744	0.0330
R-squared	0.025324	Mean dependent var		3.71E-16
Adjusted R-squared	-0.097122	S.D. dependent var		0.866297
S.E. of regression	0.907390	Akaike info criterion		2.751828
Sum squared resid	163.8481	Schwarz criterion		3.146577
Log likelihood	-283.5806	Hannan-Quinn criter.		2.911150
F-statistic	0.206820	Durbin-Watson stat		2.109130
Prob(F-statistic)	0.999988			

Heteroskedasticity Test: ARCH

F-statistic	0.196480	Prob. F(4,160)	0.9399
Obs*R-squared	0.806519	Prob. Chi-Square(4)	0.9376

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 02/22/23 Time: 09:57

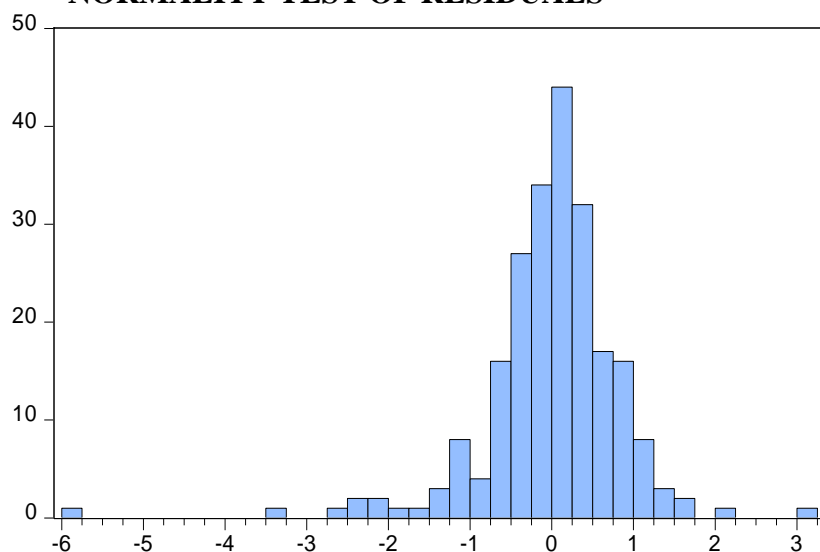
Sample (adjusted): 2010 2020

Included observations: 165 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.540447	0.126853	4.260414	0.0000
RESID^2(-1)	-0.000514	0.078986	-0.006506	0.9948
RESID^2(-2)	0.012877	0.076119	0.169165	0.8659
RESID^2(-3)	0.020931	0.038567	0.542712	0.5881
RESID^2(-4)	0.016337	0.035694	0.457690	0.6478

R-squared	0.004888	Mean dependent var	0.583115
Adjusted R-squared	-0.019990	S.D. dependent var	1.332050
S.E. of regression	1.345298	Akaike info criterion	3.460942
Sum squared resid	289.5721	Schwarz criterion	3.555061
Log likelihood	-280.5277	Hannan-Quinn criter.	3.499148
F-statistic	0.196480	Durbin-Watson stat	1.658535
Prob(F-statistic)	0.939933		

NORMALITY TEST OF RESIDUALS



Series: Residuals	
Sample 2006 2020	
Observations 225	
Mean	3.71e-16
Median	0.081875
Maximum	3.016660
Minimum	-5.790227
Std. Dev.	0.866297
Skewness	-1.719069
Kurtosis	12.94160
Jarque-Bera	1037.401
Probability	0.000000

CHAPTER SIX

CAUSAL RELATIONSHIP BETWEEN TRADE OPENNESS AND ECONOMIC GROWTH AMONG ECOWAS COUNTRIES

6.1 Introduction

The Economic Community of West African States (ECOWAS) was established in 1975 in Lagos when heads of states signed a treaty with the objective of bringing improvement and enhancement in trade, international cooperation, and to increase her economic resilience. Member countries of ECOWAS share common political and cultural orientation and it consist of fifteen member nations which are The Gambia, Ghana, Guinea, Sierra Leone, Nigeria, Liberia, and Cape Verde. These countries constitute the West African Monetary Zone. The rest are Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo, and Benin. These countries also constitute the West African Economic and Monetary Union. One of the founding members of the Union – Mauritania withdrew her membership in December 2000 to join the Maghreb union consisting of Libya, Morocco, and Algeria; but staged a comeback in August 2017 to be an associate-member of the Regional body (ECOWAS, 2020).

According to the endogenous growth models, trade openness has the potential of bringing growth in the long-run through increase in market size and the transmission of technologies (Grossman & Helpman, 1991; Rivera-Batiz & Romer, 1990). Since the Abuja treaty in 1975 which brought the formation of ECOWAS, it has instituted a trade policy which is designed to improve trade relations among member countries and to enhance economic activities in the sub-region in such a way as to positively impact on the economic well being of ECOWAS citizens. Despite these efforts by ECOWAS, the region trades more with the developed countries. For instance, even

though Senegal and the Gambia are neighbors that share border, trade relations between the two countries are still very minimal. Senegal's largest trading partner is France, while Gambia trades substantially with the United Kingdom (Mutune, 2002). ECOWAS member countries have experienced low economic performance and some countries are classified as low and middle income nations ((Iyoha & Okim, 2017). The Africa Growth Initiative report (2016) states that most ECOWAS countries are experiencing low rates of economic growth, growing poverty rates, increased corruption, rising populations, weak industrial development, and also faced challenges in global market. This is despite the huge natural resources coupled with the abundant labour force in the region. As a result of this, there has been series of discussions among African heads of state to remove trade barriers on the continent through the implementation of the African Continental Free Trade Area.

The African Continental Free Trade Area (AfCFTA) is one of the flagship projects of the African Union (AU) Agenda 2063. The objective of the AfCFTA is to significantly boost intra-Africa trade, particularly trade in value-added production and trade across all sectors of Africa's economy. It is expected to bring 55 countries of the African Union (AU) and eight (8) Regional Economic Communities (RECs) to create a single market for the continent.

The objective of this study is in three folds. First, to assess whether trade openness still play a crucial role on the economies of ECOWAS countries prior to the formation of the AfCFTA. Second, whether trade openness can induce simultaneous growth among member countries and third, how the economies of ECOWAS together can respond to shocks that can emanate from trade openness. These studies are not replete in the literature when a panel of fifteen member countries is examined on these objectives before the formation of AfCFTA. This is the motivation for this study, given the fact that the commencement of trading under the AfCFTA

was in January 1, 2021, we empirically assess one of the regional groupings which is ECOWAS to understand whether the practical implementation of the AfCFTA which is to foster industrialisation, job creation, investment, and enhancing competitiveness of Africa in the medium to long term is feasible. We achieve this objective by employing three methods. These are the PMG/ARDL, the Dumitrescu and Hurlin Granger causality test and the Impulse Response Function. The PMG/ARDL model has a practical advantage of examining the short and long run relationships, and the Dumitrescu and Hurlin Granger causality test is an improved version of the conventional Granger causality test by Granger (1969) because it is able to homogeneously determine causality in a panel setting while the Impulse Response Function enables us to detect the transmission effect of shocks. These methodologies have received little attention in estimation analysis in the context of studies in ECOWAS. This shows that more empirical work using these methodologies on this relationship seems warranted, given its obvious policy relevance.

The study findings provide empirical evidence on the long-run effect of trade openness on the growth of economies in the sub-region; however, there is no significant relationship between trade openness and economic growth in the short run. Our results evidence homogeneous causality from trade openness to growth while the response of economic growth from trade shocks fluctuates throughout the 10-year period. Our findings supported endogenous growth model's postulation that trade openness has positive effect on growth in the long run for ECOWAS countries before the formation of AfCFTA. We contribute to knowledge by examining the preparedness of one of the regional blocs prior to joining the AfCFTA. These findings will help heads of state to determine whether the introduction of a single currency is appropriate ex-post.

The rest of the chapter is as follows: the next section provides a review of the theory underpinning this objective while section 6.3 reviews the empirical literature. Section 6.4 outlines the data and empirical strategy while section 6.5 presents the findings. Section 6.6 highlights the policy implications and concludes the study.

6.2 Theoretical Literature

6.2.1 Endogenous Growth Models in Open Economies-Theory and Evidence

The processes that serve as a conduit for the linkage between trade and economic growth is still an open question in the theoretical literature. Based on this exposition, several scholars have written on the theoretical linkage. One of such theories is the endogenous growth theory by Romer (1980) and Lucas (1988). This theory asserts that trade can help countries to enjoy higher economic growth through dynamic gains. One of the submissions by Romer (1991) in the endogenous growth theory is that, when there is trade openness, it can stimulate open competition which will drive innovation, technological advancement, efficiency and greater allocation of resources.

The Heckscher-Ohlin model states that, in a situation where there are two resources in two economies especially when the resources are labor intensive and capital intensive, and then when there is trade openness, it can result in higher productivity which can make incomes earned in the respective countries to increase. In the new trade theory by Krugman (1979), it is stated that total output of a country increases when there is trade liberalization in that country.

There are several ways for countries to experience economic growth and among some of the ways are these three important conduits. These are productivity transfusion, accumulation of resources, and innovation (Srinivasan, 2001). When there is trade openness, it can improve the prospects of economic growth of countries by manipulating any of the three sources of growth.

For example when there is an economy that is opened, it can obtain factors of production easily from outside the country compared to a closed economy.

Rivera-Batiz (1995) summarized different ways through which trade and knowledge are related. The first way through which such connection can be realized is the re-allocation effect. This is whereby trade openness affects economic growth through the reallocation of resources among different factors.

The second way by which trade and knowledge are related is the spillover effect. When there is trade openness, it leads to transfer of knowledge among countries. When there are trade restrictions, it reduces the flow of technological information among countries and this can cause negative effect on long run growth. Third, is competition, when there is competition as a result of trade openness; it leads to knowledge sharing and increase competition among domestic firms. When this happens, it leads to economic growth through innovation. The third type of effect which is the competition effect is linked with simulation. That is developed economies innovates and less developed economies imitates (Grossman & Helpman, 1991).

6.3 Empirical Literature

In this section, the empirical review on trade openness and economic growth in ECOWAS is grouped into evidence based on impact studies, and evidence based on causal studies.

6.3.1 Evidence based on impact studies

Abendin and Duan (2021) used data consisting of African countries which has ECOWAS member countries included to assess whether digital economy and international trade play a role on Africa's economic growth. The study used the POLS, random effect, and fixed effects, and

the system Generalized Methods of Moments to empirically examine this relationship. The findings revealed that trade has a large positive impact on economic development in Africa.

Ijirshar (2019) examined the effect of trade liberalization on economic growth by utilizing data from 1975-2017 for ECOWAS countries. The study used the Hausman test to decide between the Pooled Mean Group (PMG) and Mean Group (MG). The PMG estimator was preferred following the result of Hausman test. The results showed that, in the long run trade openness has positive effects on growth in ECOWAS countries. However, in the short run, the results show mixed effects. The study recommends member countries to improve on their cooperation by using export consortia to help small and medium enterprises to have full access to international markets.

In a country specific study, Nketiah et al. (2019) examines the link between trade openness, foreign direct investment and economic growth in Ghana. The study period covered the year 1975-2017 and the descriptive analysis, Augmented Dickey-Fuller (ADF) test for unit root, Pearson correlation and regression estimation techniques were used to assess this relationship. The study findings reveal that trade openness is the main factor influencing growth in Ghana. In ECOWAS study, Malefane and Odhiambo (2018), used the autoregressive distributed lag (ARDL) bound testing approach to examine the dynamic impact of trade liberalization on economic growth. The result showed that trade openness has a positive and significant impact on economic growth in the long run when the ratio of total trade to GDP is used as a proxy.

Moyo (2018) assessed the effect of openness to trade on the economic growth of Ghana, and Nigeria for the period 1980 to 2016. The variables used for this study were investment, trade openness, inflation and exchange rate as the explanatory variables and the study used the ADF and the PP unit root test as well as the ARDL for the data estimation. The study revealed that,

there exist a long run association among the variables for both Ghana, and Nigeria. However, human capital development (secondary school enrolment) which is the bedrock of the endogeneous growth model by Mankiw, Romer and Weil (1992) was excluded from the regression model estimation which is inconsistent with economic growth theories. This questions the validity of the results by Moyo (2018).

Tozoke et al. (2018) examined the impact FDI has on economic growth of some countries that belong to the ECOWAS region. The study used nine countries which included Ghana, Cote d'Ivoire and Nigeria for a study that spanned from 1995 to 2015. The variables used for this study are trade openness, FDI, inflation and government final consumption using panel data approach. The result showed that free trade has a positive though insignificant effect on economic growth in the sub-region.

Iyoha and Okim (2017) examined the effect of trade openness on the economies of ECOWAS for the period 1990 to 2013. The study used pooled OLS, Fixed effects model, Random effects model, and dynamic panel regression model although the dynamic panel data estimator was preferred to handle the problem of endogeneity. The study found that exports, exchange rate and investment were significant determinants of per capita real income growth and that exports were consistently positively related to growth, which suggests that trade has a significant positive impact on economic growth in ECOWAS member countries.

In a country specific study, Keho (2017) investigated the relationship that exist between trade openness and economic growth in Cote d'Ivoire by using the Autoregressive Distributed Lag bounds test to cointegration and the Toda and Yamamoto Granger causality tests for the period 1965 and 2014. The study established positive effect of trade openness on economic growth for

the study period. The limitation of this study is that, the method employed is not robust to solve the problems of omitted variables and the issue of endogeneity among the variables.

Zahanogo (2017) used data that covered the period from 1980 to 2012 from Sub-Saharan African countries which includes three ECOWAS countries namely, Nigeria, Ghana and Cote d'Ivoire to assess the association that exist between trade liberalization and economic growth. The study utilized a dynamic model and applied the PMG which is the pooled Mean Group estimation technique for the data estimation. The study revealed that a certain threshold should be attained before openness to trade can have any substantial impact on the growth of these economies. The impact of free trade or the liberalization of trade is not linear which suggest that the numerous advantages that can be derived from openness to trade are not assured.

Kim et al. (2016) employed the Cross-Sectional Augmented Autoregressive Lag (CS-ARDL) panel data approach to assess whether there is a significant relationship between trade openness, economic growth, and growth volatility for a period spanning 1960 to 2011. The study used 73 countries which included ECOWAS member countries. The study report that more trade openness improves economic growth albeit higher volatility in growth according to the findings.

Sakyi, Commodore and Opoku (2015) examined whether FDI and openness to trade have long run influence on the economic performance in Ghana for the period 1970 – 2011, within the framework of the endogenous growth literature. Autoregressive Distributed Lag bounds testing approach to cointegration was used for the study. The study revealed that, FDI and exports are critical for the growth of the Ghanaian economy. However, the empirical discourse is whether this result can be justified when all fifteen countries in the sub-region are considered.

Other studies also report of no effect of trade openness on economic growth in the sub-region. The studies by Guei and Roux (2019) used data that covered all the 15 countries that belong to ECOWAS for a period spanning 1990-2016. They used the Autoregressive Distributed Lag (ARDL) bound testing approach and the Pooled Mean Group (PMG) model to examine the relationship. The findings reveal that trade openness has a negative effect on GDP per capita in the long run. The study recommend ECOWAS to liberalize all sectors and also create value addition to their production of goods and services to mitigate poverty and boost income since the lifting of trade barriers in all sectors among ECOWAS members would not contribute to growth.

Studies by Adu-Gyamfi et al. (2020) examined the effect of trade openness and inflation on economic growth by using nine countries in West-Africa for a period 1998 to 2017. The pooled ordinary least squares (OLS), fixed effect (FE), and random effect (RE) tests were employed to examine this relationship. The study findings reveal that trade openness has a significant negative effect on economic growth (GDP) when the pooled OLS results are used and a small effect using the fixed and random procedures.

Using some selected countries in the West African region, Wiredu et al. (2020) assessed the relationship between trade liberalization, foreign direct investment (FDI) and economic growth for Côte d'Ivoire, Ghana, Nigeria, and Senegal using data that covered the period 1998-2017. They used the static panel regression techniques to assess this relationship and evidence from the statistical analysis suggests that aggregated trade liberalization does have a positive and significant effect on economic growth in Côte d'Ivoire, Ghana, Nigeria, and Senegal.

6.3.2 Evidence based on causal studies

Egbulonu and Ezeocha (2018) investigated whether openness of trade has a positive or negative influence on economic growth for the period 1990 to 2015. The study used the Autoregressive Distributed Lag approach to cointegration and the Granger causality tests to examine the relationship. The results from the Granger causality test indicates that, there exist a unidirectional causality running from GDP to foreign direct investment, trade openness to foreign direct investment, exchange rate to gross fixed capital formation and gross fixed capital formation to trade openness. The limitation of this study is that, the scope concentrates on only one country in the sub-region and also the exclusion of human capital development as an explanatory variable is contrary to the new economic growth theories which put more attention or prominence on the role of human capital development.

In East African Community (EAC), Kisava and Myovella (2018) used the Dumistrescu and Hurlin (2012) panel causality test to examine the link between trade openness and economic growth. The study used data spanning 1970 to 2016 and the empirical findings reveal bidirectional movement in this relationship. Such methodology is scarcely used to examine the relationship in question in the context of ECOWAS. This study adds to the literature in the context of ECOWAS.

Some studies also report of no causal relationship between trade openness and economic growth. Agbahoungba and Biao (2019) examined the causal link between trade liberalization and economic performance for twelve ECOWAS member countries by utilizing data that covered the period 2000-2017. The Granger causality estimation approach was used by this study and results show that trade liberalization does not cause any of the economic performance variables examined in the study. The study recommend economic policy makers to rigorously assess trade

agreements and policies and to take into account certain macroeconomic aspects and country-specific characteristics of the West African community.

6.3.3 Gaps in literature

In sum, the empirical evidences on trade openness and economic growth focusing on ECOWAS sub-region are mixed. This study contributes to extant literature in four ways. First, most of the studies focusing on ECOWAS sub-region have investigated the long time-frame spanning over several decades for policy recommendations. However, the short-timeframe is a lacuna in extant literature in the context of ECOWAS. We therefore contribute to literature by using the PMG/ARDL to examine both the short run and the long run dynamics. This will help policy advisors in the ECOWAS region to strategize in the short run to make high growth rates their key policy goal.

Second, whether trade openness simultaneously and homogeneously induces economic growth for all the fifteen countries in the ECOWAS region has not been studied enough. This study fills that lacuna in the context of ECOWAS.

Third, how the economy responses to shocks from trade openness has not been studied enough in the ECOWAS region. This study examines the impact of shocks from trade to economic growth thereby making a modest contribution to extant literature.

Fourth, the non-inclusion of human capital development among the variables when establishing the relationship between trade openness and economic growth in ECOWAS contradicts the Mankiw, Romer and Weil (1992) endogenous growth theory which postulates that human capital development (secondary school enrollment) is one of the mechanism for the acquisition of knowledge which drives economic growth. This study adds the human capital development

(HCD) variable in the estimation analysis thereby giving it a different perspective in the studies in ECOWAS. These gaps enumerated are the motivation for this study.

6.4 Empirical Methodology

6.4.1 Panel ARDL-PMG approach by Pesaran et al. (1999)

This study employed the PMG/ARDL model developed by Pesaran et al. (1999). Pesaran et al. (1999) developed the PMG estimator and it involves pooling and averaging of the coefficients over the cross sectional units. The study adopted the PMG/ARDL model for three main reasons: first, it is compatible with the data set used in this study and secondly, the pooled mean group estimator makes the long-run coefficients to be identical, however, it allows the short-run coefficients as well as the error variances to differ across groups. Thirdly, it has the practical advantage that allows the data to be determined for each country's short-run dynamics by taking into consideration the number of time-series observations available in each case. The justification of employing the ARDL model is its adequacy to the data set. First, it can accommodate mixture of stationarity of variables such as I(0) and I(1) and not I(2) like this study. It is also suitable for studies with small sample size. This study contains 15 cross sections and 20 year time series, which are relatively small for most panel studies but can be taken care of in ARDL models. Finally, it captures the dynamics of variable of interest in both the short run and the long run.

The Mean group (MG), the dynamic fixed effects (DFE) and the pooled mean group (PMG) use the ARDL in the estimation process, however, to determine which one to apply, one needs to use the Hausman test to select the appropriate model. This study used the Hausman test to arrive at the choice of the PMG. The ARDL (p, q, q q) model can have the form;

$$y_{it} = \sum_{j=1}^p \gamma_{ij} y_{i,t-j} + \sum_{j=0}^q \beta'_{i,j} X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (6.1)$$

Where, t is the period ($t = 1, 2, 3 \dots T$) and the countries are represented by i ($i = 1, 2, 3 \dots N$); X_{it} ($k \times 1$) represents the vector of explanatory variables for group i ; μ_i is the fixed effect; γ_{ij} is scalar to denotes the coefficients of lagged dependent variable; β_{ij} are $k \times 1$ coefficient vectors and the error term is represented by ε_{it}

The error correction model for the re-parameterized ARDL ($p, q, q \dots q$) may be specified as;

$$\Delta y_{it} = \theta_i [y_{i,t-1} - \lambda'_i X_{i,t}] + \sum_{j=1}^{p-1} \gamma_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \beta'_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (6.2)$$

Where GDP per capita growth rate is represented by y ; X is a set of explanatory variables (trade openness, human capital development, foreign direct investment, gross fixed capital formation, population growth rate, inflation and exchange rate); θ_i represents the coefficient of the speed of adjustment to the long-run status; λ'_i stands for the vector of long-run relationships, $[y_{i,t-1} - \lambda'_i X_{i,t}]$ is the error correction term; γ_{ij} and β'_{ij} are short-run dynamic coefficients.

6.4.2 Dumitrescu and Hurlin (2012) non granger causality test

This study used the most recently developed Granger non-causality test in heterogeneous panels by Dumitrescu and Hurlin (2012) to examine the causal relationship that exist between trade openness and economic growth for the 15 ECOWAS member countries between 2000 and 2021. This panel causality test is a simple version of the Granger (1969) non-causality test for heterogeneous panel data models with fixed coefficients which considers two aspects of heterogeneity; the heterogeneity of the regression model used to test the Granger causality and the heterogeneity of the causal relationships.

The study first considered the following linear model:

$$y_{i,t} = \alpha_i + \sum_{k=1}^k \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^k \beta_i^{(k)} x_{i,t-k} + \varepsilon_{it}, \quad i = 1, 2, \dots, N : 1, 2, \dots, T \quad (6.3)$$

Where x and y are two stationarity variables observed for N individuals in T periods. $\beta_i = (\beta_i^{(1)}, \dots, \beta_i^{(k)})'$ and the individual effects α_i are presumed to be fixed in the time dimension. We assume that lag orders of K are identical for all cross-sectional units of the panel. We also allow the autoregressive parameters $\gamma_i^{(k)}$ and the regression coefficients $\beta_i^{(k)}$ to vary across the groups. The null hypothesis of this model assumes no causality association for any of the units of the panel. The assumption of no causal relationships among the units of the panel is termed the Homogeneous Non-Causality (HNC) hypothesis, which is defined as:

$$H_0 : \beta_i = 0 \quad \forall_i = 1, \dots, N$$

The alternative is stated explicitly as the Heterogeneous Non-Causality (HENC) hypothesis. Under this hypothesis, we allow for two subgroups of cross-section units.

There is a causality association that emanates from x to y for the first one, but it is not necessarily based on the same regression model. For the second subgroup, there is no causality relationship from x to y . We consider a heterogeneous panel data model with fixed coefficients (in time) in this group. This alternative hypothesis is as follows:

$$H_1 : \beta_i = 0 \quad \forall_i = 1, \dots, N_1$$

$$\beta_i = 0 \quad \forall_i = N_1 + 1, \dots, N$$

The study assumed that β_i may vary across groups and there are $N_1 < N$ individual processes with no causality from x to y . N_1 is unknown though it provides the condition $0 \leq N_1/N < 1$.

We proposed the average statistic $W_{N,T}^{HNC}$, which is related with the null Homogeneous Non-Causality (HNC) hypothesis, as follows:

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^N W_{i,T} \tag{6.4}$$

Where $W_{i,T}$ represents the individual Wald statistics for the i^{th} cross-section unit which corresponds to the individual test $H_0 : \beta_i = 0$.

Let $Z_i = [e : Y_i : X_i]$ be the $(T, 2K+1)$ matrix, where e indicates a $(T,1)$ unit vector and

$Y_i = [y_i^{(1)} : y_i^{(2)} : \dots : y_i^{(k)}]$, $X_i = [X_i^{(1)} : X_i^{(2)} : \dots : X_i^{(k)}]$. $\theta_i = (\alpha_i y_i' \beta_i')$ is a vector of the parameters of the model.

Also let $R = [0 : I_K]$ be a $(K, 2K + 1)$ matrix

For each $I = 1, \dots, N$, the Wald statistic $W_{i,T}$ corresponding to the individual test $H_0 : \beta_i = 0$ is

$$\text{defined as } W_{i,T} = \hat{\theta}_i' R' [\hat{\sigma}_i^2 R (Z_i' Z_i)^{-1} R']^{-1} R \hat{\theta}_i \quad (6.5)$$

Under the null hypothesis of non-causality, each individual Wald statistic converges to a chi-squared distribution with K degrees of freedom for $T \rightarrow \infty$.

$$W_{i,T} \rightarrow \chi^2(k), \forall i = 1, \dots, N$$

The standardized test statistic $Z_{N,T}^{HNC}$ for $T, N \rightarrow \infty$ is as follows:

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}} (W_{N,T}^{HNC} - K) \rightarrow N(0, 1) \quad (6.6)$$

Also, the standardized test statistic \hat{Z}_N^{HNC} for fixed T samples is as follows:

$$\hat{Z}_N^{HNC} = \sqrt{\frac{N}{2K}} \times \frac{(T-2K-5)}{(T-K-3)} \times \left[\frac{(T-2K-3)}{(T-2K-1)} W_{N,T}^{HNC} - K \right] \rightarrow N(0, 1) \quad (6.7)$$

In (3) and (4), $W_{N,T}^{HNC} = (1/N) \sum_{i=1}^N W_{i,T}$.

The comprehensive information about these statistics can be found in the study of Dumitrescu and Hurlin (2012).

6.4.3 Impulse Response Function and Forecast Error Variance Decomposition

This estimation technique is adopted to investigate how innovations or impulses to Gross Domestic Product (GDP) reverberate or takes a rebound through the system and thus, provides an answer to one of the research gaps identified in the trade openness-economic growth nexus in the ECOWAS region: The third gap in literature on the trade openness and economic growth in the ECOWAS region is that most studies have not ascertained the level of resilience for growth or recovery when there is innovation or shock emanating from trade openness to economic growth in the ECOWAS sub-region.

The Impulse Response Functions (IRFs) shows the effects of innovations or impulses on the adjustment path of variables. For instance, consider the first-order case (that is, with just one lag, with equation of evolution)

$$y_t = Ay_{t-1} + e_t \quad (6.8)$$

For developing (state) vector y and vector e of shocks. To determine, for instance, the effect of the j -th element of the vector of shocks upon the i -th element of the state vector 2 periods later, which is the particular impulse response,

$$y_{t-1} = Ay_{t-2} + e_{t-1} \quad (6.9)$$

This is used in the original equation to obtain

$$y_t = A^2y_{t-2} + Ae_{t-1} + e_t; \quad (6.10)$$

Aftermath, it is repeated by adopting lag 2 equation, to obtain

$$y_t = A^3y_{t-3} + A^2e_{t-2} + Ae_{t-1} + e_t \quad (6.11)$$

From this the effect of the j -th component of e_{t-2} upon the i -th component of y_t is the i, j element of the matrix A^2 . One can observe from the process of induction that, if there are any innovations or impulses, it will affect the elements of y infinitely far forward in time.

Nevertheless, the gravity of the impact may become smaller as time moves on with the assumption that the autogression procedure is fairly stable over time. This means that the entire Eigen values of the matrix A are less than 1 in absolute value (Lutkepohl, 2007). The main function of the Impulse Response Function (IRF) is that, in the Vector Autogression (VAR) system, it traces the effects of innovations or impulses to one variable which is endogenous on the other variables. In the VAR system, the Variance Decomposition partition or split the variation in an endogenous variable into the components shocks or impulses. The Forecast Error Variance Decomposition (FEVD) is employed to help in the explanation of a VAR model once it has been fitted (Lutkepohl, 2007). The Forecast Error Variance Decomposition (FEVD) is use to measure the contribution of each type of innovations or impulses to the Forecast Error Variance (that is, it examines the pass-through of external shocks to each economic variable). Assume we model y_t as follows,

$$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + e_t \quad (6.12)$$

This can be transformed to a VAR (1) structure by rewriting in a companion form

$$Y_t = V + AY_{t-1} + E_t \quad (6.13)$$

Where

$$A = \begin{bmatrix} A_1 & A_2 & \dots & A_{p-1} & A_p \\ I_K & 0 & \dots & 0 & 0 \\ 0 & I_K & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & I_K & 0 \end{bmatrix} y = \begin{bmatrix} y_1 \\ \vdots \\ y_p \end{bmatrix} V = \begin{bmatrix} v \\ 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix} \text{ and } u_t = \begin{bmatrix} \mu_t \\ 0 \\ \vdots \\ 0 \end{bmatrix} \quad (6.14)$$

Where y_t , v and μ represents k dimensional column vectors, A is $kp \times kp$ dimensional matrix and Y , V and E represents kp dimensional column vectors (Lutkepohl, 2007).

The mean squared error of the h -step forecast of variable j is

$$\text{MSE} [y_{j,t}(h)] = \Sigma \Sigma (e_j^1 \Phi_i e_k)^2 = (\Sigma \Phi_i \Phi_i^1)_{jj} = (\Sigma \varphi_i \Sigma_e \varphi_i^1)_{jj} \quad (6.15)$$

And where

1. e_j is the j^{th} column of I_K and the subscript jj represents the element of the matrix
2. $\Phi_i = \varphi_i P$, where P denotes a lower triangular matrix procured by a Cholesky decomposition of Σ_e such that $\Sigma_e = PP^1$, where Σ_e represents the covariance matrix of the errors e_t
3. $\varphi_i = JA^i J^l$, where $J = [I_K \ 0 \ \dots \ 0]$, so that J is $k \times kp$ dimensional matrix (Lutkepohl, 2007).

The quantity or volume of forecast error variance of variable j accounted for by exogenous shocks to variable k is denoted by $\omega_{jk,h}$,

$$\omega_{jk,h} = \Sigma (e_j^1 \Phi_i e_k)^2 / \text{MSE} [y_{j,t}(h)] \quad (6.16)$$

6.4.4 Data, samples, and preliminary analysis

The data for this study is gleaned from the World Bank database, specifically, the world development indicators. The economic growth is measured by the GDP per capita whiles trade openness is measured by total imports and exports as a percentage of GDP. The study realized that studies in the ECOWAS region have not considered human capital development (HCD) in their estimation analysis which contravenes the endogenous growth model. This study therefore adds HCD in the estimation variables. Following the works of Ourens (2016), and Ghoshal (2015), we introduced some control variables and these are; population growth rate, foreign direct investment, inflation rate, exchange rate and gross fixed capital formation. The variables

are transformed from the levels form into the natural logarithms form. The data sample for the study is from 2000-2020. This study employed annual data due to the availability of consistent data for these countries. Preliminary test included first generation unit root test and descriptive statistics. However, when cross sectional dependence is identified in the data generating process, this study employed the second generation unit root test by Pesaran (2007).

6.4.4.1 Descriptive/summary statistics

The summary of the descriptive statistics of the economic variables employed in this study objective to measure the causal relationship between trade openness and economic growth for the ECOWAS countries is shown below in Table 6.1. The critical statistics presented are the mean, median, maximum and minimum values, standard deviations, skewness and kurtosis of the variables.

Table 6.1: Descriptive statistics for the trade openness and economic growth for ECOWAS

Variable name	GDP	TO	POP	UNE MP	FDI	INF	EXCH	GFCF	HCD
Mean	1.516	65.913	2.678	5.293	4.721	6.238	1022.5	20.611	40.322
Median	1.919	57.893	2.649	4.653	2.481	3.818	497.16	19.722	39.212
Maximum	21.027	311.35	5.363	15.306	103.33	41.509	10133.	52.418	96.659
Minimum	-31.33	20.723	1.094	0.32	-2.544	-3.502	0.705	1.096	6.487
Std.Dev.	4.372	34.951	0.612	3.009	10.219	7.463	1945.2	7.994	17.735
Skewness	-1.592	3.575	0.249	0.609	6.897	1.862	3.096	1.077	0.812
Kurtosis	17.36	22.173	4.867	2.645	56.783	7.373	12.064	4.902	4.164
Jarque-Bera	2839.911	5495.996	49.04903	21.16153	40464.09	432.9999	1581.869	108.3931	52.41908
Probability	0	0	0	0.0	0	0	0	0	0
Observations	315	315	315	315	315	315	315	315	315

Note: GDP, gross domestic product; TO, trade openness; POP, population; UNEMP, unemployment; FDI, foreign direct investment; INF, inflation; EXCH, exchange rate; GFCF, gross fixed capital formation; HCD, human capital development

Over the period 2000-2020, the growth rate of GDP per capita was 1.51 percent. This can be said to be a modest rate of growth. In the ECOWAS region, the maximum GDP per capita growth rate realized was 21.02 per cent and the lowest was negative 31.33 per cent. Gross fixed capital formation is usually used as a proxy for investments or stock of private capital (Žemgulienė, 2012). Capital is a crucial ingredient of GDP growth in the Solow and endogenous growth models. In the sub-region, investment was averaged around 20.61 percent with a maximum and minimum at 52.41 and 1.09 respectively.

Human capital development is a human capital index per person based on years of schooling (Barro & Lee, 2013) and returns to education (Psacharopoulos, 1994). Human capital development averaged 40.32 per cent. The HCD had a maximum of 96.65 and a minimum of 6.5. This level of human capital development can be regarded as encouraging, since developed countries have human capital development index slightly above 3.0. Average population growth rate for ECOWAS over the study period was high at 2.67 per cent. A rise in natural growth rate of a population is considered as an opportunity cost for productive activities (Bonfond, 2014). The highest population growth rate achieved was 5.36 per cent and the lowest was 1.09 per cent.

According to Table 6.1 the average rate of inflation for the period under consideration was 6.24 per cent. This rate of inflation rate is within the single digit as envisaged in the convergence criteria. According to this protocol, headline inflation rate should be less than 10 percent under Macroeconomic Convergence Criteria (WAMI, 2015).

Trade openness for the entire study period averaged 65.91 percent which is a relatively above average level of openness. Trade openness should be higher given that, the ECOWAS countries have increased their participation in international trade by eliminating trade restrictions among

member countries. Trade openness increases competition thereby creating scope for increasing productivity and innovation. Firms can also enjoy economies of scale due to large markets.

On the descriptive statistics for the exchange rate variable for the ECOWAS countries, its interpretation is not straight forward because all the West African monetary zone (WAMZ) have different currencies as against the fixed exchange rate regime for the West African economic and monetary union countries (WAEMU). Variables that had high standard deviations implying that they had a large deviation from their means were the exchange rate and trade openness. Their standard deviations were 1945.2% and 34.95% respectively. This indicates that ECOWAS countries are far from attaining convergence in these macroeconomic variables ex-ante. Population growth, unemployment and GDP had the lowest standard deviations of 0.612%, 3.009% and 4.37% respectively. Based on the skewness and the kurtosis, the data is not normally distributed.

6.4.4.2 Statistical Properties of the Variables

This sub-section presents investigation of statistical properties of the data, specifically panel unit roots because of the long time dimension of 20 years. Also investigated is whether the variables used to ascertain the causal relationship between trade openness and economic growth in the ECOWAS region have a problem of multicollinearity and cross sectional dependence.

6.4.4.2.1 Graphical representation of levels series

The graphical representation of the log of macroeconomic variables in establishing the link between trade openness and economic growth in the ECOWAS region in their level forms is exhibited in figure 6.1 which portrays that some variables are stationary at their level forms whiles some variables require first differencing to be stationary by visual inspection. Formal tests

of normality are provided in Table 6.1 to give further clarity to the visual inspections at their level forms.

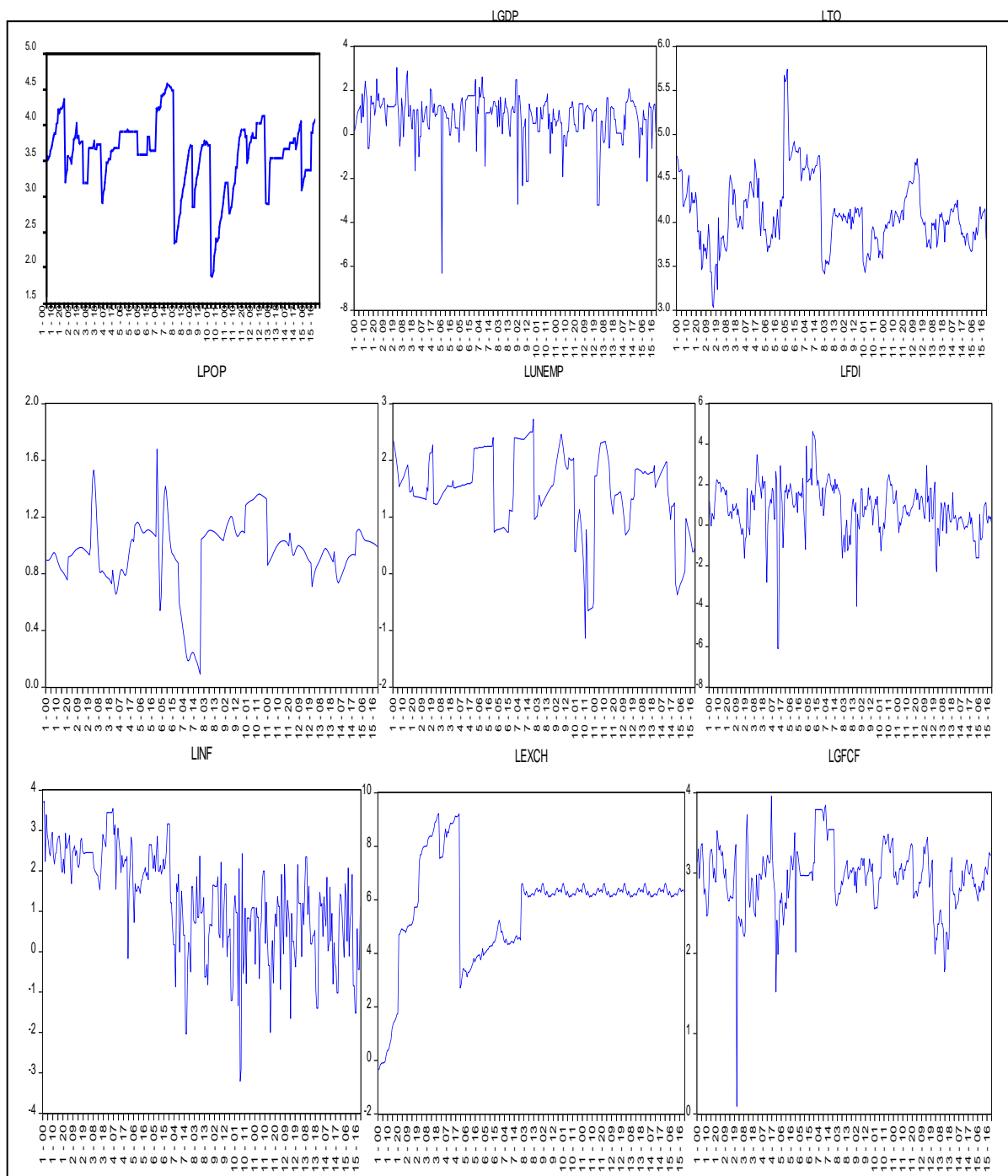


Figure 6.1: Graphical representations in levels form

6.4.4.2.2 Panel Unit Root Tests

The study covers the period 2000-2020 and totals to 20 years and 9 regressors. A time dimension of 20 years is a fairly long period and therefore the macroeconomic variables in the study were likely to have unit roots (Nelson & Plosser, 1982). A stochastic process is said to be stationary when the mean and variance do not change over time. Even though unit roots are often associated with time series dataset, there is also the need to test for stationarity of panel datasets. This is because running a regression with variables that are not stationary will produce spurious regression results (Nelson & Plosser, 1982). The study relied on four panel unit root tests: Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), ADF-Fisher chi-square and PP-Fisher chi-square. Our choice to use these panel unit root tests to examine the stationarity properties of the variables is situated on the ground construction of the individual test, where the weakness or the limitation of one is duly compensated for by the other. This is for purposes of determining the order of integration of variables and allow for comparison. The null hypothesis under LLC, IPS, ADF-Fisher chi-square and PP-Fisher chi-square is that the series contains a unit root against the alternative hypothesis that the panels are stationary.

The unit root test by Levin, Lin & Chu (2002) assume common unit root process while the unit root test by Im-Pesaran & Shin Weighted-Statistic, the Augmented Dickey Fuller (ADF)-Fisher Chi-Square and Philips-Perron (PP)-Fisher Chi-Square assume individual unit root process. When determining whether the series are stationary or otherwise, we compare the test statistics with the probability value to arrive at a decision. To procure the consistent estimates, we employ the Newey-West standard errors by Newey and West (1994) to correct for any standard errors, HAC (heteroscedasticity and autocorrelation-consistent) standard errors. The closest integer of 1 was chosen as the lag length, and the probabilities for the Fisher tests were computed by

applying the asymptotic Chi-square distribution, whilst all other tests rest on asymptotic normality.

The results of the panel unit root test in Table 6.1A indicated that, some variables were stationary at levels while others require first differencing. Since all the variables failed to conform to stationarity at level, we conducted first difference on all the series. The findings of the panel unit root test reported by Levin, Lin & Chu test, Im-Pesaran and Shin test, ADF-Fisher Chi-Square test and PP-Fisher Chi-Square test P-values at 5% level of significance, show that all the series in the model became stationary after differencing it once.

In other words, all the variables assume stationarity after the first difference. Table 6.1A presents the results for the unit root test for establishing the causal association that exist between trade openness and economic growth model.

Table 6.1.A: Panel unit root tests for the causal relationship between trade openness and economic growth (at levels)

VARIABLE NAME	LEVIN, LIN AND CHU TEST STAT (LEVELS FORM)		IM, PESARAN & SHIN W-TEST STAT (LEVELS FORM)		ADF-FISHER CI-SQUARE TEST STAT (LEVELS FORM)		PP-FISHER CH-SQUARE TEST STAT (LEVELS FORM)	
	CONSTANT	WITH TREND	CONSTANT	WITH TREND	CONSTANT	WITH TREND	CONSTANT	WITH TREND
LGDP	-5.90** (0.0000)	-3.41** (0.0003)	-6.84** (0.0000)	-5.79 (0.0000)	106.99** (0.0000)	86.60** (0.0000)	113.50** (0.0000)	97.85** (0.0000)
LTO	-3.16** (0.0008)	-4.10** (0.0000)	-3.56** (0.0002)	-5.21** (0.0000)	62.32** (0.0005)	81.93** (0.0000)	43.79** (0.0498)	35.16 (0.2366)
LPOP	0.44 (0.6722)	-2.07** (0.0189)	-1.02 (0.1527)	-6.41** (0.0000)	43.41 (0.0538)	80.25** (0.0000)	36.65 (0.1875)	28.82 (0.5269)
LUNEMP	2.41 (0.9922)	1.67 (0.9531)	3.08 (0.9990)	-0.33 (0.3689)	29.15 (0.5095)	44.77** (0.0405)	11.96 (0.9986)	11.53 (0.999)
LFDI	-3.77** (0.0001)	-0.64 (0.2584)	-4.98** (0.0000)	-3.32** (0.0004)	88.58** (0.0000)	57.01** (0.0021)	67.22** (0.0001)	48.00** (0.0198)
LINF	-4.88** (0.0000)	-4.69** (0.0000)	-5.04** (0.0000)	-5.26** (0.0000)	87.52** (0.0000)	80.08** (0.0000)	89.36** (0.0000)	90.77** (0.0000)
LEXCH	-0.40 (0.3445)	-4.07** (0.0000)	-0.35 (0.3606)	-0.60 (0.2742)	50.23** (0.0117)	30.04 (0.4633)	36.35 (0.1966)	34.68 (0.2542)
LGFCF	-3.37** (0.0004)	2.45 (0.9930)	-2.86** (0.0021)	-1.49 (0.0674)	80.00** (0.0000)	45.85** (0.0321)	72.15** (0.0000)	69.38** (0.0001)
LHCD	-3.59** (0.0002)	1.66 (0.9515)	-1.84** (0.0322)	1.44 (0.9258)	47.55** (0.0120)	27.73** (0.4788)	40.14 (0.0642)	22.29 (0.7672)

Note: LGDP: Natural log of GDP, LTO: Natural log of trade openness, LPOP: Natural log of population; LUNEMP: Natural log of unemployment, LFDI: Natural log of foreign direct investment, LINF: Natural log of inflation, LEXCH: Natural log of exchange rates, LGFCF: Natural log of gross fixed capital formation, LHCD: Natural log of human capital development. P-values are in parenthesis. ** indicate rejection at the 5% significance level. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

The results of the LLC panel unit root test, IPS test, ADF Fisher chi-square and PP-Fisher chi-square indicate that, GDP per capita; trade openness, foreign direct investment and inflation were statistically significant at five per cent level both at constant and with trend. However, on trade openness, the PP-Fisher chi-square rejects the null hypothesis of non-stationarity using only the intercept while the null hypothesis of unit root was not rejected when with trend is used. Thus, according to LLC test, IPS test, ADF Fisher chi-square and PP-Fisher chi-square, the null hypothesis that the panel contains unit roots for variables growth rate of GDP per capita, trade openness, foreign direct investment and inflation was rejected and the alternative hypothesis that the panels are stationary was not rejected. This implies that these variables were stationary at levels suggesting that they are integrated of order zero, $I(0)$. Test statistic for population and unemployment produced mixed results. When LLC test is used to check stationarity test for population, the null hypothesis of unit root is rejected when intercept is used, however, when intercept and trend is used, the null hypothesis of the variable having unit root cannot be rejected. When IPS test is used to check the stationarity property of population, the null hypothesis of unit root is rejected with trend while if intercept is used, the variable possessed unit root. When the ADF Fisher chi-square is used to check for stationarity of population, with intercept the null hypothesis of unit root is not rejected while with intercept and trend, the null hypothesis is rejected. When PP-Fisher chi-square is used to check the stationarity of the population, both intercept and intercept and trend confirmed the presence of unit root at levels. On unemployment, all the panel unit root test; LLC IPS, ADF Fisher chi-square and PP-Fisher chi-square confirmed the presence of unit root. It is only ADF Fisher chi-square that reject the null hypothesis of unit root at 5% when with trend is used. Results of stationarity test on exchange rates, gross fixed capital formation and human capital development also produced mixed results,

this is similar to the population and unemployment when all the panel unit root test are used. Thus, according to the entire panel unit root test, all these variables had at least one way or the other one unit root and required to be differenced to become stationary.

Variables that could be considered to be stationary at levels in accordance with LLC test, IPS test, and ADF and PP Fisher chi-square were GDP per capita and trade openness. When all these variables were differenced once, they became stationary suggesting that they were integrated of order one, $I(1)$. Thus, panel unit root tests results in Table 6.1A show that variables for establishing the causal relationship between trade openness and economic growth have a mixed order of integration. Some variables were integrated of order zero $I(0)$ while others were integrated of order one $I(1)$. This order of integration enables the study to use Autoregressive Distributed Lag (ARDL) cointegration technique to empirically analyse the short-run and long-run relationship between trade openness and economic growth for the ECOWAS region. Table 6.1B below depicts that all variables became stationary after differencing it once. This permitted further analysis to be carried out.

Table 6.1.B: Panel unit root tests for the causal relationship between trade openness and economic growth (at first difference)

VARIABLE NAME	LEVIN, LIN AND CHU TEST STAT (FIRST DIFFERENCE FORM)		IM, PESARAN & SHIN W-TEST STAT (FIRST DIFFERENCE FORM)		ADF-FISHER CI-SQUARE TEST STAT (FIRST DIFFERENCE FORM)		PP-FISHER CH-SQUARE TEST STAT (FIRST DIFFERENCE FORM)	
	CONSTANT	WITH TREND	CONSTANT	WITH TREND	CONSTANT	WITH TREND	CONSTANT	WITH TREND
LGDP	-16.71** (0.0000)	-14.27** (0.0000)	-17.19** (0.0000)	-15.31** (0.0000)	263.82** (0.0000)	207.31** (0.0000)	744.19** (0.0000)	287.69** (0.0000)
LTO	-10.52** (0.0000)	-10.01** (0.0000)	-11.51** (0.0000)	-10.33** (0.0000)	171.86** (0.0000)	139.20** (0.0000)	207.73** (0.0000)	167.43** (0.0000)
LPOP	-4.023 ** (0.0000)	-10.57** (0.0000)	-7.84** (0.0000)	-10.02** (0.0000)	145.90** (0.0000)	147.71** (0.0000)	42.13** (0.0697)	24.28** (0.7592)
LUNEMP	-4.96** (0.0000)	-3.60** (0.0002)	-5.79** (0.0000)	-3.39** (0.0003)	101.69** (0.0000)	68.41** (0.0001)	91.44** (0.0000)	66.35** (0.0001)
LFDI	-11.93** (0.0000)	-11.87** (0.0000)	-13.09** (0.0000)	-13.67** (0.0000)	197.25** (0.0000)	184.03** (0.0000)	478.45** (0.0000)	252.59** (0.0000)
LINF	-13.39** (0.0000)	-11.03** (0.0000)	-14.93** (0.0000)	-12.34** (0.0000)	222.48** (0.0000)	170.62** (0.0000)	874.98** (0.0000)	281.45** (0.0000)
LEXCH	-11.90** (0.0000)	-8.85** (0.0000)	-9.63** (0.0000)	-7.85** (0.0000)	138.55** (0.0000)	110.39** (0.0000)	137.88** (0.0000)	119.62** (0.0000)
LGFCF	-21.13** (0.0000)	-19.68** (0.0000)	-15.18** (0.0000)	-14.649** (0.0000)	427.156** (0.0000)	155.686** (0.0000)	549.308** (0.0000)	222.048** (0.0000)
LHCD	-8.73** (0.0000)	-12.12** (0.0000)	-8.71** (0.0000)	-10.56** (0.0000)	121.73** (0.0000)	143.04** (0.0000)	130.05** (0.0000)	154.24** (0.0000)

Note: LGDP: Natural log of GDP, LTO: Natural log of trade openness, LPOP: Natural log of population; LUNEMP: Natural log of unemployment, LFDI: Natural log of foreign direct investment, LINF: Natural log of inflation, LEXCH: Natural log of exchange rates, LGFCF: Natural log of gross fixed capital formation, LHCD: Natural log of human capital development. P-values are in parenthesis. ** indicate rejection at the 5% significance level. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

6.4.4.2.3 Cross sectional dependence test

Countries have become economically and financially integrated than never before and as a consequence, economic shocks in one country are not solely absorbed by the country but may have unintended repercussions on other countries as well. There is a significant probability for panel data to exhibit strong cross-sectional interdependencies, which may occur as a result of common shocks and unobserved components that become part of the stochastic error term (De Hoyos et.al, 2006). The presence of cross-sectional dependence in panel data distort estimation efficiencies if ignored, therefore testing for cross-sectional dependence is important in estimating panel models. Table 6.2 presents the results of the cross-sectional dependence test and helps in deciding whether to use first or second-generation panel unit root tests. To this end, three tests were performed: the Breusch-Pagan Lagrange Multiplier (LM), the Pesaran Scaled Lagrange Multiplier (LM) and the Pesaran Cross-sectional Dependence (CD). The evidence from the test reject the null hypothesis of no cross-sectional dependence at a 1% level of significance for both Breusch-Pagan Lagrange Multiplier (LM) and the Pesaran Scaled Lagrange Multiplier (LM) whereas Pesaran Cross-sectional Dependence (CD) accepts the null hypothesis of no cross sectional dependence. This means that there is a certain level of dependence among ECOWAS member countries, thus making the first-generation panel unit root tests appropriate for this study.

Table 6.2: Cross-sectional Dependence Test

Test	Test Statistic	Probability
Breusch-Pagan LM	151.48238***	0.0020
Pesaran scaled LM	3.207582***	0.0013
Pesaran CD	-1.591575	0.1115

***Significance at the 1% level

6.4.4.2.4 Multicollinearity test

The multicollinearity test is carried out to give indications of whether multicollinearity should be a concern for variables that are used to investigate the causal association that exist between trade openness and economic growth in the ECOWAS region. Table 6.3 gives a correlation matrix for variables of the trade openness-economic growth nexus model. The coefficient of correlation gives the degree of association of variables and coefficient's sign provides an idea about the direction of that relationship, which can either be positive or negative.

Table 6.3: Correlation test

Variables	LGDP	LTO	LPOP	LUNEMP	LFDI	LINF	LEXCH	LGFCF	LHCD
LGDP	1								
LTO	0.162 (0.0038)	1							
LPOP	-0.059 (0.2892)	-0.382 (0.0000)	1						
LUNEMP	-0.063 (0.2645)	0.152 (0.0066)	-0.485 (0.0000)	1					
LFDI	0.1736 (0.002)	0.447 (0.0000)	-0.122 (0.0302)	0.087 (0.1202)	1				
LINF	0.0221 (0.6952)	0.097 (0.0848)	0.016 (0.773)	0.054 (0.3308)	0.073 (0.192)	1			
LEXCH	-0.062 (0.2682)	-0.230 (0.0000)	0.102 (0.0701)	-0.218 (0.0001)	-0.250 (0.0000)	0.161 (0.0042)	1		
LGFCF	0.183 (0.0011)	0.328 (0.0000)	-0.324 (0.0000)	0.013 (0.8133)	0.214 (0.0001)	0.137 (0.0143)	0.114 (0.0425)	1	
LHCD	0.149 (0.0077)	0.458 (0.0000)	-0.549 (0.0000)	0.412 (0.0000)	0.347 (0.0000)	0.029 (0.598)	0.321 (0.0000)	0.291 (0.0000)	1

Note: LGDP: Natural log of GDP, LTO: Natural log of trade openness, LPOP: Natural log of population; LUNEMP: Natural log of unemployment, LFDI: Natural log of foreign direct investment, LINF: Natural log of inflation, LEXCH: Natural log of exchange rates, LGFCF: Natural log of gross fixed capital formation, LHCD: Natural log of human capital development, P-Values are in parenthesis.

A statistically significant correlation coefficient of more than 0.70 is considered high. The highest correlation is between trade openness and human capital development, FDI and HCD,

unemployment and human capital development with a coefficient correlation of 0.45, 0.34 and 0.41 respectively. These variables have a relatively strong linear relationship among them. All the other variables had correlation coefficient of less than 0.30 meaning that there is a weak linear relationship among them. In the overall, multicollinearity is not a major issue in establishing the relationship that exists between trade openness and economic growth in the ECOWAS region.

6.4.4.2.5 Optimal lag selection criteria

To estimate the Autoregressive Distributed Lag (p, q, q, q, q, q, q, q, q) econometric model, we first needed to determine the optimal lag length for the model. Pesaran et al, (2001) argues that the Schwarz Information Criterion (SIC) is to be preferred when dealing with panel ARDL approach. For this reason, in this study, we employed the Schwarz Information Criterion to determine the optimal lag structure.

Table 6.4: Optimal lag selection using Schwarz Information Criterion (SIC)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	7.403773	NA	8.18e-12	0.011202	0.126543	0.057439
1	296.7255	558.3401*	1.90e-12*	-1.450705*	-0.297287*	-0.988328*

*indicates lag order selected by the criterion.

The study used the unrestricted model and the Schwarz Information Criterion (SIC), to determine the optimal choice of lags for the PMG/ARDL model. The optimal lag selection is done to avoid serial correlation in the ARDL model. We therefore used lag one to estimate our model since the SIC chose lag one for our model estimation.

6.5 Results and discussion

6.5.1 PMG/ARDL Results

The study used the PMG/ARDL estimation technique to establish the relationship between trade openness and economic growth in the ECOWAS region. Some of the advantages of the PMG/ARDL are that, it assumes long run slope homogeneity which enables the model to estimate one long run coefficient for each regressor. The PMG/ARDL estimator allows the short run coefficient results to vary across the groups. Though Eviews provides average short run results, In line with Pesaran, Shin and Smith (2001), the ARDL Cointegrating and long run form was employed to derive the short-run equation. Typically, the specification of the ECM, which is the Error Correction Model is over-parameterized, Nevertheless, the algorithm of the Eview software process the re-parameterization automatically and reports the parsimonious encompassing ARDL models as (1,1,1,1,1,1,1,1) for the ECOWAS countries. The significance and magnitude of the Error Correction Term (CointEq.) is an indication of cointegration among the variables understudy. The Error Correction Term is expected to be negative and significant as well. Again the Error Correction Term should lie between 0 and -1, that is, it should not be less than -1. When this assumption is satisfied, one can conclude that the variables are cointegrated and also the regressors jointly granger cause GDP in the long run. To determine the number of years it can revert back to equilibrium position when there is shock, we calculate the inverse of the absolute values of the unrestricted ECT (-1). In order words, the inverse of the absolute value helps in determining the duration shocks to variables that cause disequilibrium can be corrected from the short-term to the long-term.

6.5.1.1 Long-run PMG/ARDL Result for ECOWAS countries

The findings of the long-run estimates of the PMG/ARDL are reported in Table 6.5 below for the ECOWAS countries. The regression reported positive and statistically significant coefficient for trade openness, 0.834211 (0.0470), positive and insignificant POP, 0.182653 (0.7901), similarly, UNEMP, FDI, INF, GFCF, and HCD, 0.106655 (0.4361), 0.046988 (0.3228), 0.045218 (0.2672), 0.109711 (0.7389) and 1.701579 (0.0043) respectively, which are positive but not statistically significant except HCD which is positive and significant as well. However, on exchange rate effect in the long run, it shows negative effect on economic growth and statistically insignificant with coefficient of -0.268493 (0.4903).

Not surprisingly, the findings of this investigation lend credence to predictions of theoretical studies. For instance, the results of the regression reported a positive and statistically significant estimated coefficient, 0.834211 (0.0470), for trade openness, which indicates that a 1% increase in trade openness would lead to 0.83% increase in GDP growth. Hence, the result give credence to the endogeneity of the OCA theory championed by Frankel and Rose (1997, 1998) which states that trade openness measured using total imports and exports as a percentage of GDP has positive long run effect on economic growth and business cycle synchronization. The result from this study is consistent with the earlier findings in N'guessan and Yue (2010) when they used the ARDL technique, the findings of their study indicated positive long run association between trade openness and RGDP in Cote d'Ivoire. The result on the trade openness and growth relationship is again consistent with the finding reported by Ulasan (2015) and Fenira (2015) as well as Amadou (2013). Their findings reveal that, trade openness is usually more profitable to countries that experience substantially high growth rates and whose industries have gotten to the stage of maturity already. The results can essentially be attributed to the fact that all the

conditions are not yet attained in the ECOWAS countries (including Cote d'Ivoire) to enable trade openness have full interactions with economic growth. The result of trade openness in the long run is also consistent with empirical results reported by Sakyi, Commodore and Opoku (2015) and Khobai, Kolisi and Moyo (2018) for studies in Ghana. Our findings on population, revealed a positive effect of population on economic growth in the long run. This result is consistent with the neoclassical growth model by Solow (1956), which states that, an increase in population coupled with knowledge has a positive effect on economic growth, though insignificant in the long run with estimated coefficient of 0.182653 (0.7901), which mean a 1% increase in population will lead to 0.18% increase in GDP. Surprisingly, on unemployment, a positive coefficient of 0.106655 (0.4361) shows that a 1% increase in unemployment leads to 0.10% increase in economic growth in the long run, though insignificant which contravenes a priori expectation. Our investigations also reveal a positive influence of FDI on economic growth in the ECOWAS region. This result is consistent with N'guessan and Yue (2010), Keho (2015) as well as Anyanwu and Yameogo (2015). The expected positive effect may be due to individual government efforts to prevent repatriation of profits by foreign investors in the sub-region experienced over the recent years.

We also evidence a positive relationship between GFCF (Investment) and economic growth with an estimated coefficient of 0.109711 (0.7389). This finding is consistent with the results of Johnston and Ramirez (2015) where their study reports of a positive effect of investment on economic growth in some ECOWAS member countries. Consistent with considerable number of empirical studies, as reported by Zahanogo (2016) and Anyanwu and Yameogo (2015), human capital development (HCD) showed evidence of a positive and significant relationship with economic growth in ECOWAS countries with an estimated coefficient of 1.701579 (0.0034).

This means a 1% increase in HCD, is expected to bring about 1.70% increases in economic growth among ECOWAS countries in the long run. This gives credence to the research gap identified in studies in ECOWAS on trade openness and economic growth on questioning the validity and reliability of trade openness-growth nexus studies when HCD was not included in the regression model in most of the studies. When we juxtapose and combine this result with the raw data reported via descriptive statistics in Table 6.1 Column 9 for ECOWAS countries provides some insight into the relationship between Human capital development (HCD) and growth of GDP per capita. For example, the average secondary school enrolment (male and female) ratio of 40.32 million to total population gives an indication that ECOWAS consider education as very important when it comes to the developmental agenda of their economies. Consistent with theoretical expectation, the elasticity coefficient of -0.268493 (0.4903) for exchange rate indicates that 1% depreciation in most West African currencies relative to the US Dollar will cause GDP to decrease by 0.26%. Inflation in the long run has a positive but not significant effect on the economies in West Africa (Note: probability values in parenthesis).

6.5.1.2 Short-run Error Correction PMG/ARDL for ECOWAS countries

The short-run dynamics results associated with the PMG/ARDL (1, 1, 1, 1, 1, 1, 1, 1, 1) in Table 6.5 for ECOWAS countries revealed that, the coefficient of the lagged Error Correction Term has the right sign, which is -0.661518 which shows the speed of adjustment to the long-run equilibrium from the short run. The magnitude of the coefficient indicated that about 66.1518% of the disequilibrium caused by previous year's shocks reverts back to equilibrium in each time period. The sum of squares residual (SSR) which gives an indication of the overall fitness of the model, reported a coefficient of 120.9. This confirms that, the model was correctly specified and the regression function explains a greater amount of total variation of the dependent variable

(GDP per capita). In the short run, the regression results indicated a negative but not significant estimated coefficient for trade openness, -0.734678 (0.3179) and a positive and insignificant estimated coefficient for population, 13.30422 (0.5288). Our findings also reported positive and insignificant estimated coefficients values for contemporaneous FDI, EXCH, GFCF and HCD of 0.121142 (0.1555), 0.621576 (0.3848), 0.024263 (0.9628) and 2.447764 (0.2761), respectively. However, unemployment and inflation reported negative effect in the short run with estimated coefficient of -2.788572 (0.0005), -0.272468 (0.1668), though the effect of unemployment in the short run is significant, that of inflation is not significant in the short run. Whiles HCD affect economic growth both in the short and in the long run, the effect of HCD is not significant in the short run but significant in the long run.

Surprisingly, in the short run, most of our results revealed a sharp contravention from predictions of theoretical studies unlike what we documented in the long run. In other words, unlike the literature on the growth effects of trade openness, our findings are considerably different from predictions of theoretical studies. For example, the results of the regression report of a negative but not significant estimated coefficient value of -0.734678 (0.3179) for trade openness, which means that a 1% increase in trade openness will lead to 0.73% reduction in GDP per capita (economic growth) in the ECOWAS region in the short run. This finding is supported by Vlastou (2010), who, using a sample of 34 African countries, found that trade openness has a negative impact on economic growth. Hence, this result in the short run fail to provide enough evidential support on the hypothesis that trade openness has positive long run effect on economic growth among ECOWAS member countries. The result of this finding is not consistent with the earlier findings in N'guessan and Yue (2010) when they used the ARDL technique to examine this relationship. They reported of a positive long run relationship between trade openness and

economic growth in one of ECOWAS member state, which is Cote d'Ivoire. The evidence in the short run is however consistent with the finding by Fenira (2015) and Amadou (2013) where their study suggested that trade openness is usually more profitable to countries that experience substantial high growth rates and whose industries have already gotten to the maturity stage.

These results can be elaborated importantly by the fact that all the conditions are not yet attained in the ECOWAS sub-region (Cote d' Ivoire included) which can enable the openness of trade to have greater interaction with economic growth as argued by Amadou (2013). A possible explanation for the negative impact of trade openness on GDP per capita in the short run is that ECOWAS countries are not able to take full advantage of exports diversification, which is a necessary condition to support economic growth.

The evidence in the findings of a positive and insignificant impact of FDI on economic growth in ECOWAS in the short run is in line with the findings of Keho (2015), Anyanwu and Yameogo (2015) and N'guessan and Yue (2010), but not consistent with the finding reported by Johnston and Ramirez (2015). Gross fixed capital formation indicated a positive but insignificant coefficient of 0.024263 (0.9628) which is in line with Johnston and Ramirez (2015) studies in Cote d'Ivoire which is a member of the ECOWAS countries. Their study showed evidence of a positive short-term influence of investment on economic growth.

Consistent with a number of empirical studies, as reviewed by Zahanogo (2016) and Anyanwu and Yameogo (2015), human capital development indicated evidence of positive though insignificant relationship with economic growth in ECOWAS in the short run but in the long run, human capital development affect economic growth positively and has a significant relationship as well in the ECOWAS region. This result combined with the raw data reported in the descriptive statistics in Table 6.5 provides more understanding on the relationship between

human capital development and economic growth in ECOWAS. Also in line with theoretical expectation, the elasticity coefficient of 0.621576 for exchange rate in the short run indicated that, a 1% depreciation in the ECOWAS currencies relative to the US Dollar will cause economic growth to increase by 0.62% in the short run which is consistent with empirical studies reported by Asfaw (2015) and Yeboah, Naanwab, Saleem and Akuffo (2012) for their studies in Ghana (Note: probability in parenthesis).

The individual cross-sectional short-run coefficients reported in Appendice 6 shows that during the period of the investigation, it was realized that, there is a mixed range of rates of adjustment toward long-term equilibrium in individual countries. It shows that all the ECOWAS member countries have the correct sign of the ECM and statistically significant which means, there is long run convergence for all member countries.

Table 6.5: Estimates of Panel Autoregressive Distributed Lag Model (Dependent variable: GDP)

Regressor	Coefficient	Standard error	t-statistics	Probability
Long-run Equation				
LTO	0.834211	0.416326	2.003744	0.0470**
LPOP	0.182653	0.684764	0.266738	0.7901
LUNEMP	0.106655	0.136561	0.781005	0.4361
LFDI	0.046988	0.047360	0.992149	0.3228
LINF	0.045218	0.040590	1.114000	0.2672
LEXCH	-0.268493	0.388202	-0.691632	0.4903
LGFCF	0.109711	0.328517	0.333958	0.7389
LHCD	1.701579	0.570645	2.981852	0.0034**
Short-run Equation				
COINTEQ01	-0.661518	0.086561	-14.30654	0.0000**
D(LTO)	-0.734678	0.732958	-1.002346	0.3179
D(LPOP)	13.30422	21.07365	0.631320	0.5288
D(LUNEMP)	-2.788572	0.784991	-3.552362	0.0005**
D(LFDI)	0.121142	0.084840	1.427886	0.1555
D(LINF)	-0.272468	0.196050	-1.389788	0.1668
D(LEXCH)	0.621576	0.713009	0.871765	0.3848
D(LGFCF)	0.024263	0.519502	0.046705	0.9628
D(LHCD)	2.447764	2.238627	1.093422	0.2761
C	-0.018128	0.028120	-0.644672	0.5202
Mean dependent var	0.011764	S.D. dependent var	1.951870	
S.E. of regression	0.922754	Akaike info criterion	2.512093	
Sum squared resid	120.9094	Schwarz criterion	4.462752	
Log likelihood	-218.8140	Hannan-Quinn criter.	3.292750	

Note: ARDL (1, 1, 1, 1, 1, 1, 1, 1, 1) was selected based on Schwarz Information Criterion. ** denotes significance at 5% level. LTO, log of trade openness; LPOP, log of population; LUNEMP, log of unemployment; LFDI, log of foreign direct investment; LINF, log of inflation; LEXCH, log of exchange rate; LGFCF, log of gross fixed capital formation; LHCD, log of human capital development

6.5.2 Pairwise Dumitrescu-Hurlin Panel Causality Test

To examine the causal relationship between trade openness and economic growth in a panel framework for the ECOWAS countries, our study employed the Dumitrescu and Hurlin (2012) Granger causality test on the pooled of cross-section time series for the period from 2000 – 2020.

The Dumitrescu-Hurlin test takes into consideration two dimensions of heterogeneity, that is, the heterogeneity of the regression model which is used to test the Granger causality and the heterogeneity of the causality relationships existing among the variables. The null hypothesis of Dumitrescu-Hurlin (D-H) test surmises that there are no causality relationships existing among the variables for any of the units of the panel. This assumption is termed the homogeneous Non-Causality (HNC) hypothesis. The alternative hypothesis is termed as Heterogeneous Non-causality (HENC) hypothesis. D-H permits the coefficients to vary across individuals entities however, it is assumed time-invariant. The test comprises of asymptotic and semi-asymptotic distributions. The asymptotic distribution is valid when $T > N$, which is appropriate for the current panel data set with 315 observations (T) and 15 countries (N). The D-H Granger causality test is dependent on the individual Wald statistic of Granger non-causality averaged across the cross-section units.

According to Granger (1969), the fundamental idea is that if previous values of trade openness are important predictors of the current value of GDP per capita even when past values of GDP per capita are been included in the model, then trade openness thus exert a causal influence on GDP per capita. The null hypothesis is that, trade openness does not Granger cause GDP per capita at the panel-level for the ECOWAS countries. If the null hypothesis is rejected, then the conclusion is that, causality from trade openness to GDP per capita exists. Since D-H test is programmed to detect causality at the panel-level, rejecting H_0 does not exclude that there is no causality for some individual countries.

The appropriate lags selected for this study were determined to be four (4) based on Schwarz Information Criterion (SIC), and the lag order (k) is similar for all the countries and the panel is balanced. The lag selection procedure is consistent with Gujarati and Porter (2016) who

indicated that, choosing fewer lags will lead to the “omission of relevant variables bias,” whose consequences can harm the validity and reliability of the estimated results. Gujarati and Porter (2009) stated explicitly that, the number of lagged terms introduced in the causality tests is an important consideration for consistent and reliable results. The direction of causality may depend more importantly on the number of lagged terms included.

For robustness check, we estimated our specified model by employing four separate lags. Thus we calculate and report the results for 1, 2, 3, and 4 lags in Table 6.6 below as extracted from Appendix 6.3. Using 1, 2 and 4 lags, the results overwhelmingly reject the null hypothesis that, trade openness does not homogeneously cause GDP, since the probability values are statistically significant at 5% level, it implies that trade openness homogeneously cause GDP in the ECOWAS sub-region. The coefficient values for lag 1, 2 and 4 are 2.60407 (0.0017), 3.89583 (0.0367) and 9.51529 (0.0270) respectively with probability values reported in parenthesis. However, the null hypothesis that trade openness does not homogeneously cause GDP could not be rejected for lag 3. And on the reverse causality from GDP to trade openness, the D-H test reported Wald statistic of 1.70312 (0.2298), 2.44442 (0.9123), 3.60690 (0.8937) and 5.39118 (0.9061) with insignificant p-value for lags 1, 2, 3 and 4, respectively. The results for lags 1, 2, 3 and 4 overwhelmingly indicated homogenous non causality (HNC), which implies that, GDP does not homogeneously cause trade openness among the ECOWAS member countries. Out of the 4 lags chosen for the causality relationship, 3 lags confirmed that trade openness homogeneously cause GDP while only 1 lag confirmed the non existence of trade openness influence on GDP. Based on this, this study can conclude that, trade openness homogeneously cause economic growth while GDP does not homogeneously cause trade openness in the ECOWAS sub-region.

Table 6.6: Dumitrescu-Hurlin Panel Causality Lags Selection

Test	Trade Openness→ GDP		GDP→ Trade Openness	
	Wald statistics	Probabililty	Wald statistics	Probabililty
Panel A : Lags(k) = 1	2.60407	0.0017	1.70312	0.2298
Panel A : Lags(k) = 2	3.89583	0.0367	2.44442	0.9123
Panel A : Lags(k) = 3	5.46612	0.1089	3.60690	0.8937
Panel A : Lags(k) = 4	9.51529	0.0270	5.39118	0.9061

Notes: → Arrow indicates direction of causality; Null Hypothesis: Trade openness does not homogeneously cause GDP; GDP does not homogeneously cause trade openness

The results of the selected lag 2 for the D-H Granger non causality test displayed in Table 6.7, indicated causality from FDI to POP, since the Wald statistic, 4.83400 (0.0008), is significant at the 5% level. Our finding evidences no reverse causation from POP and FDI, since the Wald statistic, 3.20954 (0.2488), is statistically insignificant, which implies that, heterogenous non causality exist. The D-H test also indicated causality from trade openness to GDP, since the Wald statistic, 3.89583 (0.0367), is statistically significant. On the other hand, there is no reverse causation from GDP and trade openness, since the Wald statistic, 2.44442 (0.9123), is statistically not significant, which implies that, heterogenous non causality exist. In the same vein, the D-H test also indicated causality from GDP to HCD, since the Wald statistic, 39.0738 (0.0000), is statistically significant. On the other hand, there is no reverse causation from HCD to GDP, since the Wald statistic, 2.18391 (0.8064), is statistically not significant, again this implies that heterogenous non causality exist.

The Dumitrescu-Hurlin Granger causality test thus reinforces evidence of the findings using the PMG/ARDL tests for this investigation. The PMG/ARDL test confirms that trade openness cause GDP, the positive coefficient of trade openness and having a probability which is statistically significant is in conformoty of the D-H test which confirms causal relationship

between trade openness and GDP. The result of the D-H test also shows there is no supporting evidence of bidirectional causality from any of the macroeconomic variables used to estimate the relationship between trade openness and economic growth in ECOWAS.

Population growth does not homogeneously cause GDP with Wald statistics of 2.92839 (0.4413) which shows insignificant probability value and conversely, the null hypothesis that GDP does not cause population growth could not be rejected since it has a Wald statistics of 2.75376 (0.5948). The null hypothesis that unemployment does not homogeneously cause GDP could not be rejected with a Wald statistics of 1.58910 (0.2910). On the other hand, the null hypothesis that GDP does not homogeneously cause unemployment was rejected at 5% significance level, implying that GDP growth causes unemployment with Wald statistics of 0.63044 (0.0181).

But surprisingly, when it comes to the causal relationship between FDI and GDP, INF and GDP, EXCH and GDP and GFCF and GDP, there was no causal relationship in both directions, which implies that homogeneously, there is not much direction of influence for these macroeconomic variables when they are examined homogeneously, however, when they are examined heterogeneously, the results might change. Similarly, the results are not different when it comes to the causal relationship between population and trade openness, unemployment and trade openness, FDI and trade openness as well as GFCF and trade openness. These findings from this investigation could be due to the number of factors. Principal among the factors are the selection of the lags which can have an influence on the conclusion of the results. Another reason could be due to heterogeneity of individual effects and/or heterogeneity of the individual parameters which affects the paradigm of the representative agent directly and hence the conclusions with respect to causal relationship between trade openness and economic growth in the ECOWAS region.

Table 6.7: Pairwise Dumitrescu-Hurlin Causality Tests**Lags: 2**

Dependent variable	Excluded	Wald-Statistics	Probability	D-H
TO	GDP	3.89583	0.0367	
GDP	TO	2.44442	0.9123	HENC
POP	GDP	2.92839	0.4413	
GDP	POP	2.75376	0.5948	HENC
UNEMP	GDP	1.58910	0.2910	
GDP	UNEMP	0.63044	0.0181	HENC
FDI	GDP	2.78260	0.5679	
GDP	FDI	1.22916	0.1219	HENC
INF	GDP	2.11636	0.7360	
GDP	INF	2.55979	0.7891	HENC
EXCH	GDP	2.08165	0.7006	
GDP	EXCH	2.76172	0.5873	HENC
GFCF	GDP	1.50535	0.2419	
GDP	GFCF	1.50553	0.2420	HENC
HCD	GDP	2.18391	0.8064	
GDP	HCD	39.0738	0.0000	HENC
POP	TO	3.61235	0.0887	
TO	POP	1.09445	0.0836	HENC
UNEMP	TO	2.67189	0.6743	
TO	UNEMP	1.61660	0.3084	HENC
FDI	TO	2.17317	0.7951	
TO	FDI	2.07083	0.6897	HENC
INF	TO	3.06320	0.3402	
TO	INF	2.50898	0.8429	HENC
EXCH	TO	3.13919	0.2903	
TO	EXCH	2.46295	0.8923	HENC
GFCF	TO	3.14309	0.2879	
TO	GFCF	1.59498	0.2947	HENC
HCD	TO	1.85818	0.4907	
TO	HCD	1.11703	0.0892	HENC
UNEMP	POP	1.06408	0.0764	
POP	UNEMP	2.61211	0.7348	HENC
FDI	POP	4.83400	0.0008	
POP	FDI	3.20954	0.2488	HENC

Source: Extracts using Eviews 12

6.5.3 Analysis of Impulse Response Functions

The assessment of the dynamic interactions among the variables that is used to examine the relationship between trade openness and economic growth in the ECOWAS region is conducted by employing the Impulse Response Function (IRF) and the Forecast Error Variance

Decomposition (FEVD). The Impulse Response Functions (IRFs) gives an indication of the effects of shocks on the adjustment path of the variables, while Forecast Error Variance Decomposition (FEVD) measure the contribution of each type of impulses or shock to the forecast variance. The IRFs traces out how the changes in one variable impact on current and future values of the endogenous variable (Asmah, 2013). The IRFs and FEVD provides an intuitive way to understand the interpretation of the variables in the VECM, and it is used in assessing how shocks to economic variables reverberate through the system among the fifteen ECOWAS countries.

To examine how economic growth respond to impulses or innovations from trade openness, the analysis first entails estimating an unrestricted VAR based on which an optimal lag structure is determined. In order to do this we follow the established information criteria as discussed in Lutkepohl (1991, pages 125–126) such as Akaike (AIC), Hannan-Quinn (HQC), and Schwarz (SIC) to select the appropriate or optimal lag length for the estimation. Whereas the AIC and HQC suggest a lag order (length) of three, the SIC recommends two lags. We follow the SIC in the estimation. At the chosen lag, we test whether the VAR satisfies the stability condition by ensuring that, the modulus of all the inverse roots of the characteristic autoregressive polynomial lie within the unit circle. This result is reported in appendice 6.7. This diagnostic analysis is done to establish the reliability of the model to produce valid estimates and forecasts. Once this has been achieved the structural factorization procedure would be followed to impose the necessary restrictions to form the structural VAR models based on which further analysis such as Impulse Response and Variance Decomposition would be made.

We first consider the responses of economic growth to one standard deviation innovations in all the variables used to estimate the causal relationship between trade openness and economic

growth particularly total imports and exports as a percentage to GDP which is used to proxy trade openness over a 120-month (10-year) horizon, along with the responses of economic growth to their own shocks. Table 6.8 below shows the results of the Impulse Response Functions which is extracted from appendix 6.5 for ECOWAS member countries where GDP is the dependent variable.

Table 6.8: Impulse Response Functions for ECOWAS member countries (GDP is Dependent variable)

Period	Effect	GDP	TO	POP	UNEMP	FDI	INF	EXCH	GFCF	HCD
3 Year	Short	0.267754	0.031188	-0.028375	0.056735	0.297002	-0.011466	-0.038792	0.020958	-0.098407
	Term									
6Year	Medium	0.305594	0.098466	-0.012002	0.033528	0.242890	0.007349	-0.041099	-0.003749	-0.041749
	Term									
10 Year	Long	0.317439	0.086431	-0.016691	-0.006553	0.257733	0.037757	-0.004671	-0.005406	-0.026072
	Term									
Decision		Increasing	Fluctuating	Fluctuating	Decreasing	Fluctuating	Increasing	Fluctuating	Decreasing	Increasing

Note: GDP: gross domestic product per capita, TO: trade openness, POP: population; UNEMP: unemployment, FDI: foreign direct investment, INF: inflation, EXCH: exchange rates, GFCF: gross fixed capital formation, HCD: human capital development. All variables were transformed into first difference

The result of IRFs in Appendix 6.5 for the ECOWAS countries summarized in Table 6.8 reported the IRFs of the log of first differences of trade openness, human capital development, population growth, foreign direct investment, inflation, exchange rate and gross fixed capital formation for the ECOWAS member countries. The IRFs is used to produce the time path of GDP per capita in the VECM, to shocks from OPNES, HCD, POP, FDI, INF, EXCHR and GFCF. The following conclusions emerged from the examination of the Impulse Response Functions for the ECOWAS countries. From Table 6.8, year 3 is classified as short term while year 6 is classified as medium term and year 10 is classified as long term. The effect of transmission of GDP on its own shocks in the short run is 0.267% while in the medium term it increases to 0.305% and in the long run, it shows an upward trend of 0.317%. This means that own shocks to GDP shows an increasing trend. This indirectly means that the transmission effect of GDP to GDP in ECOWAS was permanent and will continue to have positive impact on the economy in the long-term. The transmission effect of openness to GDP in event of policy shock in the short-term was 0.031%. This effect continues to increase to 0.098% in the medium-term, and in the long term, it decreased gradually to 0.086%. This indirectly means that the transmission effect of openness to GDP in ECOWAS fluctuates and its impact on the economy in the long-term is unclear. The evidence from the IRFs indicated that the effect of population in the short-term was -0.028%, meaning it had negative transmission effect in the short term. However in the medium term, the transmission effect to GDP continued to be negative around -0.012% and the negative impact was also seen in the long term around -0.016%. This shows that, the policy shock exhibit a fluctuating trend and may require stabilization measures to sustain the positive impact on the economy in the long run. For unemployment, the unanticipated shock in

the short term was 0.056%, which decreased to 0.033% in the medium-term and -0.006% in the long-term, indicating that the shock has a decreasing trend.

Evidence from the IRFs result also indicated that the positive effect of policy shock on FDI in the short-term was 0.297%, and decreased to 0.242% in the medium term, however in the long term, it increased marginally to 0.257% in the long run, indicating that the shock will have a positive impact on the economy in the short term through to the long term albeit a fluctuating trend. Evidence from results of the IRFs, however, indicated short-term negative effect for inflation to be -0.011%, which means impulses from inflation has a negative effect on GDP in the short term, however in the medium term, its effect becomes 0.007%, which indicates an increase and positive effect, again the increase continues to be seen in the long run around 0.037%, this shows an increasing trend. The evidence from the IRFs of exchange rate to GDP shows negative impact in the short term and this negative effect permeates through the medium to the long term as well with -0.038%, -0.041% and -0.004% respectively albeit a fluctuating trend indicating that the shock is permanent. The unanticipated shock for GFCF on GDP was 0.020% in the short-term, and continues to decrease to -0.003% in the medium term, however in the long term it still exhibits a negative trend of -0.005%. Shocks from GFCF to GDP shows a decreasing trend. For HCD, unanticipated shock in the short-term recorded -0.098%, which increased to -0.041% in the medium-term and -0.026% in the long-term showing negative increase effect on GDP which indicates that the shock is permanent.

Figures 6.2.A display the graphical representation of IRFs of the log of first differences of trade openness, human capital development, population growth, foreign direct investment, inflation, exchange rate and gross fixed capital formation for the ECOWAS member countries to Cholesky one standard deviation structural shocks. The graphs are based on the output of the Vector Error

Correction Model (VECM) estimates over 10-year period and the Cholesky degrees of freedom adjusted, which show the response to Cholesky one standard deviation innovations which is explained above in details in the Table form (Table 6.8) whiles Figure 6.2.B shows the combined graph for the variables in the Model that represented innovations/shocks/impulses on GDP.

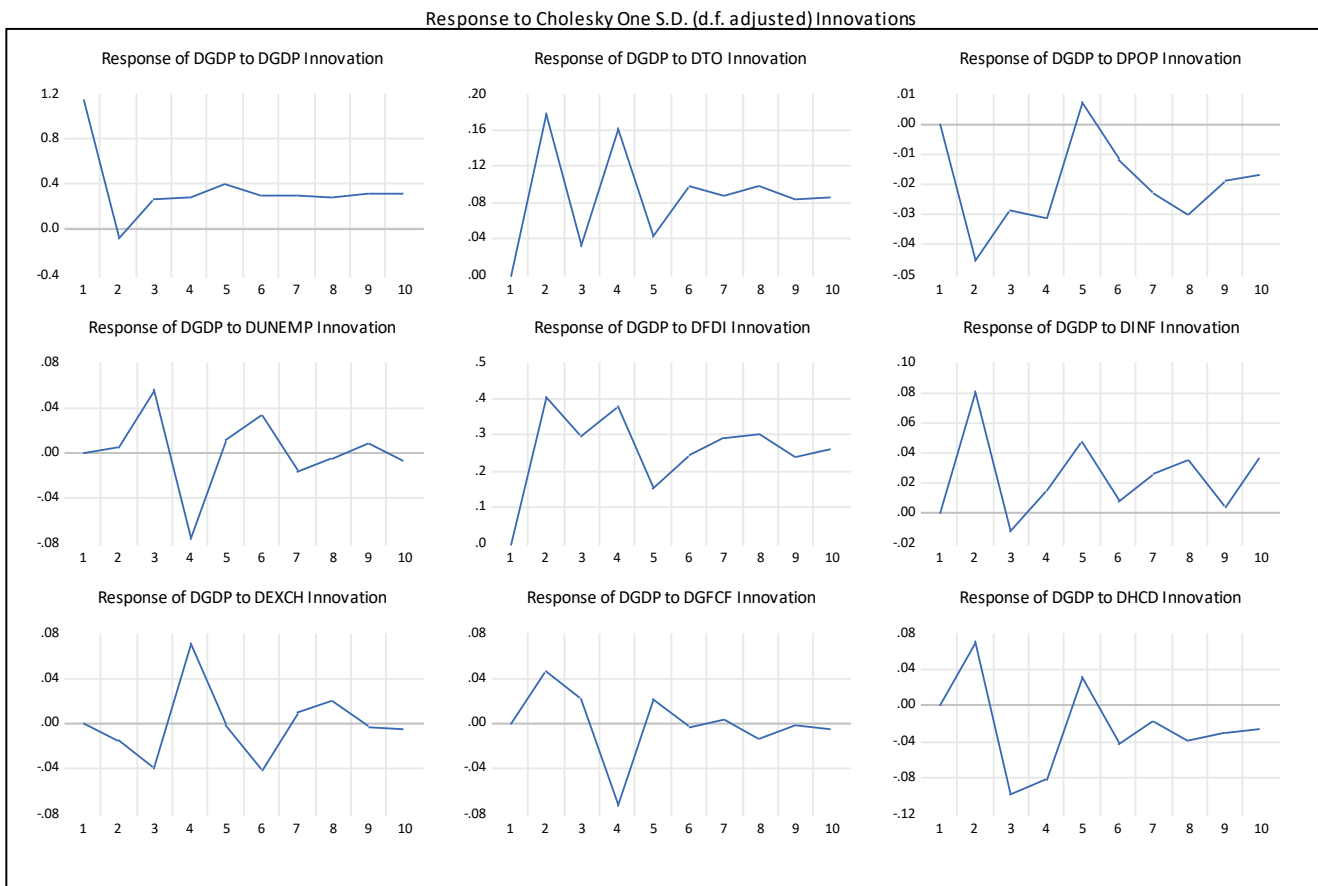


Figure 6.2.A: Response to Cholesky One S.D (d.f.adjusted) innovations

The response of GDP to innovative shocks in openness is contemporaneously weak and steadily fluctuates over the 10-year forecast period in ECOWAS. This means that the transmission effect of openness to GDP in ECOWAS fluctuates and its impact on the economy in the long-term is unclear. The response of GDP to Cholesky innovations shows that the response of GDP to its own shocks shows an increasing trend. This indirectly means that the transmission effect of GDP

to GDP in ECOWAS was permanent and will continue to have positive impact on the economy in the long-term.

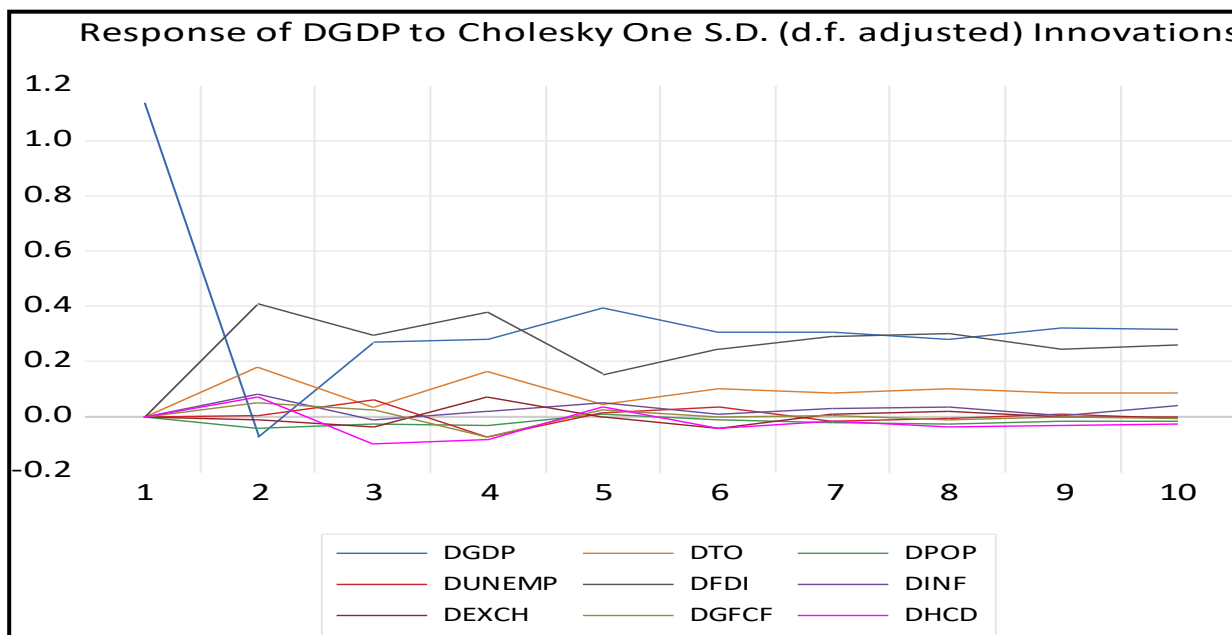


Figure 6.2 B: Comined Response to Cholesky One S.D (d.f.adjusted) innovations

6.5.4 Analysis of Forecast Error Variance Decomposition

The Impulse Response Functions trace the effects of a shock to one endogenous variable on other variables in the VAR (in this case VECM), while the alternative Variance Decomposition technique measures the proportion of Forecast Error Variance in one variable explained by innovations in it and other variables (Asmah, 2013). Thus, from the Forecast Error Variance Decomposition (FEVD) for ECOWAS, the study identifies orthogonalized innovations in GDP for ECOWAS and the dynamic responses to such innovations; hence the variance-covariance matrix of the VECM was factorized using the Cholesky decomposition. The results of the FEVD of the endogenous variables, at various terms (short-, medium- and long-term) generated by the nine variables, derived from VECM are summarized in Table 6.9.

The results show that the percentage of variance explained by own shock account for 81.16% in the short-term which means that impulses or innovations to GDP account for 81.16% variation of the fluctuations in GDP (own shocks) and continue falling until it ends with an average around 68.41% at the end of the 10th period for ECOWAS. This implies that economic growth is explained predominantly by its own innovative shocks (68.41%). In the short term, shock to trade openness can cause 1.94% fluctuations in GDP and in the medium term, the shock causes 3.04% fluctuations in GDP and increases to 3.37% in the long term. It means shocks to trade openness can cause an increasing fluctuations in GDP from the short to the medium term as well as the long term. Also, over the whole 120 months, shocks on population contributed a little over 0.20% to the movement in GDP. Thus, we argue that the impact of population has not been very important in determining the growth of economies in West Africa. From the results, over a 120-month horizon, 0.29% of the Forecast Error Variance of GDP can be accounted by shocks to exchange rates. Shocks to unemployment in the short, medium and long term accounted for 0.19%, 0.44% and 0.36% respectively of the Forecast Error Variance of GDP. The contribution of FDI shocks to the dynamics of GDP is rated second to shocks to GDP (own shocks) in terms of proportion within 120 month period highlighting the important role of foreign direct investment. In the short term, impulses to Human capital development (HCD) account for 0.87% variation of the fluctuations in GDP while in the medium term variation increased to 1.05% and reduced to 0.92% in the long term. Gross fixed capital formation (GFCF) recorded 0.28% variations of the fluctuations in GDP in the long run.

The overall findings confirm the importance of nominal variables in contributing to GDP growth in ECOWAS. The FEVD results indicated that trade openness variation on GDP in ECOWAS tends to increase from the short term to the medium and long term, and hence may be of positive

effect on the economy in the long run. It means that, trade openness can have a significantly positive impact on GDP per capita in the long run. This implies that ECOWAS economies should make trade liberalisation as their primary source of economic growth. Countries that have signed the African Continental Free Trade Agreement should take pragmatic steps to liberalize all their sectors to trade.

Table 6.9: Forecast Error Variance Decomposition for ECOWAS (Normalized Variable is GDP)

Period	Effect	GDP	TO	POP	UNEMP	FDI	INF	EXCH	GFCF	HCD
3 Year	Short	81.16098	1.937804	0.170413	0.192346	15.00768	0.398587	0.100974	0.153242	0.877972
	Term									
6Year	Medium	73.46463	3.040263	0.175290	0.447050	20.69352	0.401217	0.360424	0.362436	1.055170
	Term									
10 Year	Long	68.41721	3.367446	0.201815	0.356055	25.74373	0.418969	0.291404	0.283795	0.919566
	Term									
Decision		Decreasing	Increasing	Increasing	fluctuating	Increasing	Increasing	fluctuating	fluctuating	fluctuating

Note: GDP: gross domestic product per capita, TO: trade openness, POP: population; UNEMP: unemployment, FDI: foreign direct investment, INF: inflation, EXCH: exchange rates, GFCF: gross fixed capital formation, HCD: human capital development. All variables were transformed into first difference

6.6 Conclusion and policy implication

This research objective was undertaken to investigate the causal relationship between trade openness and economic growth in the ECOWAS region. The study employed several econometric techniques to achieve this research objective. The LLC, IPS, ADF Fisher chi square and the PP Fisher chi square unit root test was employed to examine if the time series data set exhibit unit root properties, that is, if the data set is stationary. Having established stationarity of all the time series, the next step was to select the number of lags for the ARDL estimation. The PMG/Autoregressive Distributed Lag (ARDL) test was employed to investigate both the short and the long run co-integrating relationship between trade openness and GDP per capita growth. This was followed by Dumestriscu and Hurlin (2012) causality test to investigate the causal relationship between trade openness and economic growth. The IRFs and FEVDs were employed in examining the response of the dependent variable (GDP per capita) to impulse in trade openness and other explanatory variables.

The discussion of the findings is therefore, presented on the basis of the specific methodology employed for this objective.

To examine the long run effect of trade openness on economic growth in ECOWAS, the study employed the PMG/ARDL approach. First, the result of the PMG/ARDL test confirms the existence of long-run equilibrium relationship between trade openness and economic growth in ECOWAS. Not surprisingly, like the literature on the growth effects of trade openness, findings of this investigation are consistent with predictions of theoretical studies. The regression reported a positive and significant relationship between trade openness and economic growth among ECOWAS member countries in the long run. The long-run PMG/ARDL results of trade openness with respect to economic growth is 0.834211 (0.0470), which indicates that a 1%

increase in trade openness would lead to 0.83% increase in GDP growth, however, the regression results reported a negative but not significant estimated coefficient for trade openness, -0.734678 (0.3179) in the short run. Hence, the result support the hypothesis that trade openness has long run effect on economic growth in ECOWAS. The results supports earlier findings in Saibu (2004), Effiom, Ubi, Okon and Itam (2011), Mohammed and Jian (2016) and more recently in Khobai, Kolisi and Moyo (2018) and Egbulonu and Ezeocha (2018), which reported a positive relationship between trade openness and economic growth. The evidence of the finding of a positive relationship between trade openness and economic growth in the long run is consistent with the earlier findings in N'guessan and Yue (2010) using ARDL technique, which indicated positive long run relationship between trade openness and economic growth.

The short-run elasticity using Error Correction regression for the ECOWAS countries indicated that the dynamic encompassing parsimonious models $((1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1))$ for ECOWAS fits to the data quite well. The short run Error Correction Term of -0.661518 (0.0000) which is statistically significant, implies that about 66.15% of the disequilibrium caused by previous year's shocks converges back to equilibrium in each period.

On the causality between trade openness and economic growth, the results are largely consistent with the PMG/ARDL results which suggested that the trade openness cause economic growth in the long run.

The D-H results report that using lag 1, 2 and 4, we reject the null hypothesis that trade openness does not granger cause economic growth. The reported coefficient of the wald statistics are 2.60407 (0.0017), 3.89583 (0.0367), 9.51529 (0.0270) with P-values reported in parenthesis for lag 1, 2 and 4 respectively implies that trade openness granger cause economic growth in ECOWAS. On the other hand there is no reverse causation from GDP to OPNES, since the Wald

statistics, 1.70312 (0.2298), 2.44442 (0.9123), 3.60690 (0.8937), 5.39118 (0.9061) for lag 1, 2, 3 and 4 respectively is not statistically significant (Note: probability in parenthesis). Again, the findings reported no bidirectional causality in each of the variables. It can be concluded on the basis of this result that there is unidirectional causality from trade openness to economic growth in ECOWAS within the period from 2000 - 2020. The result is consistent with the findings of Saibu (2004) which indicated a unidirectional causation running from trade openness to real GDP, but contradict with the findings of Nwinee and Olulu-Briggs (2016) which indicated bidirectional causation between trade openness and economic growth. There was no causal relationship between FDI and GDP, INF and GDP, EXCH and GDP and GFCF and GDP in both directions. However, there was a unidirectional causality relationship from GDP to HCD.

Results from the IRFs indicated transmission response of GDP to impulse in trade openness in ECOWAS countries. The effect of transmission of GDP on its own shocks was permanent and will continue to have positive impact on the economy in the long-term.

The transmission effect of OPNES to GDP in event of policy shock was fluctuating and its impact on the economy in the long-term is unclear. The evidence from the IRFs also indicated that the effect of innovations of POP on GDP was temporary as the positive effect declines over the 10-year period. For unemployment, the unanticipated shock indicates that the shock has a decreasing trend.

Evidence from the IRFs result also indicated permanent policy shock of FDI with positive impact on GDP in the long-term. The results also, indicated positive and increasing trend of inflation on GDP. The evidence from the IRFs of exchange rate to GDP shows negative impact in the short term and this negative effect permeates through the medium to the long term albeit a

fluctuating trend indicating that the shock is permanent. For HCD, unanticipated shock shows negative increase effect on GDP which indicates that the shock is permanent.

The percentage of variance explained by own shock account for 81.160% in the short-term and continue falling until it ends with an average around 68.417% at the end of the 10th period. This implies that economic growth is explained predominantly by its own innovative shocks (68.417%) while innovative shocks of trade openness, population, unemployment, FDI, INF, EXCH, GFCF and HCD contribute to GDP by 3.367446%, 0.201815%, 0.356055%, 25.74373%, 0.418969%, 0.291404%, 0.283795% and 0.919566% respectively, at the end of the 10-year forecast period. This shows that international trade is a weak driver of economic growth in ECOWAS; however, FDI and HCD can be the driving factors for economic growth within the sub-region.

Since, intra region trade among ECOWAS member countries is low; the best policy regarding the unpredictability of the shocks of trade openness on economic growth is to raise both the volume and quality of exports, and also initiate appropriate fiscal policies that can reduce unfavourable terms of trade which hinders economic growth.

We established empirically that trade openness is not sufficient on its own to foster growth, since, quality and quantity of human capital development in terms of education and technological skills acquired, the quality and quantity of net inflow of FDI into the domestic economy and the stabilization of the exchange rate of the domestic currency and it's prudent management are the main ingredients that can complements the contribution of trade to growth. We therefore recommend ECOWAS heads of state to control trade openness through macroeconomic policies which is devoted to bring increased local production of manufactured and agricultural goods so as to reduce importation, which can boost economic growth.

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APPENDICES

APPENDIX 6.1: Cross-section short run coefficients (PMG/ARDL results)

GHANA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.951218	0.033727	-28.20386	0.0001
D(DTO)	0.103480	0.682202	0.151686	0.8891
D(DPOP)	-55.20066	814.3332	-0.067786	0.9502
D(DUNEMP)	-4.340969	2.769656	-1.567332	0.2150
D(DFDI)	0.568920	0.149860	3.796335	0.0321
D(DINF)	-0.425706	0.081982	-5.192707	0.0139
D(DEXCH)	-1.432760	2.580172	-0.555297	0.6174
D(DGFCF)	1.349625	0.541098	2.494233	0.0882
D(DHCD)	2.514621	4.246854	0.592114	0.5954
C	0.040322	0.021819	1.848052	0.1617

NIGERIA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.661518	0.062782	-10.53678	0.0018
D(DTO)	-1.268200	0.204246	-6.209165	0.0084
D(DPOP)	-100.1405	3928.971	-0.025488	0.9813
D(DUNEMP)	1.551272	1.503247	1.031947	0.3780
D(DFDI)	0.027503	0.015832	1.737165	0.1808
D(DINF)	-0.575826	0.031806	-18.10449	0.0004
D(DEXCH)	-0.165133	1.453059	-0.113645	0.9167
D(DGFCF)	-0.617429	0.533828	-1.156605	0.3312
D(DHCD)	0.919414	1.292983	0.711080	0.5283
C	-0.109530	0.010287	-10.64786	0.0018

SIERRA LEONE

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.661518	0.062782	-10.53678	0.0018
D(DTO)	-1.268200	0.204246	-6.209165	0.0084
D(DPOP)	-100.1405	3928.971	-0.025488	0.9813
D(DUNEMP)	1.551272	1.503247	1.031947	0.3780
D(DFDI)	0.027503	0.015832	1.737165	0.1808
D(DINF)	-0.575826	0.031806	-18.10449	0.0004
D(DEXCH)	-0.165133	1.453059	-0.113645	0.9167
D(DGFCF)	-0.617429	0.533828	-1.156605	0.3312
D(DHCD)	0.919414	1.292983	0.711080	0.5283
C	-0.109530	0.010287	-10.64786	0.0018

GUINEA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.002807	0.046143	-21.73280	0.0002
D(DTO)	2.262489	1.484263	1.524318	0.2248
D(DPOP)	-8.814064	35.00219	-0.251815	0.8174
D(DUNEMP)	-4.021168	13.00396	-0.309226	0.7774
D(DFDI)	-0.037084	0.002569	-14.43418	0.0007
D(DINF)	0.457187	0.039159	11.67518	0.0013
D(DEXCH)	-3.232447	0.800270	-4.039193	0.0273
D(DGFCF)	-0.027518	0.163194	-0.168619	0.8768
D(DHCD)	3.508541	7.941185	0.441816	0.6885
C	0.037358	0.015926	2.345769	0.1007

GAMBIA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.087203	0.018057	-60.21119	0.0000
D(DTO)	-2.403824	2.107356	-1.140683	0.3368
D(DPOP)	111.9379	3045.142	0.036760	0.9730
D(DUNEMP)	-7.346010	43.81116	-0.167674	0.8775
D(DFDI)	0.490834	0.174612	2.810998	0.0672
D(DINF)	-2.794327	0.275084	-10.15810	0.0020
D(DEXCH)	6.163756	7.310721	0.843112	0.4611
D(DGFCF)	1.391149	0.310329	4.482823	0.0207
D(DHCD)	29.63832	522.4202	0.056733	0.9583
C	-0.014642	0.052597	-0.278377	0.7988

LIBERIA

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.901037	0.042010	-21.44838	0.0002
D(DTO)	-0.583648	0.069851	-8.355594	0.0036
D(DPOP)	-0.676074	1.453445	-0.465153	0.6735
D(DUNEMP)	-0.203554	0.266744	-0.763105	0.5009
D(DFDI)	0.073685	0.003388	21.74947	0.0002
D(DINF)	0.253359	0.027340	9.267042	0.0027
D(DEXCH)	0.563350	0.505545	1.114342	0.3464
D(DGFCF)	0.051780	0.109261	0.473914	0.6679
D(DHCD)	0.187322	0.626374	0.299058	0.7844
C	0.078270	0.006790	11.52707	0.0014

CAPE VERDE

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.656294	0.009288	-178.3352	0.0000
D(DTO)	-4.502502	4.604255	-0.977900	0.4002
D(DPOP)	-32.19312	106.1289	-0.303340	0.7815
D(DUNEMP)	-2.265572	10.46088	-0.216576	0.8424
D(DFDI)	0.109311	0.036115	3.026797	0.0565
D(DINF)	0.115899	0.016028	7.231169	0.0055
D(DEXCH)	2.082858	1.742572	1.195278	0.3179
D(DGFCF)	-4.354949	1.392742	-3.126888	0.0522
D(DHCD)	-3.837341	9.720933	-0.394750	0.7194
C	0.030634	0.013686	2.238332	0.1111

BURKINA FASO

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.811147	0.111208	-16.28617	0.0005
D(DTO)	2.013013	6.275504	0.320773	0.7694
D(DPOP)	62.47540	8560.377	0.007298	0.9946
D(DUNEMP)	-3.033895	5.760576	-0.526665	0.6349
D(DFDI)	-0.056428	0.004788	-11.78425	0.0013
D(DINF)	-0.082913	0.029737	-2.788180	0.0685
D(DEXCH)	-0.230865	2.865631	-0.080563	0.9409
D(DGFCF)	-2.406436	2.709281	-0.888219	0.4399
D(DHCD)	-1.625554	19.29205	-0.084260	0.9382
C	-0.254972	0.028936	-8.811700	0.0031

MALI

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.171617	0.092689	-12.64035	0.0011
D(DTO)	3.291510	19.39068	0.169747	0.8760
D(DPOP)	46.42713	2040.210	0.022756	0.9833
D(DUNEMP)	-1.176477	26.48336	-0.044423	0.9674
D(DFDI)	0.753540	0.844890	0.891879	0.4382
D(DINF)	-0.445236	0.113517	-3.922180	0.0295
D(DEXCH)	5.727519	9.124160	0.627731	0.5747
D(DGFCF)	0.281998	10.20847	0.027624	0.9797
D(DHCD)	10.54549	185.5331	0.056839	0.9582
C	0.049803	0.135744	0.366892	0.7381

NIGER

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.745513	0.024938	-69.99372	0.0000
D(DTO)	-4.783227	2.915780	-1.640462	0.1994
D(DPOP)	246.5438	3388.036	0.072769	0.9466
D(DUNEMP)	0.033591	0.024488	1.371730	0.2637
D(DFDI)	0.268105	0.049072	5.463490	0.0121
D(DINF)	-0.121503	0.002197	-55.31463	0.0000
D(DEXCH)	-1.014414	2.732562	-0.371232	0.7351
D(DGFCF)	3.168432	2.677231	1.183473	0.3219
D(DHCD)	-4.373905	2.726918	-1.603974	0.2071
C	-0.058341	0.014116	-4.133033	0.0257

SENEGAL

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.267969	0.059981	-21.13953	0.0002
D(DTO)	-5.547166	3.039620	-1.824954	0.1655
D(DPOP)	-23.63058	9866.269	-0.002395	0.9982
D(DUNEMP)	-0.083515	1.573500	-0.053076	0.9610
D(DFDI)	-0.300704	0.586952	-0.512314	0.6438
D(DINF)	-0.212312	0.019362	-10.96511	0.0016
D(DEXCH)	0.773436	1.877164	0.412023	0.7080
D(DGFCF)	2.688853	7.298813	0.368396	0.7370
D(DHCD)	-0.460605	8.657662	-0.053202	0.9609
C	-0.211887	0.046109	-4.595365	0.0194

TOGO

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.579418	0.053228	-29.67289	0.0001
D(DTO)	1.226082	1.787376	0.685968	0.5420
D(DPOP)	11.41000	56.84187	0.200732	0.8537
D(DUNEMP)	0.266634	2.072923	0.128627	0.9058
D(DFDI)	0.084346	0.006627	12.72712	0.0010
D(DINF)	-0.142235	0.003248	-43.79642	0.0000
D(DEXCH)	1.228546	0.798352	1.538852	0.2215
D(DGFCF)	-1.335603	1.271410	-1.050489	0.3706
D(DHCD)	-2.152269	1.385187	-1.553775	0.2181
C	-0.014371	0.006387	-2.250054	0.1099

GUINEA BISSAU

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.119769	0.017647	-63.45296	0.0000
D(DTO)	0.498417	1.531094	0.325530	0.7662
D(DPOP)	-22.95642	1887.115	-0.012165	0.9911
D(DUNEMP)	-7.003550	38.85777	-0.180236	0.8685
D(DFDI)	-0.399948	0.021394	-18.69477	0.0003
D(DINF)	-0.491615	0.053039	-9.268982	0.0027
D(DEXCH)	-1.186570	3.373511	-0.351731	0.7483
D(DGFCF)	-1.348387	0.270173	-4.990820	0.0155
D(DHCD)	5.062303	4.502382	1.124361	0.3427
C	0.123012	0.043545	2.824928	0.0665

COTE D'IVOIRE

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.358833	0.028853	-47.09455	0.0000
D(DTO)	1.584966	1.762527	0.899257	0.4348
D(DPOP)	-10.35648	48.98565	-0.211419	0.8461
D(DUNEMP)	-0.953403	0.377190	-2.527648	0.0856
D(DFDI)	0.113530	0.034573	3.283787	0.0463
D(DINF)	0.121161	0.003870	31.30496	0.0001
D(DEXCH)	0.816659	0.481135	1.697359	0.1882
D(DGFCF)	-0.408601	0.394043	-1.036945	0.3760
D(DHCD)	-5.523073	1.733756	-3.185611	0.0499
C	0.117830	0.006813	17.29369	0.0004

BENIN

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.002650	0.027483	-36.48226	0.0000
D(DTO)	-3.773712	2.235990	-1.687714	0.1901
D(DPOP)	-31.49248	1246.112	-0.025273	0.9814
D(DUNEMP)	-7.351965	2.599042	-2.828721	0.0663
D(DFDI)	0.397608	0.042816	9.286532	0.0026
D(DINF)	0.091169	0.010459	8.716790	0.0032
D(DEXCH)	2.698140	1.863786	1.447666	0.2435
D(DGFCF)	2.515423	1.428785	1.760533	0.1765
D(DHCD)	5.217203	5.865683	0.889445	0.4393
C	-0.046404	0.021969	-2.112229	0.1251

APPENDIX 6.2: PMG/ARDL lag selection

VAR Lag Order Selection Criteria

Endogenous variables: DGDP DTO DPOP DUNEMP DFDI DINF DEXCH DGFCF DH...

Exogenous variables: C

Date: 12/24/22 Time: 09:25

Sample: 2001 2020

Included observations: 285

Lag	LogL	LR	FPE	AIC	SC	HQ
0	7.403773	NA	8.18e-12	0.011202	0.126543	0.057439
1	296.7255	558.3401*	1.90e-12*	-1.450705*	-0.297287*	-0.988328*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX 6.3: Pairwise Dumitrescu-Hurlin Panel Causality test

The pairwise Dumitrescu and Hurlin (2012) non-granger causality test results are displayed below.

We report estimation results for four (4) separate lags.

Our decision to estimate four separate lags for the homogeneous causality was to ensure robustness of the results.

Pairwise Dumitrescu Hurlin Panel Causality Tests
 Date: 12/02/22 Time: 09:00
 Sample: 2001 2020
 Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
DTO does not homogeneously cause DGDP	2.60407	3.13183	0.0017
DGDP does not homogeneously cause DTO	1.70312	1.20081	0.2298
DPOP does not homogeneously cause DGDP	0.52755	-1.31880	0.1872
DGDP does not homogeneously cause DPOP	0.54094	-1.29009	0.1970
DUNEMP does not homogeneously cause D...	0.77213	-0.79457	0.4269
DGDP does not homogeneously cause DUN...	0.31592	-1.77237	0.0763
DFDI does not homogeneously cause DGDP	0.94734	-0.41906	0.6752
DGDP does not homogeneously cause DFDI	1.11444	-0.06091	0.9514
DINF does not homogeneously cause DGDP	1.50078	0.76714	0.4430
DGDP does not homogeneously cause DINF	1.08641	-0.12098	0.9037
DEXCH does not homogeneously cause DGDP	0.88592	-0.55069	0.5818
DGDP does not homogeneously cause DEXCH	0.99886	-0.30863	0.7576
DGFCF does not homogeneously cause DGDP	1.35949	0.46431	0.6424
DGDP does not homogeneously cause DGFCF	1.03946	-0.22161	0.8246
DHCD does not homogeneously cause DGDP	1.36079	0.46709	0.6404
DGDP does not homogeneously cause DHCD	2.83282	3.62210	0.0003
DPOP does not homogeneously cause DTO	1.06230	-0.17266	0.8629
DTO does not homogeneously cause DPOP	1.52050	0.80941	0.4183
DUNEMP does not homogeneously cause DTO	0.87158	-0.58142	0.5610
DTO does not homogeneously cause DUNEMP	1.21867	0.16248	0.8709
DFDI does not homogeneously cause DTO	1.90359	1.63048	0.1030
DTO does not homogeneously cause DFDI	1.46475	0.68992	0.4902
DINF does not homogeneously cause DTO	1.07500	-0.14545	0.8844
DTO does not homogeneously cause DINF	0.96771	-0.37539	0.7074
DEXCH does not homogeneously cause DTO	1.50300	0.77190	0.4402
DTO does not homogeneously cause DEXCH	2.05993	1.96556	0.0493
DGFCF does not homogeneously cause DTO	1.06662	-0.16340	0.8702
DTO does not homogeneously cause DGFCF	1.06503	-0.16681	0.8675
DHCD does not homogeneously cause DTO	0.59982	-1.16390	0.2445
DTO does not homogeneously cause DHCD	0.45389	-1.47666	0.1398
DUNEMP does not homogeneously cause D...	1.29422	0.32442	0.7456
DPOP does not homogeneously cause DUN...	1.07368	-0.14827	0.8821
DFDI does not homogeneously cause DPOP	1.32847	0.39782	0.6908
DPOP does not homogeneously cause DFDI	0.90269	-0.51475	0.6067
DINF does not homogeneously cause DPOP	0.22593	-1.96525	0.0494
DPOP does not homogeneously cause DINF	0.30450	-1.79685	0.0724
DEXCH does not homogeneously cause DPOP	1.44410	0.64565	0.5185
DPOP does not homogeneously cause DEXCH	2.64425	3.21793	0.0013
DGFCF does not homogeneously cause DPOP	0.91459	-0.48924	0.6247
DPOP does not homogeneously cause DGFCF	1.52757	0.82455	0.4096
DHCD does not homogeneously cause DPOP	0.73796	-0.86781	0.3855
DPOP does not homogeneously cause DHCD	2.16756	2.19624	0.0281
DFDI does not homogeneously cause DUNEMP	1.21409	0.15267	0.8787
DUNEMP does not homogeneously cause DFDI	0.70693	-0.93432	0.3501
DINF does not homogeneously cause DUNEMP	0.87345	-0.57743	0.5636
DUNEMP does not homogeneously cause DINF	0.65415	-1.04745	0.2949
DEXCH does not homogeneously cause DU...	1.08184	-0.13078	0.8960
DUNEMP does not homogeneously cause D...	1.04715	-0.20513	0.8375
DGFCF does not homogeneously cause DU...	0.65462	-1.04643	0.2954
DUNEMP does not homogeneously cause D...	1.09654	-0.09927	0.9209
DHCD does not homogeneously cause DUN...	0.49069	-1.39778	0.1622
DUNEMP does not homogeneously cause D...	1.40311	0.55780	0.5770
DINF does not homogeneously cause DFDI	1.14533	0.00530	0.9958
DFDI does not homogeneously cause DINF	0.98123	-0.34642	0.7290
DEXCH does not homogeneously cause DFDI	1.70004	1.19420	0.2324
DFDI does not homogeneously cause DEXCH	0.51692	-1.34158	0.1797
DGFCF does not homogeneously cause DFDI	1.18826	0.09731	0.9225
DFDI does not homogeneously cause DGFCF	1.49794	0.76104	0.4466
DHCD does not homogeneously cause DFDI	0.78790	-0.76077	0.4468
DFDI does not homogeneously cause DHCD	0.99317	-0.32083	0.7483
DEXCH does not homogeneously cause DINF	1.41614	0.58573	0.5581
DINF does not homogeneously cause DEXCH	2.11032	2.07358	0.0381
DGFCF does not homogeneously cause DINF	0.75386	-0.83374	0.4044
DINF does not homogeneously cause DGFCF	1.12846	-0.03085	0.9754
DHCD does not homogeneously cause DINF	0.62684	-1.10598	0.2687
DINF does not homogeneously cause DHCD	0.75396	-0.83352	0.4046
DGFCF does not homogeneously cause DE...	1.28217	0.29858	0.7653
DEXCH does not homogeneously cause DG...	1.75020	1.30172	0.1930
DHCD does not homogeneously cause DEXCH	1.29146	0.31851	0.7501
DEXCH does not homogeneously cause DHCD	1.29334	0.32253	0.7471
DHCD does not homogeneously cause DGFCF	0.57696	-1.21288	0.2252
DGFCF does not homogeneously cause DHCD	1.65156	1.09030	0.2756

Pairwise Dumitrescu Hurlin Panel Causality Tests
 Date: 12/02/22 Time: 09:02
 Sample: 2001 2020
 Lags: 2

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
DTO does not homogeneously cause DGDP	3.89583	2.08895	0.0367
DGDP does not homogeneously cause DTO	2.44442	0.11014	0.9123
DPOP does not homogeneously cause DGDP	2.92839	0.76996	0.4413
DGDP does not homogeneously cause DPOP	2.75376	0.53188	0.5948
DUNEMP does not homogeneously cause D...	1.58910	-1.05599	0.2910
DGDP does not homogeneously cause DUN...	0.63044	-2.36299	0.0181
DFDI does not homogeneously cause DGDP	2.78260	0.57121	0.5679
DGDP does not homogeneously cause DFDI	1.22916	-1.54671	0.1219
DINF does not homogeneously cause DGDP	2.11636	-0.33713	0.7360
DGDP does not homogeneously cause DINF	2.55979	0.26743	0.7891
DEXCH does not homogeneously cause DGDP	2.08165	-0.38446	0.7006
DGDP does not homogeneously cause DEXCH	2.76172	0.54274	0.5873
DGFCF does not homogeneously cause DGDP	1.50535	-1.17017	0.2419
DGDP does not homogeneously cause DGFCF	1.50553	-1.16992	0.2420
DHCD does not homogeneously cause DGDP	2.18391	-0.24503	0.8064
DGDP does not homogeneously cause DHCD	39.0738	50.0497	0.0000
DPOP does not homogeneously cause DTO	3.61235	1.70246	0.0887
DTO does not homogeneously cause DPOP	1.09445	-1.73037	0.0836
DUNEMP does not homogeneously cause DTO	2.67189	0.42027	0.6743
DTO does not homogeneously cause DUNEMP	1.61660	-1.01850	0.3084
DFDI does not homogeneously cause DTO	2.17317	-0.25968	0.7951
DTO does not homogeneously cause DFDI	2.07083	-0.39920	0.6897
DINF does not homogeneously cause DTO	3.06320	0.95376	0.3402
DTO does not homogeneously cause DINF	2.50898	0.19816	0.8429
DEXCH does not homogeneously cause DTO	3.13919	1.05737	0.2903
DTO does not homogeneously cause DEXCH	2.46295	0.13541	0.8923
DGFCF does not homogeneously cause DTO	3.14309	1.06268	0.2879
DTO does not homogeneously cause DGFCF	1.59498	-1.04796	0.2947
DHCD does not homogeneously cause DTO	1.85818	-0.68912	0.4907
DTO does not homogeneously cause DHCD	1.11703	-1.69959	0.0892
DUNEMP does not homogeneously cause D...	1.06408	-1.77178	0.0764
DPOP does not homogeneously cause DUN...	2.61211	0.33876	0.7348
DFDI does not homogeneously cause DPOP	4.83400	3.36802	0.0008
DPOP does not homogeneously cause DFDI	3.20954	1.15328	0.2488
DINF does not homogeneously cause DPOP	1.57920	-1.06948	0.2849
DPOP does not homogeneously cause DINF	0.70513	-2.26116	0.0237
DEXCH does not homogeneously cause DPOP	3.72663	1.85827	0.0631
DPOP does not homogeneously cause DEXCH	3.43022	1.45415	0.1459
DGFCF does not homogeneously cause DPOP	2.62538	0.35685	0.7212
DPOP does not homogeneously cause DGFCF	4.89689	3.45376	0.0006
DHCD does not homogeneously cause DPOP	1.70059	-0.90399	0.3660
DPOP does not homogeneously cause DHCD	3.06074	0.95041	0.3419
DFDI does not homogeneously cause DUNEMP	1.71556	-0.88357	0.3769
DUNEMP does not homogeneously cause DFDI	1.81558	-0.74721	0.4549
DINF does not homogeneously cause DUNEMP	1.78588	-0.78770	0.4309
DUNEMP does not homogeneously cause DINF	2.06680	-0.40469	0.6857
DEXCH does not homogeneously cause DU...	1.79444	-0.77603	0.4377
DUNEMP does not homogeneously cause D...	2.48381	0.16384	0.8699
DGFCF does not homogeneously cause DU...	2.33198	-0.04316	0.9656
DUNEMP does not homogeneously cause D...	3.20335	1.14484	0.2523
DHCD does not homogeneously cause DUN...	2.24065	-0.16768	0.8668
DUNEMP does not homogeneously cause D...	2.39315	0.04024	0.9679
DINF does not homogeneously cause DFDI	2.10752	-0.34918	0.7270
DFDI does not homogeneously cause DINF	2.64909	0.38918	0.6971
DEXCH does not homogeneously cause DFDI	3.82863	1.99733	0.0458
DFDI does not homogeneously cause DEXCH	2.41760	0.07357	0.9414
DGFCF does not homogeneously cause DFDI	3.29163	1.26520	0.2058
DFDI does not homogeneously cause DGFCF	3.00300	0.87169	0.3834
DHCD does not homogeneously cause DFDI	0.82689	-2.09515	0.0362
DFDI does not homogeneously cause DHCD	1.64512	-0.97960	0.3273
DEXCH does not homogeneously cause DINF	2.12551	-0.32466	0.7454
DINF does not homogeneously cause DEXCH	2.60682	0.33156	0.7402
DGFCF does not homogeneously cause DINF	0.96062	-1.91284	0.0558
DINF does not homogeneously cause DGFCF	2.66377	0.40919	0.6824
DHCD does not homogeneously cause DINF	1.99973	-0.49614	0.6198
DINF does not homogeneously cause DHCD	1.91779	-0.60786	0.5433
DGFCF does not homogeneously cause DE...	2.82502	0.62903	0.5293
DEXCH does not homogeneously cause DG...	3.69906	1.82068	0.0687
DHCD does not homogeneously cause DEXCH	3.05221	0.93878	0.3478
DEXCH does not homogeneously cause DHCD	2.80898	0.60717	0.5437
DHCD does not homogeneously cause DGFCF	1.15571	-1.64685	0.0996
DGFCF does not homogeneously cause DHCD	1.83332	-0.72302	0.4697

Pairwise Dumitrescu Hurlin Panel Causality Tests
 Date: 12/02/22 Time: 09:05
 Sample: 2001 2020
 Lags: 3

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
DTO does not homogeneously cause DGDP DGDP does not homogeneously cause DTO	5.46612 3.60690	1.60320 -0.13368	0.1089 0.8937
DPOP does not homogeneously cause DGDP DGDP does not homogeneously cause DPOP	3.70680 3.20394	-0.04036 -0.51013	0.9678 0.6100
DUNEMP does not homogeneously cause D... DGDP does not homogeneously cause DUN...	1.95239 1.72751	-1.67932 -1.88941	0.0931 0.0588
DFDI does not homogeneously cause DGDP DGDP does not homogeneously cause DFDI	3.26878 2.90152	-0.44955 -0.79265	0.6530 0.4280
DINF does not homogeneously cause DGDP DGDP does not homogeneously cause DINF	3.16755 4.20205	-0.54413 0.42230	0.5864 0.6728
DEXCH does not homogeneously cause DGDP DGDP does not homogeneously cause DEXCH	3.23788 6.92026	-0.47842 2.96166	0.6324 0.0031
DGFCF does not homogeneously cause DGDP DGDP does not homogeneously cause DGFCF	3.00963 3.31327	-0.69165 -0.40799	0.4892 0.6833
DHCD does not homogeneously cause DGDP DGDP does not homogeneously cause DHCD	3.12109 35.1512	-0.58752 29.3350	0.5569 0.0000
DPOP does not homogeneously cause DTO DTO does not homogeneously cause DPOP	10.3825 2.81795	6.19610 -0.87072	6.E-10 0.3839
DUNEMP does not homogeneously cause DTO DTO does not homogeneously cause DUNEMP	4.24518 2.94883	0.46259 -0.74845	0.6437 0.4542
DFDI does not homogeneously cause DTO DTO does not homogeneously cause DFDI	3.51502 2.99822	-0.21952 -0.70231	0.8262 0.4825
DINF does not homogeneously cause DTO DTO does not homogeneously cause DINF	6.87986 3.77243	2.92391 0.02095	0.0035 0.9833
DEXCH does not homogeneously cause DTO DTO does not homogeneously cause DEXCH	3.69923 2.69862	-0.04743 -0.98220	0.9622 0.3260
DGFCF does not homogeneously cause DTO DTO does not homogeneously cause DGFCF	7.18510 3.30649	3.20906 -0.41433	0.0013 0.6786
DHCD does not homogeneously cause DTO DTO does not homogeneously cause DHCD	2.05104 1.75117	-1.58716 -1.86730	0.1125 0.0619
DUNEMP does not homogeneously cause D... DPOP does not homogeneously cause DUN...	2.73871 4.60915	-0.94475 0.80262	0.3448 0.4222
DFDI does not homogeneously cause DPOP DPOP does not homogeneously cause DFDI	4.39647 3.35459	0.60393 -0.36939	0.5459 0.7118
DINF does not homogeneously cause DPOP DPOP does not homogeneously cause DINF	3.37841 2.53789	-0.34714 -1.13235	0.7285 0.2575
DEXCH does not homogeneously cause DPOP DPOP does not homogeneously cause DEXCH	5.56174 4.56856	1.69252 0.76470	0.0905 0.4445
DGFCF does not homogeneously cause DPOP DPOP does not homogeneously cause DGFCF	6.69335 5.13199	2.74968 1.29106	0.0060 0.1967
DHCD does not homogeneously cause DPOP DPOP does not homogeneously cause DHCD	2.33052 5.34856	-1.32608 1.49338	0.1848 0.1353
DFDI does not homogeneously cause DUNEMP DUNEMP does not homogeneously cause DFDI	2.70113 2.97161	-0.97986 -0.72717	0.3272 0.4671
DINF does not homogeneously cause DUNEMP DUNEMP does not homogeneously cause DINF	4.30269 3.61357	0.51632 -0.12745	0.6056 0.8986
DEXCH does not homogeneously cause DU... DUNEMP does not homogeneously cause D...	2.95859 3.87335	-0.73933 0.11524	0.4597 0.9083
DGFCF does not homogeneously cause DU... DUNEMP does not homogeneously cause D...	4.38360 12.0144	0.59191 7.72058	0.5539 1.E-14
DHCD does not homogeneously cause DUN... DUNEMP does not homogeneously cause D...	2.61941 3.30537	-1.05620 -0.41537	0.2909 0.6779
DINF does not homogeneously cause DFDI DFDI does not homogeneously cause DINF	3.46022 4.52817	-0.27071 0.72697	0.7866 0.4672
DEXCH does not homogeneously cause DFDI DFDI does not homogeneously cause DEXCH	3.60121 3.81872	-0.13900 0.06420	0.8894 0.9488
DGFCF does not homogeneously cause DFDI DFDI does not homogeneously cause DGFCF	4.35256 4.71866	0.56291 0.90492	0.5735 0.3655
DHCD does not homogeneously cause DFDI DFDI does not homogeneously cause DHCD	3.06135 3.40511	-0.64333 -0.32220	0.5200 0.7473
DEXCH does not homogeneously cause DINF DINF does not homogeneously cause DEXCH	3.26119 2.92821	-0.45664 -0.76772	0.6479 0.4427
DGFCF does not homogeneously cause DINF DINF does not homogeneously cause DGFCF	3.09527 3.80004	-0.61165 0.04675	0.5408 0.9627
DHCD does not homogeneously cause DINF DINF does not homogeneously cause DHCD	3.64849 4.51651	-0.09483 0.71607	0.9245 0.4739
DGFCF does not homogeneously cause DE... DEXCH does not homogeneously cause DG...	3.89192 5.16631	0.13258 1.32311	0.8945 0.1858
DHCD does not homogeneously cause DEXCH DEXCH does not homogeneously cause DHCD	4.15945 4.30640	0.38251 0.51979	0.7021 0.6032
DHCD does not homogeneously cause DGFCF DGFCF does not homogeneously cause DHCD	2.43470 2.39347	-1.22875 -1.26727	0.2192 0.2051

Pairwise Dumitrescu Hurlin Panel Causality Tests
 Date: 12/02/22 Time: 09:06
 Sample: 2001 2020
 Lags: 4

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
DTO does not homogeneously cause DGDP	9.51529	2.21094	0.0270
DGDP does not homogeneously cause DTO	5.39118	-0.11792	0.9061
DPOP does not homogeneously cause DGDP	9.28981	2.08361	0.0372
DGDP does not homogeneously cause DPOP	7.20106	0.90410	0.3659
DUNEMP does not homogeneously cause D...	2.82185	-1.56880	0.1167
DGDP does not homogeneously cause DUN...	2.57040	-1.71079	0.0871
DFDI does not homogeneously cause DGDP	4.90804	-0.39074	0.6960
DGDP does not homogeneously cause DFDI	3.52912	-1.16941	0.2422
DINF does not homogeneously cause DGDP	5.61611	0.00910	0.9927
DGDP does not homogeneously cause DINF	4.66270	-0.52929	0.5966
DEXCH does not homogeneously cause DGDP	4.24085	-0.76750	0.4428
DGDP does not homogeneously cause DEXCH	6.08828	0.27573	0.7828
DGFCF does not homogeneously cause DGDP	5.51504	-0.04798	0.9617
DGDP does not homogeneously cause DGFCF	5.48052	-0.06747	0.9462
DHCD does not homogeneously cause DGDP	5.85508	0.14404	0.8855
DGDP does not homogeneously cause DHCD	30.6051	14.1202	0.0000
DPOP does not homogeneously cause DTO	21.3796	8.91063	0.0000
DTO does not homogeneously cause DPOP	4.59870	-0.56543	0.5718
DUNEMP does not homogeneously cause DTO	7.14768	0.87397	0.3821
DTO does not homogeneously cause DUNEMP	4.05766	-0.87095	0.3838
DFDI does not homogeneously cause DTO	4.68655	-0.51582	0.6060
DTO does not homogeneously cause DFDI	3.72551	-1.05851	0.2898
DINF does not homogeneously cause DTO	9.24277	2.05704	0.0397
DTO does not homogeneously cause DINF	4.76781	-0.46993	0.6384
DEXCH does not homogeneously cause DTO	4.50385	-0.61899	0.5359
DTO does not homogeneously cause DEXCH	4.21943	-0.77960	0.4356
DGFCF does not homogeneously cause DTO	5.58905	-0.00618	0.9951
DTO does not homogeneously cause DGFCF	4.87840	-0.40748	0.6837
DHCD does not homogeneously cause DTO	3.68132	-1.08346	0.2786
DTO does not homogeneously cause DHCD	2.39441	-1.81017	0.0703
DUNEMP does not homogeneously cause D...	4.03946	-0.88122	0.3782
DPOP does not homogeneously cause DUN...	6.24220	0.36265	0.7169
DFDI does not homogeneously cause DPOP	9.76660	2.35285	0.0186
DPOP does not homogeneously cause DFDI	5.80295	0.11461	0.9088
DINF does not homogeneously cause DPOP	4.27238	-0.74970	0.4534
DPOP does not homogeneously cause DINF	5.40786	-0.10850	0.9136
DEXCH does not homogeneously cause DPOP	6.82164	0.68985	0.4903
DPOP does not homogeneously cause DEXCH	9.69569	2.31281	0.0207
DGFCF does not homogeneously cause DPOP	5.44484	-0.08762	0.9302
DPOP does not homogeneously cause DGFCF	6.45463	0.48260	0.6294
DHCD does not homogeneously cause DPOP	3.77241	-1.03202	0.3021
DPOP does not homogeneously cause DHCD	9.77365	2.35683	0.0184
DFDI does not homogeneously cause DUNEMP	5.94005	0.19202	0.8477
DUNEMP does not homogeneously cause DFDI	3.65932	-1.09589	0.2731
DINF does not homogeneously cause DUNEMP	5.64384	0.02475	0.9803
DUNEMP does not homogeneously cause DINF	8.37521	1.56714	0.1171
DEXCH does not homogeneously cause DU...	3.42398	-1.22878	0.2192
DUNEMP does not homogeneously cause D...	6.06127	0.26047	0.7945
DGFCF does not homogeneously cause DU...	6.39621	0.44962	0.6530
DUNEMP does not homogeneously cause D...	19.5402	7.87194	4.E-15
DHCD does not homogeneously cause DUN...	2.58527	-1.70240	0.0887
DUNEMP does not homogeneously cause D...	8.19644	1.46619	0.1426
DINF does not homogeneously cause DFDI	4.22667	-0.77551	0.4380
DFDI does not homogeneously cause DINF	8.27488	1.51048	0.1309
DEXCH does not homogeneously cause DFDI	3.15870	-1.37858	0.1680
DFDI does not homogeneously cause DEXCH	6.15305	0.31230	0.7548
DGFCF does not homogeneously cause DFDI	6.26194	0.37379	0.7086
DFDI does not homogeneously cause DGFCF	5.00703	-0.33484	0.7377
DHCD does not homogeneously cause DFDI	3.35485	-1.26782	0.2049
DFDI does not homogeneously cause DHCD	4.85891	-0.41849	0.6756
DEXCH does not homogeneously cause DINF	5.78442	0.10414	0.9171
DINF does not homogeneously cause DEXCH	5.09526	-0.28502	0.7756
DGFCF does not homogeneously cause DINF	4.28445	-0.74288	0.4576
DINF does not homogeneously cause DGFCF	4.26474	-0.75401	0.4508
DHCD does not homogeneously cause DINF	5.18587	-0.23386	0.8151
DINF does not homogeneously cause DHCD	8.49640	1.63558	0.1019
DGFCF does not homogeneously cause DE...	4.33644	-0.71352	0.4755
DEXCH does not homogeneously cause DG...	8.38902	1.57494	0.1153
DHCD does not homogeneously cause DEXCH	7.16942	0.88624	0.3755
DEXCH does not homogeneously cause DHCD	8.69393	1.74712	0.0806
DHCD does not homogeneously cause DGFCF	5.94903	0.19709	0.8438
DGFCF does not homogeneously cause DHCD	3.45898	-1.20902	0.2267

APPENDIX 6.4: Lag Selection for Impulse Response Function

VAR Lag Order Selection Criteria

Endogenous variables: DGDG DTO DPOP DUNEMP DFDI DINF DEXCH DGFCF DH...

Exogenous variables: C

Date: 12/05/22 Time: 11:53

Sample: 2001 2020

Included observations: 180

Lag	LogL	LR	FPE	AIC	SC	HQ
0	287.0668	NA	3.68e-13	-3.089631	-2.929983*	-3.024900
1	472.4632	350.1932	1.16e-13	-4.249591	-2.653112	-3.602287
2	675.5535	363.3061	2.99e-14*	-5.606150*	-2.572841	-4.376274*
3	755.0946	134.3361	3.09e-14	-5.589940	-1.119801	-3.777491
4	835.6050	127.9221	3.20e-14	-5.584500	0.322470	-3.189478
5	917.6348	122.1333	3.33e-14	-5.595943	1.747858	-2.618348
6	980.9471	87.93364	4.38e-14	-5.399412	3.381219	-1.839244
7	1035.065	69.75231	6.60e-14	-5.100725	5.116737	-0.957984
8	1136.615	120.7317*	6.12e-14	-5.329059	6.325234	-0.603745

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX 6.5: Response of GDP to cholesky one S.D (d.f adjusted) innovations

Period	DGDG	DTO	DPOP	DUNEMP	DFDI	DINF	DEXCH	DGFCF	DHCD
1	1.135911	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	-0.075669	0.177997	-0.045460	0.004751	0.405829	0.081151	-0.014028	0.046294	0.071495
3	0.267754	0.031188	-0.028375	0.056735	0.297002	-0.011466	-0.038792	0.020958	-0.098407
4	0.279862	0.161523	-0.031224	-0.076201	0.377705	0.015560	0.070167	-0.072658	-0.082506
5	0.394321	0.041247	0.007307	0.011913	0.151193	0.047365	-0.001118	0.022049	0.031595
6	0.305594	0.098466	-0.012002	0.033528	0.242890	0.007349	-0.041099	-0.003749	-0.041749
7	0.303042	0.086953	-0.023389	-0.017146	0.290648	0.026707	0.009107	0.003929	-0.018680
8	0.278221	0.098404	-0.029774	-0.005146	0.302077	0.035371	0.019205	-0.012909	-0.038103
9	0.319770	0.082993	-0.018487	0.008977	0.241353	0.003509	-0.003948	-0.001238	-0.030975
10	0.317439	0.086431	-0.016691	-0.006553	0.257733	0.037757	-0.004671	-0.005406	-0.026072

Cholesky One S.D. (d.f. adjusted)

Cholesky ordering: DGDG DTO DPOP DUNEMP DFDI DINF DEXCH DGFCF DHCD

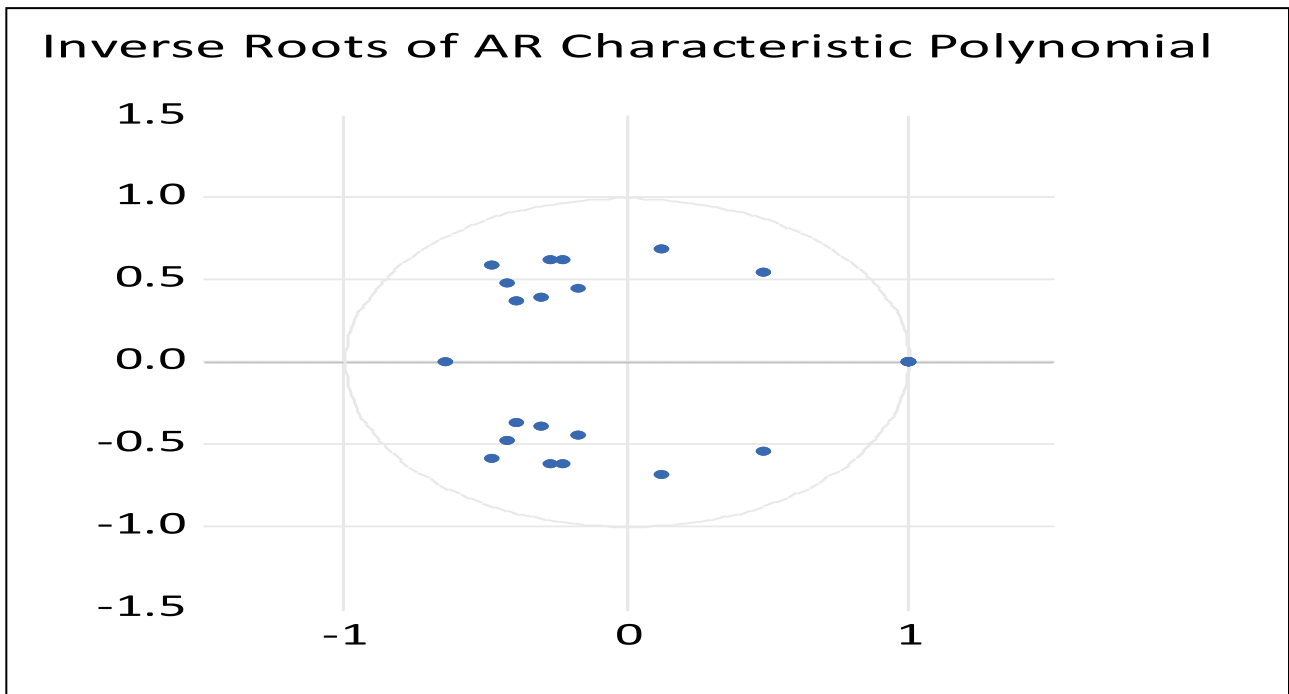
APPENDIX 6.6: Variance decomposition

Period	S.E.	DGDP	DTO	DPOP	DUNEMP	DFDI	DINF	DEXCH	DGFCF	DHCD
1	1.135911	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1.228220	85.91300	2.100253	0.136998	0.001496	10.91775	0.436549	0.013044	0.142070	0.338843
3	1.298146	81.16098	1.937804	0.170413	0.192346	15.00768	0.398587	0.100974	0.153242	0.877972
4	1.398675	73.91716	3.002892	0.196632	0.462504	20.22030	0.355726	0.338653	0.401861	1.104269
5	1.462964	74.82829	2.824260	0.182225	0.429379	19.55025	0.429971	0.309601	0.390033	1.055990
6	1.518918	73.46463	3.040263	0.175290	0.447050	20.69352	0.401217	0.360424	0.362436	1.055170
7	1.578919	71.67094	3.116872	0.184163	0.425512	22.53919	0.399914	0.336879	0.336032	0.990495
8	1.635689	69.67552	3.266204	0.204735	0.397478	24.41244	0.419399	0.327686	0.319341	0.977199
9	1.686499	69.13543	3.314524	0.204600	0.376721	25.01162	0.394941	0.308786	0.300442	0.952938
10	1.738224	68.41721	3.367446	0.201825	0.356055	25.74373	0.418969	0.291404	0.283795	0.919566

Cholesky One S.D. (d.f. adjusted)

Cholesky ordering: DGDP DTO DPOP DUNEMP DFDI DINF DEXCH DGFCF DHCD

APPENDIX 6.7: Inverse roots of AR characteristic Polynomial



CHAPTER SEVEN

SUMMARIES, CONCLUSIONS AND POLICY RECOMMENDATIONS

7.1 Introduction

This chapter, which is the concluding episode of the "essays on the proposed monetary integration in the ECOWAS region," summarises what was done in the preceding chapters and critical findings, draw conclusions based on the results and offer recommendations for policy uptake. We also suggest some potential areas for future research on the subject of monetary integration.

7.2 Summary of the research

This research piece sought to investigate some critical issues on monetary integration in ECOWAS region. The study was informed by the several postponement of the introduction of a single currency in the sub-region. Monetary integration has emerged in the milieu of the discussion on development finance policy after the successful introduction of the Euro due to its importance in the promotion of trade. The importance of monetary integration is projected by the African Union to reduce the overdependence of the sub-region from foreign aid. Moreover, heads of states of ECOWAS have shown commitment to introduce the single currency by the end of 2027 though it has not met all the convergence criteria. The reason is that member countries economies are more heterogenous than being homogenous, which hitherto has widened the convergence gap. Monetary integration provides a better chance of promoting trade among member countries.

We support the work of the academic community towards finding the best possible scenario of introducing a single currency in the sub-region by exploring the ex-post monetary integration in the ECOWAS region. We contribute to knowledge and understanding of the subject matter by resolving the following questions;

1. What is the level of interdependence of exchange rates among ECOWAS countries?
2. What is the extent of stock market development and economic growth among ECOWAS countries?
3. What is the extent of labor migration and economic growth among ECOWAS countries?
4. What is the causal relationship between trade openness and economic growth among ECOWAS countries?

7.3 Conclusions and findings

7.3.1 Interdependence of exchange rates in ECOWAS

This essay employed the wavelets methods to examine the interdependence of exchange rates in ECOWAS. Our estimations were based on the bivariate, wavelet multiple correlation and cross correlation by Fernando-Macho (2012). We established that co-movement of exchange rates in the sub-region is weak at the higher frequencies (lower scale); however interdependence is seen to accelerate when it is transitioning from the medium to the long term which is the lower frequency. This finding suggests that, the long-run integration of currencies is more plausible and efficacious than in the short run. We established that cross-correlation analysis depicts lead (lag) effects are time-varying and heterogeneous, showing no particular country's exchange rates as leader or follower. Different currencies have the potential to lead or lag at varying scales. We established that exchange rates take time to adjust and gravitate towards the lower frequencies.

This also suggests that there are intertemporal outcomes as far as co-movement of exchange rates is concerned. Therefore, there is the need to have a short-run and long-run perspective of the outcomes in mind as far as policy implementations are concerned.

7.3.2 Stock market development and economic growth in ECOWAS

The basis of the second empirical essay was to establish whether the effect of stock market development on growth is dependent on institutional quality variables and institutional quality index. We therefore employed the Hansen (1996, 2000) threshold regression to examine this relationship. First using institutional quality index, our evidence suggests that, stock market development and economic growth nexus is contingent on institutional quality. Thus, the quality of the development of the stock market is crucial for economic growth, where better institutional quality is effective in ensuring the efficiency of stock markets in enhancing growth. The results also indicate that low quality of institutions tends to distort the ability of foreign direct investment (FDI) and domestic credit to the private sector to have any positive significant influence on growth. When we disaggregated the institutional quality index into its various dimensions whiles we constructed a stock market development index, our evidence suggests that, stock market development has a positive and significant effect on growth when political stability is beyond the threshold level. We further realized that, when government effectiveness is the threshold variable, stock market development has a positive and significant relationship with growth below the threshold level whiles higher regulatory control has a negative effect on how stock market development influence growth. This indicates that too much government interference inhibit the development of stock market to have a substantial positive influence on growth. This corroborates the financial repression and financial liberalisation theory by McKinnon and Shaw (1973) which is tested in this study objective. We established that, below

the threshold level of voice and accountability, rule of law, and control of corruption, economic growth is largely insensitive to stock market development. The main conclusion drawn is that higher levels of institutional quality thus promote economic growth in the long run.

7.3.3 Labor migration and economic growth in ECOWAS

In this essay, we unravelled two objectives, first to estimate the linear relationship between labor migration and economic growth by using the PMG/ARDL, and secondly, to find whether there is nonlinearities in labor migration and economic growth in ECOWAS. We employed the NARDL developed by Shin et al. (2014) and the non-linear Error Correction Model (ECM) under the NARDL model setting was estimated using the Stepwise Least Square regression method with backward unidirectional iteration to arrive at the model's final specification results. First, the baseline ARDL was estimated and the results show that labor migration has negative and significant effect on economic growth in the long-run for the destination countries in ECOWAS with coefficient of -0.663509 at 0.01% significance level. In the NARDL model, we established that, in the long run, an increase in labor migration has a detrimental though insignificant impact on economic growth in the destination countries while a 1% decrease in labor migration in the destination country would lead 1.36% increase in GDP in the destination country. We thus established nonlinear relationship in labor migration and economic growth nexus in ECOWAS. The central policy imperative from the two estimations is that, labor migration negatively affects economic growth in the destination country.

7.3.4 Causal relationship between trade openness and economic growth in ECOWAS

In the last empirical chapter, we sought to examine three objectives: one, to investigate the effect of trade openness on economic growth, Second, to examine whether there is homogeneous

causal relationship between trade openness and economic growth and third, to analyze how growth response to innovation or shocks from trade openness in ECOWAS. This was done by employing the PMG/ARDL, Dumitrescu and Hurlin (2012) Granger causality test and the Impulse Response Function and the Forecast Error Variance Decomposition respectively. We established that, the long-run PMG/ARDL results of trade openness with respect to economic growth is 0.834211 (0.0470), which indicates that a 1% increase in trade openness would lead to 0.83% increase in GDP growth. The D-H results report that using lag 1, 2 and 4, we reject the null hypothesis that trade openness does not granger cause economic growth, in other words, we established that trade openness in the ECOWAS sub-region homogeneously promote economic growth while the transmission effect of trade openness to GDP in event of policy shock was fluctuating and its impact on the economy in the long-term is unclear. The policy implication is that trade openness thus promote economic growth hence policy makers should institute pragmatic measures to promote free trade.

7.4 Recommendations

Empirical findings for the first objective on the co-movement of exchange rates in the ECOWAS region which is necessary for the establishment of a monetary union have indicated that exchange rates convergence in the ECOWAS needs time to converge, therefore given the passage of time, exchange rates in the region would converge. This implies that, when bilateral and multilateral trade activities are intensified in the region, the prospects of exchange rates convergence is high. From the study findings, no country's exchange rates has the potential to lead(lag) the market, which means that policies from individual governments that are geared towards trade liberalization is a panacea for exchange rates convergence which is one of the ingredients of introducing monetary integration in the sub-region. When there is exchange rates

stabilization in the region, it reduces income differences among member countries. Thus, proper regulation of the exchange rates is crucial to reduce income difference in the sub-region. Further, this study finding, recommend that maintaining an exchange rate regime can improve export competitiveness. We recommend that, care should also be taken to maintain low inflationary pressures among ECOWAS countries. It is, therefore, reasonable to put in place policies that control inflation in the region. When inflation is also controlled, it can create a stable macroeconomic environment which is necessary to enhance per capita growth of GDP.

The second empirical essay reveals that the relationship between stock market development and economic growth is affected by the level of institutional quality. Given the threshold effects mediated by the institutional quality, it is pertinent for ECOWAS countries to first improve on the institutional structures in member countries as a way of increasing growth through the development of the stock market. This is correct, because as institutional structures are been improved, investors may begin to have faith in the financial intermediation process which can improve the growth enhancing effect from financial markets. Institutional policy decisions should be occasioned by in-depth research and analysis before they are implemented to achieve the desire results. Once such regulatory policies are implemented, it must be subjected to regular checks from the appropriate regulatory agencies in order for member countries to reap the full benefits of such policies. Again; policies to improve the development of the stock market must be pro-new entrant to encourage start-up companies to patronize the stock markets in the sub-region.

Shifting attention from stock market development to labor migration, in the fifth chapter, we discovered that, the effect of labor migration on economic growth is nonlinear but generally leaned towards an insignificant relationship. We also establish that, an increase in labor

migration reduces GDP both in the ARDL and NARDL model while a decrease in labor migration increases GDP in the NARDL model in the destination countries. This implies that, labor migration has a negative effect on destination countries. Given this, we recommend destination countries to institute measures to prevent capital flight. In the ARDL model, we also observed that an increase in remittance reduces GDP while in the NARDL model, a positive shock or increase in remittance increases GDP albeit insignificant in the long term. This implies that, remittance inflows in the sub-region are largely used for consumption rather than into investment. Given this, we recommend ECOWAS heads of states to create an enabling environment to encourage local investors to venture into more diversified businesses. Labor mobility in the ECOWAS region is low; we therefore recommend heads of states to institute measures that can enhance labor mobility through the reduction of institutional distance, increased social integration and economic interconnectedness.

The fourth objective of the study was establishing the causal relationship between trade openness and economic growth in the ECOWAS region. When trade openness in the region is high, it can contribute to the synchronization of business cycles which is a necessary condition for the establishment of a monetary union. The study findings showed that, when there is integration of trade in the ECOWAS region, it can foster business cycle synchronization and the susceptibility of the region to asymmetric economic shocks can be reduced. This finding reiterates that, the need for the reduction of tariff and non-tariff barrier is desirable in the region. This is because trade integration can thus promote synchronization of business cycles in ECOWAS.

We also recommend that, ECOWAS heads of states should develop a unified sectoral policy that is capable of reducing differences in structural landscape of their economies and also to promote the development of similar industries which can lead to the enhancement of business cycle

synchronization. We strongly advice against sectoral specialization since it has the potential to hinder business cycle synchronization.

7.5 Areas in need of further research efforts

While this thesis has touched on critical issues on monetary integration in ECOWAS, we realize that the problem areas are not adequately exhaustive. We have some critical topical issues that require further research. In the area of trade, future research can concentrate on the statistical determinants of trade openness in the sub-region. Further research can be carried out in this area by concentrating on, transportation, logistics performance indexes and communication as variables in their regression equation model since they play a critical role in the reduction of transaction and the promotion of global integration. Currently, there is data on transportation, logistic performance and communication from the World Bank database. The database has over 160 countries and the time span is from 2000 to 2020. It is necessary that future researchers include these variables in their model to examine their effects on trade openness in the ECOWAS sub-region.

On stock market development and economic growth in ECOWAS, future studies can concentrate on how corruption perception indices, social capital, formal and informal rule affect the development of the stock market on economic growth in the region once data becomes available. This should provide further insights into whether the effect of stock market on growth is conditioned on these variables. The 2007 global financial crisis has evidenced that countries have become more integrated through various ways. Some of these ways are through financial markets such that disturbances in one country can have a spill-over to other countries. Therefore, in analyzing stock market development and growth in ECOWAS, the degree of financial integration index can be included.

With regards to labor mobility, effect of social factors such as culture, values, norms and language and their implication on labor migration and economic growth in ECOWAS can be investigated by future studies.

Lastly, COVID-19 pandemic has had a devastating effect on most economies in the world. Indeed it has been documentd to be one of the worst pandemics in modern times. It has affected almost every aspect of our social life. Key among them is the exchange rate stabilization in ECOWAS sub-region. We recommend that future studies explore the extent of how this pandemic has affected exchange rates convergence in the sub-region.

7. 6 Limitation of the study

The data for this thesis have a number of concealed limitations, and they should be highlighted. First, since quarterly data is mostly difficult to rely upon, with the exception of the exchange rates data which is monthly data from the International Financial Statistics (IFS) database from the IMF, all the other data are yearly. Again, the entire thesis gleaned data from three databases, which is the International Financial Statistics (IFS) from the IMF, the World Development Indicators (WDI) from the World Bank and the International Organization of Migration (IOM) from the United Nations (UN). This therefore, can affect the validity of the results. We recommend future studies to source data from multiple databases either than only three sources.

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